



# **WAYNE STATE UNIVERSITY**

## **PRENTIS BUILDING RENOVATION**

**5201 Cass Avenue  
Detroit, MI 48202**

**WSU Project No.: 000-000000**

### **ARCHITECT**

**Niagara Murano**

2215 Cole Street  
Birmingham, MI 48009  
(248) 646-5765 (T)  
(248) 646-5813 (F)

NM Project No.: 18113.0

### **ENGINEER**

**IMEG Engineers**

26200 Town Center Drive  
NOVI, MI 48375  
(248) 313-6902 (T)  
(248) 344-1650 (F)

IMEG Project No.: 0000-00

### **OWNER**

**Wayne State University**

5045 Cass Avenue  
Detroit, MI 48201  
(313) 577-4301 (T)  
(313) 577-1817 (F)

WSU Project No.: XXXXXXXX

**ISSUED: FOR BIDS**

**DATE: DECEMBER 11, 2018**

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**SECTION 011000  
SUMMARY**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including the Standard and Supplementary Conditions and other Division 1 Specification Sections, apply to this section.

**1.2 WORK COVERED BY CONTRACT DOCUMENTS**

- A. Project Identification: The Project consists of stabilizing portions of the precast wall panels and adding structural steel supports to the Life Science Building located at the **Wayne State University Main Campus** in Detroit, Michigan.

1. Project Location: Wayne State University  
Prentis Building Renovation  
5201 Cass Avenue  
Detroit, Michigan 48202
2. Owner: Wayne State University  
and the Board of Governors

- B. Architect Identification: The Bid Documents, dated **December 4, 2018** were prepared for the Project by:

Niagara Murano Architecture  
2215 Cole Street  
Birmingham, Michigan 48009

IMEG Engineers  
26200 Town Center Drive  
Novi, Michigan 48375

- C. Project Manager: The Wayne State University Design and Construction Services will appoint a Project Manager.

- D. The Work consists of renovations to portions of the **Prentis Building** on the Wayne State University Main Campus. The renovation will include approximately **13,100 sq. ft.** of new office, labs, support space, and restrooms. Major aspects of the work includes, but is not limited to:

1. The Work includes selective interior demolition, new partition construction, enlargement and replacement of rooms, new flooring and suspended lay-in ceilings, new and reworked ceiling assembly, revisions to HVAC, new lighting fixtures and electrical service.
2. Major aspects of the work include:
  - a. Demolition of existing walls, wall finishes, floor finishes, ceilings, doors and frames, mechanical and electrical system as required to accommodate new construction.
  - b. Interior doors, frames and hardware.
  - c. Reworking existing rooms and adding new gypsum board assemblies.

- d. Metal fabrication, including slotted metal channels to support ceiling mounted equipment.
- e. Revision of existing HVAC systems, ductwork.
- f. Alarm and telecommunication Systems.
- g. Electrical lighting, data and power.
- h. New plumbing work, including domestic hot and cold water, drainage, waste and vent plumbing.
- i. New interior finishes, including ceramic tile, acoustic panel assemblies, carpet tile, resilient base and painting

### 1.3 CONTRACT

- A. Contract Type: A single prime contract based on a Stipulated Price as described in Owner's Bidding Instructions.

### 1.4 WORK SEQUENCE

- A. The Work shall be conducted in **one phase**. Refer to drawings for extent of work.

### 1.5 ALTERNATES

- A. Alternates included in project. Refer to Section 012300.

### 1.6 SCHEDULE

- A. The Work shall be Start: **February 1, 2019**.
- B. The Work shall be completed: **April 30, 2019**.
- C. Refer to WSU Front End Documents.

### 1.7 USE OF PREMESIS

- A. General: Contractor shall have full use of premises for construction operations, including use of Project site, during construction period. Contractor's use of premises is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- B. Owner intends to continue to occupy adjacent portions of the existing **building** during the entire construction period. Owner intends to occupy the Project upon completion of each phase of construction. Cooperate with Owner to minimize conflict and to facilitate Owner's operations. The General Contractor to work around WSU Occupancy Schedule and coordinate work tasks with Owner. Drilling, grinding and noisy activities must be coordinated in advance with WSU Project Manager.
- C. Construction Operations: Limited to areas noted on Drawings.
- D. Arrange use of site and premises to allow:
  - 1. Owner occupancy.
  - 2. Work by Owner.
  - 3. Use of site and premises by the public.
- E. Provide access to and from site as required by law and by Owner:
  - 1. Emergency Building and Site Circulation and Exits During Construction: Keep **all exits required by code open** during construction period; provide temporary exit signs if exit routes are temporarily altered.

2. Do not obstruct roadways, sidewalks, or other public ways without permit.

F. Utility Outages and Shutdown:

1. Coordinate shutdowns and outages with Owner per Owner's General, Supplemental and Special Conditions.

1.8 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 16-division format and CSI/CSC's "MasterFormat" numbering system.

1. Section Identification: The Specifications use section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of sections in the Contract Documents.

B. 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. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.

2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.

a. 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.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

**END OF SECTION 011000**



**SECTION 011400  
WORK RESTRICTIONS**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including the Standard and Supplementary Conditions and other Division 1 Specification Sections, apply to this section.

**1.2 USE OF PREMISES**

- A. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of site beyond areas in which the Work is indicated.
  - 1. Limits: Confine construction operations to the location renovated area and immediate surroundings, except as may be necessary for construction access through other designated portions of the building.
  - 2. Owner Occupancy: Allow for Owner occupancy of site and use by the public.
- B. Use of Existing Building: Maintain existing building in good condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.

**1.3 OCCUPANCY REQUIREMENTS**

- A. Partial Owner Occupancy: Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.
  - 1. Obtain Certificate of Occupancy from authorities having jurisdiction before Owner occupancy.
  - 2. Before Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will provide, operate, and maintain mechanical and electrical systems serving occupied portions of building.
  - 3. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

**PART 2 – PRODUCTS (Not Used)**

**PART 3 – EXECUTION (Not Used)**

**END OF SECTION 011400**

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**SECTION 012100  
ALLOWANCES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. This Section includes administrative and procedural requirements governing the following:
  - 1. Lump-sum allowances.
- B. See Division 1 Section "Unit Prices" for procedures for using unit prices.
- C. See Division 1 Section "Quality Requirements" for procedures governing the use of allowances for testing and inspecting.

**1.2 SELECTION AND PURCHASE**

- A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
- B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Architect from the designated supplier.

**1.3 SUBMITTALS**

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.
- B. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

**1.4 COORDINATION**

- A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

**1.5 LUMP-SUM ARCHITECTURAL ALLOWANCE**

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner under allowance and shall include taxes, freight, and delivery to Project site.
- B. Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner under allowance shall be included as part of the Contract Sum and not part of the allowance.

**1.6 LUMP-SUM ELECTRICAL-MECHANICAL ALLOWANCE**

- A. Use the electrical mechanical allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance. The allowance will be used to move items in the ceiling that interfere with the structural stabilization work above the ceilings and walls.

- B. Contractor's **overhead, profit, and** related costs for products and equipment ordered by Owner under the allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, taxes, insurance, equipment rental, and similar costs.
- C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit margins.
- D. At Project closeout, credit unused amounts remaining in the electrical mechanical allowance to Owner by Change Order.

PART 2 - PRODUCTS- Not included

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

- A. Allowance No. 1 XXXXXXXXX-XXXXXXXXXX:

**END OF SECTION 012100.**

**SECTION 012300  
ALTERNATES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes administrative and procedural requirements governing Alternates.

**1.3 DEFINITIONS**

- A. Definition: An alternate is an amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if the Owner decides to accept a corresponding change in either the amount of construction to be completed, or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
  - 3. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate the Alternate into the Work. No other adjustments are made to the Contract Sum.
  - 4. The cost or credit of each alternate includes the cost of premiums for Labor and Material Payment Bonds and Performance Bonds.

**1.4 PROCEDURES**

- A. Coordination: Modify or adjust affected adjacent Work as necessary to completely and fully integrate that Work into the Project.
  - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not mentioned as part of the Alternate.
- B. Notification: Immediately following the award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate whether alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.
- C. Execute accepted alternates under the same conditions as other Work of this Contract.
- D. Schedule: A "Schedule of Alternates" is included at the end of this Section. Specification Sections referenced in the Schedule contain requirements for materials necessary to achieve the Work described under each alternate.

PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. ADD Alternate No. 1: Existing Ceiling Replacement XXXXXXXX
  - 1. Base Bid: Existing Ceilings and Lights remain.
  - 2. Reference Drawings
  - 3. Field verify conditions prior to starting work.
    - a. Remove existing metal ceiling and light fixtures in Lobby areas XXXXXx and replace with new acoustic tile and suspension assembly.

END OF SECTION 012300

**SECTION 014000  
QUALITY REQUIREMENTS**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including the Standard and Supplementary Conditions and other Division 1 Specification Sections, apply to this section.

**1.2 SUMMARY**

- A. This Section specifies administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
  - 2. Specified tests, inspections, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with the Contract Document requirements.
  - 3. Requirements for Contractor to provide quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

**1.3 DEFINITIONS**

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

**1.4 DELEGATED DESIGN**

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

1.5 SUBMITTALS

- A. Qualification Data: For testing agencies specified in “Quality Assurance” Article to demonstrate their capabilities and experience. Include proof of qualification in the form of a recent report on the inspection of the testing agency by a recognized authority.
- B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by design professional, indicating that products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.
- C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
  - 1. Specification Section number and title.
  - 2. Description of test and inspection.
  - 3. Identification of applicable standards.
  - 4. Identification of test and inspection methods.
  - 5. Number of tests and inspections required.
  - 6. Time schedule or time span for tests and inspections.
  - 7. Entity responsible for performing tests and inspections.
  - 8. Requirements for obtaining samples.
  - 9. Unique characteristics of each quality-control service.
- D. Reports: Prepare and submit certified written reports that include the following:
  - 1. Date of issue.
  - 2. Project title and number.
  - 3. Name, address, and telephone number of testing agency.
  - 4. Dates and locations of samples and tests or inspections.
  - 5. Names of individuals making tests and inspections.
  - 6. Description of the Work and test and inspection method.
  - 7. Identification of product and Specification Section.
  - 8. Complete test or inspection data.
  - 9. Test and inspection results and an interpretation of test results.
  - 10. Ambient conditions at time of sample taking and testing and inspecting.

11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

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

## 1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- C. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- D. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installation of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.
- F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
  1. Requirement for specialists shall not supersede building codes and similar regulations governing the Work, not interfere with local trade-union jurisdictional settlements and similar conventions.
- G. Testing Agency Qualifications: An agency with the experience and capability to conduct testing and inspecting indicated, as documented by ASTM E 548, and that specializes in types of tests and inspections to be performed.
- H. Preconstruction Testing: Testing agency shall perform preconstruction testing for compliance with specified requirements for performance and test methods.
  1. Contractor responsibilities include the following:
    - a. Provide test specimens and assemblies representative of proposed materials and construction. Provide sizes and configurations of assemblies to adequately demonstrate capability of product to comply with performance requirements.

- b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
  - c. Fabricate and install test assemblies using installers who will perform the same tasks.
  - d. When testing is complete, remove assemblies; do not reuse materials on Project.
2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

#### 1.7 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
- 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of the types of testing and inspecting they are engaged to perform.
  - 2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
  - 3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
- B. Contractor Responsibilities: Unless otherwise indicated, provide quality-control services specified and required by authorities having jurisdiction.
- 1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
    - a. Contractor shall not employ the same entity engaged by Owner, unless agreed to in writing by Owner.
  - 2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
  - 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  - 4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  - 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Special Tests and Inspections: Owner will engage a testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner.
- 1. Testing agency will notify Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
  - 2. Testing agency will submit a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.



3. Testing agency will submit a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
  4. Testing agency will interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
  5. Testing agency will retest and reinspect corrected work.
- D. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.
- E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that revised or replaced Work that failed to comply with requirements established by the Contract Documents.
- F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  2. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  3. Do not release, revoke, alter, or increase requirements of the Contract Documents or approve or accept any portion of the Work.
- G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
  2. Incidental labor and facilities necessary to facilitate tests and inspections.
  3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
  4. Facilities for storage and field-curing of test samples.
  5. Delivery of samples to testing agencies.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 30 days of date established for commencement of the Work.

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

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
  1. Provide materials and comply with installation requirements specified in other Sections of these Specifications. Restore patched areas and extend restoration into adjoining areas in a manner that eliminates evidence of patching.
  2. Comply with Contract Document requirements for Division 1 Section “Cutting and Patching”.
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor’s responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

**SECTION 014200**  
**REFERENCES**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including the Standard and Supplementary Conditions and other Division 1 Specification Sections, apply to this section.

**1.2 DEFINITIONS**

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. “Approved”: The term “approved”, when used in conjunction with Architect’s action on Contractor’s submittals, applications, and requests, is limited to Architect’s duties and responsibilities as stated in the Conditions of the Contract.
- C. “Directed”: Terms such as “directed”, “requested”, “authorized”, “selected”, “approved”, “required”, and “permitted” mean directed by Architect, requested by Architect, and similar phrases.
- D. “Indicated”: The term “indicated” refers to graphic representations, notes, or schedules on Drawings; or to other paragraphs or schedules in Specifications and similar requirements in the Contract Documents. Terms such as “shown”, “noted”, “scheduled”, and “specified” are used to help the user locate the reference.
- E. “Regulations”: The term “regulations” includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. “Furnish”: The term “furnish” means to supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. “Install”: The term “install” describes operations at Project site including unloading, temporary storage, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. “Provide”: The term “provide” means furnish and install, complete and ready for the intended use.
- I. “Installer”: An installer is Contractor or another entity engaged by Contractor, as an employee, subcontractor, or contractor of lower tier, to perform a particular construction operation, including installation, erection, application, and similar operations.
- J. The term “experienced”, when used with the term “installer”, means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with the special requirements indicated; and having complied with requirements of authorities having jurisdiction.
  - 1. Using a term such as “carpentry” does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as “carpenter”. It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.

- K. “Project site” is the space available for performing construction activities, either exclusively or in conjunction with others performing other work as part of Project. The extent of Project site is shown on the Drawings and may or may not be identical with the description of the land on which Project is to be built.

### 1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of the date of the Contract Documents, unless otherwise indicated.
- C. Conflicting Requirements: Where compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.
1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of the requirements. Refer uncertainties to Architect for a decision before proceeding.
- D. Copies of Standards: Each entity engaged in construction on Project must be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from the publication source and make them available on request.
- E. Abbreviations and Names: Abbreviations and acronyms are frequently used in the Specifications and other Contract Documents to represent the name of a trade association, standards-developing organization, authorities having jurisdiction, or other entity in the context of referencing a standard or publication. Where abbreviations and acronyms are used in the Specifications or other Contract Documents, they mean the recognized name of these entities. Refer to Gale Research’s “Encyclopedia of Associations” or Columbia Books’ “National Trade & Professional Associations of the U.S.”, which are available in most libraries.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 014200

**SECTION 015000  
TEMPORARY FACILITIES AND CONTROLS**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including the General and Supplementary Conditions and other Division 1 Specification Sections, apply to this section.

**1.2 SUMMARY**

- A. This Section includes requirements for temporary facilities and controls, including temporary utilities, support facilities, and security and protection facilities.
- B. Temporary utilities include, but are not limited to, the following:
  - 1. Sanitary facilities.
  - 2. Temporary utilities
  - 3. Air Quality Control during work.
  - 3. Lighting.
  - 4. Telephone service.
  - 5. Security requirements.
  - 6. Waste removal facilities and services.
  - 7. Field Office.
  - 8. Vehicular access and parking.
- C. The Owner will include, but are not limited to, the following:
  - 1. Electrical power, consisting of connection to existing facilities.
  - 2. Water supply, consisting of connection to existing facilities.
- D. Security and protection facilities include, but are not limited to, the following:
  - 1. Barricades and warning signs.
  - 2. Fire protection during welding operations.

**1.3 USE CHARGES**

- A. General: Cost or use charges for temporary facilities are not chargeable to Owner or Architect and shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, the following:
  - 1. Owner's construction forces.
  - 2. Occupants of Project.
  - 3. Architect.
  - 4. Testing Agencies.
  - 5. Personnel of authorities having jurisdiction.
- B. Water Service: Use water from Owner's existing water system without metering and without payment of use charges. Use trigger-operated nozzles for water hoses, to avoid waste of water.

- C. Electric Power Service: Use electric power from Owner's existing system without metering and without payment of use charges.

#### 1.4 QUALITY ASSURANCE

- A. Standards: Comply with ANSI A10.6, NECA's "Temporary Electrical Facilities," and NFPA 241.

#### 1.5 PROJECT CONDITIONS

- A. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:
  - 1. Keep temporary services and facilities clean and neat.
  - 2. Relocate temporary services and facilities as required by progress of the Work.

### PART 2 – PRODUCTS

#### 2.1 MATERIALS

- A. General: Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Architect. Provide materials suitable for use intended.
- B. Lumber and Plywood: Comply with requirements in Division 6 Section "Rough Carpentry."
- C. Water: Potable.

#### 2.2 EQUIPMENT

- A. General: Provide equipment suitable for use intended.
- B. **Fire Extinguishers:** Hand carried, portable, UL rated. Provide class and extinguishing agents as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.
  - 1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.
- C. Drinking Water Fixtures: Containerized, tap-dispenser, bottled-water drinking water units, including paper cup supply.
- D. Electrical Outlets: Properly configures, NEMA-polarized outlets to prevent insertion of 110 to 120 V plugs into higher-voltage outlets; equipped with ground fault circuit interrupters, reset button, and pilot light.
- E. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-v ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.

### PART 3 – EXECUTION

#### 3.1 INSTALLATION, GENERAL

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

### 3.2 TEMPORARY UTILITY INSTALLATION

- A. Water Service: Use of Owner's existing water service facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
  - 1. Provide rubber hoses as necessary to serve Project site. Use trigger-operated nozzles for water hoses, to avoid waste of water.
- B. Sanitary Facilities:
  - 1. Toilets: Use of Owner's existing toilet facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
  - 2. Drinking-Water Facilities: Provide bottle-water, drinking water units.
- C. **Ventilation and Humidity Control: Provide temporary ventilation required by CONSTRUCTION ACTIVITIES for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed.**
- D. Electric Power Service: Use of Owner's existing electric power service will be permitted, as long as equipment is maintained in a condition acceptable to Owner.
- E. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and equipment.
- F. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations and traffic conditions.
- G. Telephone Service shall include:
  - 1. Windows-based personal computer dedicated to project telecommunications, with necessary software and laser printer throughout construction period for common-use facilities used by all personnel engaged in construction activities.
  - 2. At telephone, post a list of important telephone numbers.
    - a. Police Department.
    - b. Ambulance services.
    - c. Contractor's home office.
    - d. Architect's office.
    - e. Engineer's office.
    - f. Owner's office.
    - g. Principal subcontractors' field and home offices.
  - 2. Provide an answering machine on superintendent's telephone.

### 3.3 PROTECTION FACILITIES INSTALLATION

- A. Avoid using tools and equipment that produce harmful noise. Restrict use of noisemaking tools and equipment to hours that will minimize complaints from persons or firms near Project site.

**B. Temporary Fire Protection:**

1. Locate fire extinguishers where convenient and effective for their intended purpose; provide not less than one extinguisher.
2. Store combustible materials in containers in fire-safe locations.
3. Maintain unobstructed access to fire extinguishers, temporary fire-protection facilities, stairways and other access routes for firefighting. Prohibit smoking in hazardous fire-exposure areas.
4. Provide **FIRE WATCH PROFESSIONAL** during welding activities.

### 3.4 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
1. Materials and facilities that constitute temporary facilities are the property of Contractor. Owner reserves the right to take possession of Project identification signs.
  2. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in Division 1 Section "Closeout Procedures."

END OF SECTION 015000



**SECTION 015100  
CONSTRUCTION AIR QUALITY**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including the Standard and Supplementary Conditions and other Division 1 Specification Sections, apply to this section.

**1.2 SUMMARY**

- A. This Section includes requirements for construction air quality including exhaust mitigation on this Project.
- B. Related Sections:
  - 1. Air Handling Units.
  - 2. Air Filters.
  - 3. HVAC Ducts.

**1.3 QUALITY ASSURANCE**

- A. Indoor Air Quality Reports: Review periodic Indoor Air Quality Reports provided by others and promptly comply with report recommendations.
- B. Inspection and Maintenance: Periodically inspect project conditions to assure that indoor air quality measures are being implemented. Maintain indoor air quality measures to assure operational effectiveness.

**PART 2 - PRODUCTS**

**2.1 AIR INFILTRATION**

- A. Provide air filters or filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 or as specified, whichever is greater.

**PART 3 - EXECUTION**

**3.1 HVAC SYSTEM PROTECTION**

- A. Protect HVAC systems per Related Sections.
- B. Ductwork Contamination: Provide professional cleaning for all ductwork contaminated with construction debris and dust.

### 3.2 SOURCE/POLLUTION CONTROL

- A. Temporary Heat and Hazardous Exhaust: Provide temporary heaters that exhaust combustion air directly to the outside of the building, or that prevents hazardous exhaust levels within the construction area. Limit the use of exhaust producing equipment inside the construction area.
- B. Assure exhaust fumes are not drawn into new and existing air intakes.
- C. Volatile Organic Compounds (VOC) control: Limit the buildup of VOCs within the construction area by storing VOCs in tight containers, providing ventilation with outside air during installation of VOC emitting material. Locate pollutant sources in one designated area away from supply ducts, areas occupied by workers, and absorbent materials.
- D. Smoking is prohibited in all **Wayne State University** buildings and grounds.

### 3.3 PATHWAY INTERRUPTION

- A. Construction partitions: Provide air tight temporary construction partitions to separate completed areas from active construction areas.
- B. Construction area pressurization: Provide temporary fans or portions of the permanent air handling system to maintain a negative pressure in the construction areas relative to adjacent completed spaces.
- C. Provide construction entry mats at each entry to limit dirt and debris from entering the building.

### 3.4 HOUSEKEEPING

- A. Perform daily housekeeping to prevent the accumulation and tracking of debris, dirt, dust, and moisture within the construction area. Coordinate activities of the various trades to organize work areas to assure that routine cleaning is effective.
- B. Provide thorough cleaning of all building interior surfaces prior to HVAC filter replacement, testing and balancing, and commissioning activities.

### 3.5 SCHEDULING

- A. Schedule high pollution activities that utilize high VOC level products such as paints, sealants, adhesives, caulking and cleaners to take place prior to installing highly absorbent materials such as ceiling tiles, carpet, fabric furniture, acoustic panels, insulation, and gypsum board.
- B. Where practical, perform high VOC work during off-hours to minimize personnel exposure.
- C. Coordinate schedule for installation of low-VOC products with temperature requirements.
- D. Schedule delivery to minimize storage requirements of materials on the project site.
- E. Where air testing or building flush-out procedures are required, provide adequate time to conduct these activities prior to building occupancy.

3.6 DIESEL EXHAUST MITIGATION

- A. All diesel equipment utilized on the project site except delivery trucks shall be fueled with biodiesel B-20. In case of extreme cold weather, biodiesel B-5 is acceptable. Provide records of refueling receipts when requested by the owner.
- B. All diesel equipment utilized on the project for more than ten workdays shall utilize exhaust after-treatment devices to reduce emission from diesel engines. Exhaust after treatment devices shall be either diesel oxidation catalyst type or diesel particulate filters. The required minimum percent reduction in emissions for either device shall be, PM: 20%, HC: 40%, CO: 10%.

END OF SECTION 015100

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**SECTION 016000  
PRODUCT REQUIREMENTS**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including the Standard and Supplementary Conditions and other Division 1 Specification Sections, apply to this section.

**1.2 SUMMARY**

- A. This Section includes the following administrative and procedural requirements: selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.
- B. Related Sections including the following:
  - 1. Division 1 Section "References" for applicable industry standards for products specified.
  - 2. Division 1 Section "Closeout Procedures" for submitting warranties for contract closeout.
  - 3. Division 2 through 16 Sections for specific requirements for warranties on products and installations specified to be warranted.

**1.3 DEFINITIONS**

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material", "equipment", "system", and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
  - 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
- C. **Basis-of-Design Product Specification:** Where a specific manufacturer's product is named and accompanied by the words "basis of design", including make or model number or other designations, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

- D. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
- E. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

#### 1.4 SUBMITTALS

- A. Product List: Submit a list, in tabular form, showing specified products. Include generic names of products required. Include manufacture's name and proprietary product names for each product.
  - 1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
  - 2. Form: Tabulate information for each product under the following column headings:
    - a. Specification Section number and title.
    - b. Generic name used in the Contract Documents.
    - c. Proprietary name, model number, and similar designations.
    - d. Manufacturer's name and address.
    - e. Supplier's name and address.
    - f. Installer's name and address.
    - g. Projected delivery date or time span of delivery period.
    - h. Identification of items requiring early submittal approval for scheduled delivery date.
  - 3. Initial Submittal: Within 30 days after date of commencement of the Work, submit 3 copies of initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.
    - a. At Contractor's option, initial submittal may be limited to product selections and designations that must be established early in Contract period.
  - 4. Completed List: Within 60 days after date of commencement of the Work, submit 3 copies of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.
  - 5. Architect's Action: Architect will respond in writing to Contractor within 15 days of receipt of completed product list. Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement that products comply with the Contract Documents.
- B. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Substitution Request Form: Use CSI Form 13.1A.

2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified material or product cannot be provided.
    - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
    - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
    - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
    - e. Samples, where applicable or requested.
    - f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
    - g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
    - h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
    - i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
    - j. Cost information, including a proposal of change, if any, in the Contract Sum.
    - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
    - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
  3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
    - a. Form of Acceptance: Change Order.
    - b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.
- C. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 1 Section "Submittal Procedures". Show compliance with requirements.

## 1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.
  - 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
  - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

## 1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
  - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
  - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
  - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
  - 4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
  - 5. Store products to allow for inspection and measurement of quantity or counting of units.
  - 6. Store materials in a manner that will not endanger Project structure.
  - 7. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
  - 8. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
  - 9. Protect stored products from damage.
- B. Storage: Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

## 1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.



1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  2. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 1 Section "Closeout Procedures".

## PART 2 – PRODUCTS

### 2.1 PRODUCT OPTIONS

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged, and unless otherwise indicated, that are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
  4. Where products are accompanied by the term "as selected", Architect will make selection.
  5. Where products are accompanied by the term "match sample", sample to be matched is Architect's.
  6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
  7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved", comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures: Procedures for product selection include the following:
1. Product: Where Specification paragraphs or subparagraphs titled "Product" name a single product and manufacturer, provide the product named.
    - a. Substitutions may be considered, unless otherwise indicated.
  2. Manufacturer/Source: Where Specification paragraphs or subparagraphs titled "Manufacturer" or "Source" name single manufacturers or sources, provide a product by the manufacturer or from the source named that complies with requirements.
    - a. Substitutions may be considered, unless otherwise indicated.
  3. Products: Where Specification paragraphs or subparagraphs titled "Products" introduce a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.

4. Manufacturers: Where Specification paragraphs or subparagraphs titled “Manufacturers” introduce a list of manufacturer’s names, provide a product by one of the manufacturers listed that complies with requirements.
  - a. Substitutions may be considered, unless otherwise indicated.
5. Available Products: Where Specification paragraphs or subparagraphs titled “Available Products” introduce a list of both products and manufacturers, provide one of the products listed or another product that complies with requirements. Comply with provisions in “Comparable Products” Article to obtain approval for use of an unnamed product.
6. Available Manufacturers: Where Specification paragraphs or subparagraphs titled “Available Manufacturers” introduce a list of manufacturers’ names, provide a product by one of the manufacturers listed or another manufacturer that complies with requirements. Comply with provisions in “Comparable Products” Article to obtain approval for use of an unnamed product.
7. Product Options: Where Specification paragraphs titled “Product Options” indicate that size, profiles, and dimensional requirements on Drawings are based on specific product or system, provide either the specific product or system indicated or a comparable product or system by another manufacturer. Comply with provisions in “Product Substitutions” Article.
8. Basis-of-Design Products: Where Specification paragraphs or subparagraphs titled “Basis-of-Design Product” are included and also introduce or refer to a list of manufacturers’ names, provide either the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in “Comparable Products” Article to obtain approval for use of an unnamed product.
  - a. Substitutions may be considered, unless otherwise indicated.
9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product (and manufacturer) that complies with requirements and matches Architect’s sample. Architect’s decision will be final on whether a proposed product matches satisfactorily.
  - a. If no product available within specified category matches satisfactorily and complies with other specified requirements, comply with provisions of the Contract Documents on “substitutions” for selection of a matching product.
10. Visual Selection Specification: Where Specifications include the phrase “as selected from manufacturer’s colors, patterns, textures” or a similar phrase, select a product (and manufacturer) that complies with other specified requirements.
  - a. Standard Range: Where Specifications include the phrase “standard range of colors, patterns, textures” or similar phrase, Architect will select color, pattern, or texture from manufacturer’s product line that does not include premium items.
  - b. Full Range: Where Specifications include the phrase “full range of colors, patterns, textures” or similar phrase, Architect will select color, pattern, or texture from manufacturer’s product line that includes both standard and premium items.

## 2.2 PRODUCT SUBSTITUTIONS

- A. Timing: Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.

- B. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
  2. Requested substitution does not require extensive revisions to the Contract Documents.
  3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
  4. Substitution request is fully documented and properly submitted.
  5. Requested substitution will not adversely affect Contractor's Construction Schedule.
  6. Requested substitution has received necessary approvals of authorities having jurisdiction.
  7. Requested substitution is compatible with other portions of the Work.
  8. Requested substitution has been coordinated with other portions of the Work.
  9. Requested substitution provides specified warranty.
  10. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

## 2.3 COMPARABLE PRODUCTS

- A. Where products or manufacturers are specified by name, submit the following, in addition to other required submittals, to obtain approval of an unnamed product:
1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
  2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
  3. Evidence that proposed product provides specified warranty.
  4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.

PART 3 – EXECUTION (Not Used)

END OF SECTION 01600

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**SECTION 016100  
REQUEST FOR SUBSTITUTION FORM**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Standard and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

**1.2 CONTRACT:**

- A. To: \_\_\_\_\_ Date: \_\_\_\_\_  
Project / Contract: \_\_\_\_\_  
Specified Item: \_\_\_\_\_  
Provide Description: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Proposed Substitution: \_\_\_\_\_  
Provide Description: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**PART 2 – PRODUCTS**

**2.1 SUBSTITUTION**

- A. The undersigned proposes the above listed substitution in accordance with the provisions of Section 01600.
1. The data attached includes product description, specifications, drawings, performance and test data, certifications and product guarantees for evaluation of the proposed substitution. Applicable portions of the data are clearly identified. The product description includes composition and materials, basic use, applicable properties and standards, and limitations on its use.
  2. Also, attached is a description of the changes to the Work required if the proposed substitution is accepted.
  3. Also, attached a description of the differences between the proposed substitution and the specified or drawn item; and fully describe how the acceptance of the substitution will affect

the project due to dimensional differences or differences in the relationship with architectural items / assemblies or differences in the relationship with the structural, mechanical, and electrical systems.

- B. The undersigned declares that the following statements, except as may be modified on the attachments, are correct:
1. The proposed substitution does not affect dimensions on the Drawings.
  2. The proposed substitution will have no adverse effect on other work of the Contract or the construction schedule.
  3. The guarantee, maintenance and service provisions for the proposed substitution are the same, or better than the specified item.
- C. The Contractor will declare that the use of the proposed substitution:
1. ☐ Will result in a credit to the Owner of \$\_\_\_\_\_.
  2. ☐ Will result in no change (monetarily or in time) to the Contract with the Owner.
- D. The Contractor understands that they shall pay for the Architect's reviewing time and all the extra time required to modify the drawings should new drawings or changes to the existing contract drawings be required due to the substitution.
- E. The Contractor understands that:
1. The Architect's Recommendation below does not modify the Contract.
  2. The Owner's Comments below do not modify the Contract.
- F. The completion of a properly executed Change Order shall ONLY modify the CONTRACT.

### PART 3 – EXECUTION

#### 3.1 SUBMITTAL

A. Submitted by: \_\_\_\_\_  
Signature of Officer \_\_\_\_\_  
Print Name and Title \_\_\_\_\_  
Company \_\_\_\_\_  
Company Address \_\_\_\_\_  
City and State \_\_\_\_\_  
Telephone Number \_\_\_\_\_  
Fax Number \_\_\_\_\_

B. Manufacturer of proposed substitution materials: \_\_\_\_\_  
Signature of Officer \_\_\_\_\_  
Print Name and Title \_\_\_\_\_  
Company \_\_\_\_\_  
Company Address \_\_\_\_\_  
City and State \_\_\_\_\_  
Telephone Number \_\_\_\_\_  
Fax Number \_\_\_\_\_

C. Architectural Recommendation:  
( \_\_\_\_ ) Accept ( \_\_\_\_ ) Accept As Noted ( \_\_\_\_ ) Not Accept  
Firm: \_\_\_\_\_  
Representative of Firm: \_\_\_\_\_  
Remarks: \_\_\_\_\_  
\_\_\_\_\_

D. Owner's Comments:  
Remarks: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

E. Owner's remarks, including apparent acceptance, do not modify the Contract

END OF SECTION 01610





**SECTION 017700  
CLOSEOUT PROCEDURES**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including the Standard and Supplementary Conditions and other Division 1 Specification Sections, apply to this section.

**1.1 SUMMARY**

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

1. Inspection procedures.
2. Warranties.
3. Final cleaning.

- B. Related Sections include the following:

1. Division 1 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
2. Division 1 Section "Photographic Documentation" for submitting Final Completion construction photographs and negatives.
3. Division 1 Section "Execution Requirements" for progress cleaning of Project site.
4. Division 1 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
5. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
6. Division 1 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
7. Divisions 2 through 26 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

**1.2 SUBSTANTIAL COMPLETION**

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.

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. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. 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.
5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs **and photographic negatives**, damage or settlement surveys, property surveys, and similar final record information.
6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.

7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
8. Complete startup testing of systems.
9. Submit test/adjust/balance records.
10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
11. Advise Owner of changeover in heat and other utilities.
12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
13. Complete final cleaning requirements, including touchup painting.
14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

### 1.3 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to Division 1 Section "Payment Procedures."
2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report and warranty.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

### 1.4 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. **Use CSI Form 14.1A.**

1. Organize list of spaces in sequential order.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.

3. Include the following information at the top of each page:

- a. Project name.
- b. Date.
- c. Name of Architect.
- d. Name of Contractor.
- e. Page number.

1.5 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
  - 1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
  - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
  - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.
- E. Provide Three (3) copies of documents listed above, plus an electronic version in PDF format.

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 FINAL CLEANING

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

- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
- a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
  - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
  - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
  - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
  - e. Remove snow and ice to provide safe access to building.
  - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
  - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
  - h. Sweep floors broom clean in unoccupied spaces.
  - i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials.
  - j. Remove labels that are not permanent.
  - k. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
  - l. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
  - m. Leave Project clean and ready for occupancy.
- C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 017700

**SECTION 02222**  
**SELECTIVE DEMOLITION**

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
1. Demolition and removal of selected portions of **Prentis Building**.
  2. Ceilings, wall and flooring.
  3. Salvage of existing items to be reused or recycled.
  4. Refer to **Drawings** for shoring and bracing existing precast panels.
  5. Coordinate bracing of walls prior to the demolition of window assemblies. Note: Window and sill removal are by WSU Abatement Contractor.
  6. Flooring and base removal including mastic removal in area of Alternate No. 1 is by WSU Abatement Contractor.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction and deliver them to Owner.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 SUBMITTALS

- A. Pre-demolition Photographs or Videotapes: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by demolition operations.
- B. Landfill Records: Indicate receipt and acceptance of wastes by a landfill facility licensed to accept wastes.

1.5 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

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

#### 1.6 PROJECT CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to demolition area. Conduct demolition so Owner's operations will not be disrupted.
1. Comply with requirements specified in **WSU** Supplemental General Conditions.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with demolition.
- D. **Hazardous Materials: Hazardous materials will be encountered in the Work.**
1. **If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and WSU Project Manager. Owner will remove hazardous materials under a separate contract.**
- E. Owner has the right of first refusal for all salvageable items to be demolished. Items, which the Owner declines shall be promptly removed from site.
- F. Storage or sale of removed items or materials on-site is not permitted.
- G. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during demolition operations.

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

#### PART 3 – EXECUTION

##### 3.1 EXAMINATION

- A. Survey existing conditions and correlate with requirements indicated to determine extent of demolition required.
- B. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly report to Architect.

##### 3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during demolition operations.
1. Comply with requirements for existing services/systems interruptions specified in **WSU** Supplemental General Conditions. **Seven (7) day notice is required.**

#### SELECTIVE DEMOLITION

### 3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct demolition and debris-removal operations to ensure minimum interference with roads, walks, and other adjacent occupied and used facilities. Protection of items to be in place and remain during work activities.
1. Do not close or obstruct roads, walks, or other adjacent occupied or used facilities without permission from Owner.
  2. Protect existing site improvements, appurtenances, and landscaping to remain.
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent areas to remain.
1. Provide protection to ensure safe passage of people around demolition area and to and from occupied portions of building.
  2. Protect existing finish work that are to remain or that are exposed during demolition operations.
  3. Cover and protect items that have not been removed.
- C. Temporary Partitions: Erect and maintain partitions and temporary enclosures to limit dust and dirt migration and to separate occupied areas from construction areas.

### 3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work as follows:
1. Proceed with demolition systematically.
  2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
  3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
  5. Maintain adequate ventilation when using cutting torches.
  6. Dispose of demolished items and materials promptly.
- B. Removed and Salvaged Items:
1. Clean salvaged items.
  2. Pack or crate items after cleaning. Identify contents of containers.
  3. Store items in a secure area until delivery to Owner.
  4. Transport items to Owner's storage area on-site.
  5. Protect items from damage during transport and storage.
- C. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
  2. Pack or crate items after cleaning and repairing. Identify contents of containers.
  3. Protect items from damage during transport and storage.
  4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling

during demolition.

### 3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Remove all miscellaneous fasteners, anchors, and brackets, not required for the structural integrity of the precast seating units.
- E. Remove all existing joint sealants at locations of new work.

### 3.7 PATCHING AND REPAIRS

- A. General: Promptly repair damage to adjacent construction caused by demolition operations.
- B. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
  - 1. Completely fill holes and depressions in existing precast seating units that are to remain with and approved patching material applied according to manufacturer's written recommendations.
- C. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

### 3.8 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
  - 1. Do not allow demolished materials to accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

### 3.9 CLEANING

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

END OF SECTION 02222



**SECTION 051200  
STRUCTURAL STEEL**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. This Section includes structural steel for openings in walls.
- B. Beams, plates and bearing plates.

**1.2 PERFORMANCE REQUIREMENTS**

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand **ASD-service LRFD** loads indicated and comply with other information and restrictions indicated.
  - 1. Select and complete connections using **schematic details indicated and AISC's "Manual of Steel Construction, Allowable Stress Design," Part 4.**

**1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.
- C. Welding certificates.
- D. Mill test reports.
- E. Source quality-control test reports.

**1.4 QUALITY ASSURANCE**

- A. Fabricator Qualifications: A qualified fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category Sbd.
- B. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."
- C. Comply with applicable provisions of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

## PART 2 - PRODUCTS

### 2.1 STRUCTURAL-STEEL MATERIALS

- A. Channels, Angles -Shapes: **ASTM A 36/A 36M.**
- B. Plate and Bar: **ASTM A 36/A 36M.**
- C. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade **B.**
- D. Welding Electrodes: Comply with AWS requirements.

### 2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts; ASTM A 563 (ASTM A 563M) heavy hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M) hardened carbon-steel washers.
  - 1. Finish: **Plain.**
  - 2. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8,) compressible-washer type.
    - a. Finish: **Plain.**
- B. Unheaded Anchor Rods: **ASTM F 1554, Grade 36.**
  - 1. Configuration: **Straight.**
  - 2. Finish: **Plain.**
- C. Threaded Rods: **ASTM A 193/A 193M.**
  - 1. Finish: **Plain.**

### 2.3 PRIMER

- A. Primer: SSPC-Paint 25, Type II, iron oxide, zinc oxide, raw linseed oil, and alkyd.
- B. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.

### 2.4 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

## 2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's **"Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."**

## 2.6 SHOP CONNECTIONS

- A. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

## 2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
  - 1. Surfaces to be field welded.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
  - 1. SSPC-SP 2, "Hand Tool Cleaning."
  - 2. SSPC-SP 3, "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
  - 1. Prime all field welded connections.

## 2.8 SOURCE QUALITY CONTROL

- A. Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports. Comply with testing and inspection requirements of Part 3, Article "Field Quality Control."
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

# PART 3 - EXECUTION

## 3.1 ERECTION

- A. Examination: Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.

1. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "**Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design.**"
- C. **Base and Bearing** Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base **and bearing** plates. Clean bottom surface of base **and bearing** plates.
  1. Set base **and bearing** plates for structural members on wedges, shims, or setting nuts as required.
  2. Weld plate washers to top of base plate.
  3. **Snug-tighten** anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base **or bearing** plate before packing with grout.
  4. Promptly pack grout solidly between bearing surfaces and base **or bearing** plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. **Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.**
- D. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

### 3.2 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
  1. Joint Type: **Snug tightened.**
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
  1. **Obtain Approval for site welding of connections from Wayne State University prior to start of this work.**

### 3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect **field welds.**
- B. Bolted Connections: Shop-bolted connections will be **tested and** inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.
  1. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option:

- a. Liquid Penetrant Inspection: ASTM E 165.
  - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
  - c. Ultrasonic Inspection: ASTM E 164.
  - d. Radiographic Inspection: ASTM E 94.
- D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

END OF SECTION 051200

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**SECTION 054000**  
**COLD FORMED METAL FRAMING**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Standard and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Provide cold formed metal framing for building interior and exterior walls and where indicated. Include related anchors, fasteners, bracing, connectors deflection connections.
  - 1. Interior non-bearing steel-stud walls.
  - 2. Interior steel-stud framing.

**1.3 SUBMITTALS**

- A. Shop Drawings: Detail fabrication and erection of each cold formed metal framing member indicated. Include plans, elevations, sections, and details of their connections and accessory items.
  - 1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

**1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: A qualified Installer experienced in erecting cold formed metal framing similar to those indicated for this Project and with a record of successful in-service performance.
- B. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- C. Standards: AISI, Specification for Design of Cold-Formed Steel Structural Members.
- D. Engineer Qualifications: Design Connections and structural elements under the direct supervision of a registered professional engineer.
- E. Exterior Non-Load-Bearing, Curtain-Wall Framing: Horizontal deflection of 1/240 of the wall height.
- F. Fabrication Tolerances: 1/8 inch in 10 feet.
- G. Erection Tolerances: 1/16 inch.

## 1.5 PROJECT CONDITIONS

- A. Field Measurements: Where steel studs are indicted to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
  - 1. Establish Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating steel joists without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Allow for trimming and fitting.

## 1.6 COORDINATION

- A. Coordinate installation of anchorages to beams, steel joists and walls. Furnish setting drawings, elevations, templates, and directions for installing anchorages, angles, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

## PART 2 – PRODUCTS

### 2.1 COLD FORMED METAL FRAMING

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Standards: AISI, Specification for Design of Cold-Formed Steel Structural Members.
- C. Fabrication Tolerances: 1/8 inch in 10 feet.
- D. Erection Tolerances: 1/16 inch.
- E. Steel Sheet: ASTM A 653/A, structural steel, G6D zinc coating, Grade 33 for minimum uncoated steel thickness of 43 mil and less; Grade 50 for minimum uncoated steel thickness of 54 mil and greater.
- F. Framing: Manufacturer's standard steel studs, of web depths indicated, with stiffened flanges, Complying with ASTM C 955, and as follows:
  - 1. Minimum Uncoated-Steel Thickness: 43 mil.
  - 2. Minimum Flange Width: 1-5/8 inches.
  - 3. Track: Manufacturer's standard U-shaped steel track, unpunched, with straight flanges, complying with ASTM C 955, manufacturer's standard flange width, and minimum uncoated- steel thickness matching steel studs.
  - 4. Finish: Galvanized, ASTM A 525, G6D.
- G. Framing Accessories:
  - 1. Supplementary framing.
  - 2. Bracing, bridging, and solid blocking.
  - 3. Web stiffeners.
  - 4. Gusset plates.
  - 5. Deflection track and vertical side clips
  - 6. Stud kickers and grits.
  - 7. Reinforcement plates.
  - 8. Anchors, clips, and fasteners.



- F. Structural Framing: Manufacturer's standard structural steel studs, of web depths indicated, with stiffened flanges.
  - 1. Gauge: DEA specifications, refer to drawings.
  - 2. Track: Manufacturer's standard U-shaped steel track, unpunched, with straight flanges, complying with ASTM C 955, manufacturer's standard structural flange width, and minimum uncoated- steel thickness matching steel studs.
  - 3. Finish: Galvanized, ASTM A 525, G6D.

### PART 3 – EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Fabricate and install cold formed metal framing members in compliance with manufacturer's requirements and recommendations. Provide anchorage devices and fasteners where necessary for securing metal decks to in-place construction. Include anchorage to concrete angles, beams, steel joists and other structural steel components.
- B. Fitting and Placement: Perform fitting required for installing cold formed metal framing members. Set members accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- C. Provide temporary bracing or anchors in for items that are to be built into concrete, masonry, or similar construction. Brace existing deck at new construction.
- D. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.
- E. Install materials and systems in accordance with ASTM C 1007, manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with work of other sections.
- F. Comply with requirements of ASTM C 1007 for installation of steel studs and accessories and metal Lath/Steel Framing Association Lightweight Steel Framing Systems Manual.
- G. Restore damaged components. Protect work from damage.

END OF SECTION 054000

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**SECTION 061000  
ROUGH CARPENTRY**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Standard and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Fire Rated wood blocking in walls.
  - 2. Fire Rated veneer core plywood sheathing.
  - 3. Fire Rated wood framing.
  - 4. Traffic Barriers.
  - 5. Scaffolding.

**1.3 DEFINITIONS**

- A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise indicated.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
  - 1. NELMA – Northeastern Lumber Manufacturers Association.
  - 2. NLGA – National Lumber Grades Authority.
  - 3. RIS Redwood Inspection Service.
  - 4. SPIB – Southern Pine Inspection Bureau.
  - 5. WCLIB – West Coast Lumber Inspection Bureau.
  - 6. WWPA – Western Wood Products Association.

**1.4 SUBMITTALS**

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
  - 1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials, both before and after exposure to elevated temperatures when tested according to ASTM D 5516 and ASTM D 5664.

- B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:

1. Fire-retardant-treated wood.

#### 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- B. Source Limitations for Fire-Retardant-Treated Wood: Obtain each type of fire-retardant-treated wood product through one source from a single producer.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber, plywood, and other panels; place spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

### PART 2 – PRODUCTS

#### 2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.
1. Provide dressed lumber, S4S, unless otherwise indicated.
  2. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.
- B. Wood Structural Panels:
1. Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.
  2. Thickness: As needed to comply with requirements specified by not less than thickness indicated.
  3. Comply with “Code Plus” provisions in APA Form No. E30K, “APA Design/Construction Guide: Residential & Commercial”.
  4. Factory mark panels according to indicated standard.

#### 2.2 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, provide materials that comply with performance requirements in AWPA C20 (lumber) and AWPA C27 (plywood). Identify fire-retardant-

treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5664, for lumber and ASTM D 5516, for plywood.
2. Use treatment that does not promote corrosion of metal fasteners.
3. Use Interior Type A High Temperature (HT), unless otherwise indicated.

## 2.3 MISCELLANEOUS LUMBER (FIRE-RETARDANT-TREATED)

A. General: Provide lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.

B. For items of dimension lumber size, provide Construction, Stud, or No. 2 grade lumber with 19 percent maximum moisture content and any of the following species:

1. Mixed southern pine; SPIB.
2. Hem-fir or Hem-fir (north); NLGA, WCLIB, or WWPA.
3. Spruce-pine-fir (south) or Spruce-pine-fir; NELMA, NLGA, WCLIB, or WWPA.
4. Eastern softwoods; NELMA.
5. Northern species; NLGA.
6. Western woods; WCLIB or WWPA.

C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine, No. 2 grade; SPIB.
2. Hem-fir or Hem-fir (north), Construction or 2 Common grade; NLGA, WCLIB, or WWPA.
3. Spruce-pine-fir (south) or Spruce-pine-fir, Construction or 2 Common grade; NELMA, NLGA, WCLIB, or WWPA.
4. Eastern softwoods, No. 2 Common grade; NELMA.
5. Northern species, No. 2 Common grade; NLGA.
6. Western woods, Construction or No. 2 Common grade; WCLIB or WWPA.

2.4 PLYWOOD BACKING PANELS (FIRE-RETARDANT-TREATED)

- A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2 inch thick.

2.5 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for materials and manufacturer
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: CABO NER-272.
- D. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- E. Bolts: Steel bolts complying with ASTM A 307, grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- F. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
  - 1. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

PART 3 – EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- B. Do not use materials with defects that impair quality of rough carpentry or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- C. Apply field treatment complying with AWWA M4 to cut surfaces of preservative-treated lumber and plywood.
- D. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. Table 2305.2, "Fastening Schedule", in the BOCA National Building Code.
- E. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully 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; predrill as required.

END OF SECTION 061000

**SECTION 061600  
SHEATHING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Wall sheathing- fire rated veneer core.
  - 2. Sheathing joint-and-penetration treatment.
- B. Related Sections include the following:
  - 1. Division 6 Section Rough Carpentry for plywood backing panels.

**1.3 SUBMITTALS**

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
  - 1. Include data for fire treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
  - 2. For building wrap, include data on air-/moisture-infiltration protection based on testing according to referenced standards.
- B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:
  - 1. Fire-retardant-treated veneer core plywood.

**1.4 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for the years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Stack plywood and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

## PART 2 - PRODUCTS

### 2.1 WOOD PANEL PRODUCTS, GENERAL

- A. Veneer Core (F.R.) interior plywood: unless otherwise indicated.
- B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- C. Factory mark panels to indicate compliance with applicable standard.

### 2.2 FIRE-RETARDANT-TREATED VENEER CORE PLYWOOD

- A. General: Comply with performance requirements in AWPAC27.
  - 1. Use treatment that does not promote corrosion of metal fasteners.
  - 2. Use exterior type for exterior locations and where indicated.
- B. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Identify fire-retardant-treated plywood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
- D. Application: Treated veneer core plywood indicated on Drawings, and the following:
  - 1. Wall veneer core plywood.

### 2.3 WALL SHEATHING

- A. Exterior Grade Veneer Plywood Wall Sheathing: Exterior, Structural I sheathing.
  - 1. Span Rating: Not less than 16/0.
  - 2. Nominal Thickness: Not less than 3/4 inch.

### 2.4 FASTENERS

- A. General: Provide **stainless steel** fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
  - 1. For wall sheathing, provide **stainless steel fasteners** complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. **Stainless Steel Screws** for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by **stainless steel** screw manufacturer for material being fastened.



## 2.5 MATERIALS

- A. Provide Manufacturer's recommended sheathing joint wrap recommended by sheathing manufacturer for application indicated, and complying with requirements for elastomeric sealants specified in Division 7 Section "Joint Sealants."

## 2.6 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01, ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
  - 1. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
- D. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

### 3.2 SHEATHING JOINT-AND-PENETRATION TREATMENT

- A. Seal sheathing joints according to sheathing manufacturer's written instructions.
  - 1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient quantity of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.

**END OF SECTION 061600**

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**SECTION 072100  
BUILDING INSULATION**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. This Section includes the following:
  - 1. Cavity-wall insulation within interior wall assembly.
  - 2. Concealed building insulation.
  - 3. Attachment devices.
  - 4. Miscellaneous slag-wool-fiber/ rock wool fiber insulation.

**1.2 PERFORMANCE REQUIREMENTS**

- A. Plenum Rating: Provide slag-wool-fiber/rock-wool-fiber insulation where indicated in window- wall plenums whose test performance is rated as follows for use in plenums as determined by testing identical products per "Erosion Test" and "Mold Growth and Humidity Test" described in UL 181, or on comparable tests from another standard acceptable to authorities having jurisdiction.
  - 1. Erosion Test Results: Insulation shows no visible evidence of cracking, flaking, peeling, or delamination of interior surface of duct assembly, after testing for 4 hours at air velocity.
  - 2. Mold Growth and Humidity Test Results: Insulation shows no evidence of mold growth, delamination, or other deterioration due to the effects of high humidity, after inoculation with Chaetomium globosium on all surfaces and storing for 60 days at 100 percent relative humidity in the dark.

**1.3 SUBMITTALS**

- A. Product Data: For product indicated.
- B. Samples for Verification: Full-size units for each type of exposed insulation indicated.
- C. Product test reports.
- D. Research/Evaluation Reports: For foam-plastic insulation.

**1.4 QUALITY ASSURANCE**

- A. Retain ASTM test method below based on product and kind of fire-resistance characteristic specified for each product in Part 2. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84 for surface-burning characteristics and other methods indicated with product, by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1.5 DELIVERY AND STORAGE

- A. Deliver materials to the site ready for use in the manufacturer's original and unopened containers and packaging, bearing labels as to type and brand. Delivered materials shall be identical to approved samples.
- B. Store materials under cover in a dry and clean location, off the ground. Remove materials which are damaged or otherwise not suitable for installation and replace with acceptable materials.
- C. Take every precaution to prevent the insulation from becoming wet, cover with tarps or other weather/watertight sheet goods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
  - 2. Products: Subject to compliance with requirements, provide one of the products specified.
  - 3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
  - 4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SLAG-WOOL-FIBER/ROCK-WOOL-FIBER BLANKET INSULATION

- A. Manufacturers:
  - 1. Fibrex Insulations Inc.
  - 2. Owens Corning.
  - 3. Thermafiber.
- B. Unfaced, Slag-Wool-Fiber/Rock-Wool-Fiber Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- C. Where slag-wool-fiber/rock-wool-fiber blanket insulation is indicated by the following thicknesses, provide blankets in batt form with thermal resistances indicated:
  - 1. 5-1/4 inches thick with a thermal resistance of 19 deg F x h x sq. ft./Btu at 75 deg F.
  - 2. 6 inches thick with a thermal resistance of 22 deg F x h x sq. ft./Btu at 75 deg F.
  - 3. Thicknesses shown on drawings.

### 2.3 AUXILIARY INSULATING MATERIALS

- A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

### 2.4 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate or Angles formed from perforated galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square, welded to projecting copper-coated steel spindle 0.105 inch in diameter and of length capable of holding insulation of thickness indicated securely in position with 1-1/2-inch- square or diameter self-locking washers complying with the following requirements:
  - 1. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick galvanized steel sheet, with beveled edge for increased stiffness.
- B. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space indicated on drawings between face of insulation and substrate to which anchor is attached.
- C. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.

### 2.5 ACCESSORIES

- A. Clips for Securing Insulation to Encountered Surfaces: Spindle anchor and washer type consisting of perforated metal plates with spindle welded to center and snap on washers. Spindle and washers shall receive a corrosion-resistant electro-zinc plating. Adhesives for securing clips in place shall be recommended by the approved clip manufacturer.
  - 1. Acceptable Manufacturers:
    - a. Miracle Adhesives Corp.
    - b. Stic-Klip Mfg. Co., Inc.
    - c. Midwest Fasteners
- B. Adhesive for Bonding Insulation: The type recommended by the insulation manufacturer, and complying with fire-resistance requirements.
  - 1. For bonding rigid polystyrene insulation to masonry or concrete, provide adhesive equal to "Foamgrab PS" made by Dacor Products Co. or equal made by ChemRex Inc. or Miracle Adhesives.
- C. Protection Board: Pre-molded, semi-rigid asphalt/fiber composition board, 1/4" thick, formed under heat and pressure, standard sizes.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.
- E. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

### 3.2 INSTALLATION OF INSULATION

- A. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.

### 3.3 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Seal joints between foam-plastic insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.
- C. Set vapor-retarder-faced units with vapor retarder in location indicated of construction, unless otherwise indicated.
  - 1. Tape joints and ruptures in vapor retarder and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
- D. Install mineral-fiber insulation in cavities formed by framing members according to the following requirements:
  - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
  - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
  - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures.

4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping stapling flanges to flanges of metal studs.
  - a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.

**END OF SECTION 072100**

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**SECTION 076200**  
**SHEET METAL TRIM**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Standard and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. This Section includes the following:

- 1. Sheet metal accessories.
- 2. Sheet metal trim.

**1.3 SUBMITTALS**

- A. Submit for approval samples, shop drawings, product data.

**1.4 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for the years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

**PART 2 – PRODUCTS**

**2.1 METALS**

- A. Sheet Metal Flashing and Trim:

- 1. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, No. 2D finish.
  - a. Wall trim: 0.0156 inch (28 gage) thick.
- 2. Pre-painted, Metallic-coated Steel Sheet: Zinc-coated (galvanized) steel sheet, ASTM A 653/A 653M, G90 coating designation; Structural quality: pre-painted by the coil-coating process to comply with ASTM A 755/A 755M. High-performance organic finish (Kynar).
  - a. Wall accessories: 0.0276 inch (24 gage) thick.
- 3. Aluminum Sheet: ASTM B 209, Alloy 3003, 3004, 3105, or 5005, Temper suitable for forming and structural performance required, but not less than H14. High-performance organic finish (Kynar).

- b. Closures: 0.0400 inch (18 gage) thick.
  - c. Wall trim: 0.0320 inch (20 gage) thick.
  - d. Color: Match Existing.
- B. Fabricated Units: Compliance with SMACNA Sheet Metal Manual.
- D. Auxiliary Materials:
  - 1. Mastic and elastomeric sealants.
  - 2. Accessories.

### PART 3 – EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide exterior grade veneer core plywood and fasten plywood where necessary for securing to in-place construction.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing flashing, fascia, gutters and downspouts, exterior wall flashing and expansion joints.
- C. Fit exposed connections accurately together to form hairline joints.

#### 3.2 INSTALLATION

- A. Provide work to sized, shapes and profiles indicated. Install work to comply with quality standards referenced. Back prime work and install plumb, level and straight with tight joints; scribe work to fit.
- B. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with work of other sections.
- C. Comply with manufacturer's requirements for cutting, handling, fastening and working materials.
- D. Follow recommendations for SMACNA Sheet Metal Manual. Allow for expansion. Isolate dissimilar materials.
- E. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.
- F. Copings: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data sheet 1 – 49.
- G. Restore damaged components and finishes. Clean and protect work from damage.

**END OF SECTION 076200**

**SECTION 079200**  
**JOINT SEALERS**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Standard and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Provide joint sealers at interior vertical and horizontal joints.

**1.3 SUBMITTALS**

- A. Submit for approval samples, product data.
  - 1. Samples for Initial Selection for Standard Colors: For each type and color of joint sealant scheduled for color selection by Architect, provide Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
  - 2. Samples for Verification of Color Match: For each type and color of joint sealant scheduled to match other materials or surfaces, provide Samples with joint sealants in ½-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

**1.4 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

**PART 2 – PRODUCTS**

**2.1 MATERIALS**

- A. Single-Component Mildew-Resistant Neutral-Curing Silicone Elastomeric Joint Sealant:
  - 1. Products
    - a. Pecora Corporation; 898

- b. Tremco: Tremsil 600 White.
  - 2. Type and Grade: ASTM C 920, S (single component) and NS (nonsag).
  - 3. Class: 25.
  - 4. Use Related to Exposure: NT (nontraffic).
  - 5. Uses Related to Joint Substrates: M, G, A, and O as applicable to joint substrates indicated.
- B. Multicomponent Non-sag Urethane Elastomeric Joint Sealant:
- 1. Products:
    - a. Bostik Findley; Chem-Calk 500.
    - b. Pacific Polymer, Inc.; Elsto-Thane 227R Type II (Gun Grade).
    - c. Polymeric Systems Inc.; PSI-270
    - d. Tremco; Dymeric.
  - 2. Type and Grade: ASTM C 920, M (multicomponent) and NS (nonsag).
  - 3. Class: 25.
  - 4. Use Related to Exposure: NT (nontraffic).
  - 5. Uses Related to Joint Substrates: M, G, A, and O as applicable to joint substrates indicated.
- C. Multicomponent Pourable Urethane Elastomeric Joint Sealant:
- 1. Products:
    - a. Bostik Findley; Chem-Calk 550.
    - b. Meadows, W.R., Inc.; POURTHANE.
    - c. Pacific Polymer, Inc.; Elasto-Thane 227 High Shore Type I (Self Leveling) or Elasto-Thane 227 Type I (Self Leveling).
    - d. Pecora Corporation; Urexpam NR-200.
    - e. Polymeric Systems Inc.; PSI-270SL.
    - f. Schnee-Morehead, Inc.; Permthane SM 7201.
    - g. Tremco; THC-901, THC-900, or Vulkem 245.
  - 2. Type and Grade: ASTM C 920, M (multicomponent) and P (pourable).
  - 3. Class: 25.
  - 4. Use Related to Exposure: T (traffic).
  - 5. Uses Related to Joint Substrates: M, A, and O as applicable to joint substrates indicated.
- D. Single-Component Non-sag Urethane Elastomeric Joint Sealant:
- 1. Products:
    - a. Bostik Findley; Chem-Calk 900, Chem-Calk 2639.
    - b. Pecora Corporation; Dynatrol I-XL.
    - c. Polymeric Systems Inc.; Flexiprene 1000 or PSI-901.
    - d. Schnee-Morehead, Inc.; Permthane SM7100, SM7108, or SM 7110.
    - e. Sika Corporation, Inc.; Sikaflex – 15LM.
    - f. Tremco; DyMonic.
  - 2. Type and Grade: ASTM C 920, S (single component) and NS (non-sag).
  - 3. Class: 25.
  - 4. Use Related to Exposure: NT (nontraffic).

6. Uses Related to Joint Substrates: M, G, A, and O as applicable to joint substrates indicated.
- E. Single-Component Pourable Urethane Elastomeric Joint Sealant:
1. Products:
    - a. Bostik Findley; Chem-Calk 950.
    - b. Pecora Corporation; Urexpam NR-201.
    - c. Polymeric Systems Inc.; Flexiprene 952.
    - d. Schnee-Morehead, Inc.; Permthane SM7101.
    - e. Tremco; Tremflex S/L or Vulkem 45.
- F. Acrylic-Based Solvent-Release Joint Sealant: Comply with ASTM C 1311 or FS TT-S-00230.
1. Schnee-Morehead, Inc.; Acryl-R Acrylic Sealant.
  2. Tremco; Mono 555.
- G. Butyl-Rubber-Based Solvent-Release Joint Sealant: Comply with ASTM C 1085.
1. Bostik Findley; Bostk 300.
  2. Fuller, H.B. Company; SC-0296 or SC-0288.
  3. Pecora Corporation; BC-158.
  4. Polymeric Systems Inc.; PSI-301.
  5. Sonneborn, Division of ChemRex Inc.; Sonneborn Multi-Purpose Sealant.
  6. Tremco; Tremco Butyl Sealant.
- H. Latex Sealant: Comply with ASTM C 834, Type P, Grade NF.
1. Bostik Findley; Chem-Calk 600.
  2. Pecora Corporation; AC-20+.
  3. Schnee-Morehead, Inc.; SM 8200.
  4. Sonneborn, Division of ChemRex Inc.; Sonolac.
  5. Tremco; Tremflex 834.
- I. Acoustical Sealant for Exposed and concealed Joints: Manufacturer's standard non-sag, paintable, non-staining latex sealant complying with ASTM C 834 and the following:
1. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
  2. Products:
    - a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
    - b. United STes Gypsum Co.; SHEETROCK Acoustical Sealant.
- J. Auxiliary Materials:
1. Plastic foam joint fillers.
  2. Elastomeric Tubing backer rods.
  3. Bond breaker tape.
  4. Primer.
  5. Cleaners for Nonporous Surfaces.
  6. Masking Tape.

## PART 3 – EXECUTION

### 3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants.
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant.
    - a. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.
  - 2. Remove laitance and form-release agents from concrete.
    - a. Clean nonporous 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 in writing by join-sealant manufacturer, based on preconstruction joint-sealant-substrate test or prior experience. Apply primer to comply with join-sealant manufacturer's written instructions. Confine primers to areas of join-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Making Tape: Use masking tape where required to prevent contact of sealant 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. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type 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.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. 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.
- F. Tooling of Non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified 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 configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
- 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.

**END OF SECTION 079200**

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## 079200S - JOINT SEALANT SCHEDULE

EXTERIOR TRAFFIC JOINTS	SEALANT CHEMISTRY	COLOR
Control and expansion joints in standard gray concrete	Urethane	Standard
Joints between standard gray concrete paving & building walls & other vertical surfaces	Urethane	Standard
EXTERIOR NON-TRAFFIC JOINTS	SEALANT CHEMISTRY	COLOR
Building expansion joints in unit masonry	Preformed Foam w/Silicone cover	Match mortar
Control and expansion joints in cast-in-place concrete	Urethane	Standard
Control and expansion joints in architectural concrete	Urethane	Custom
Joints between precast architectural concrete	Urethane	Match precast concrete
Control and expansion joints in cast stone	Urethane	Custom
Control and expansion joints in decorative unit masonry	Urethane	Match mortar
Control and expansion joints in unity masonry (unfinished)	Urethane	Match mortar
Control and expansion joints in EIFS systems	Urethane	Match surface color
Joints between pre-finished metal panels	Urethane or Silicone	Match metal
Joints between metal flashings (concealed)	Butyl	Standard
Joints between prefinished metal flashings (exposed)	Urethane or Silicone	Match metal flashing
Joints between unfinished metal flashings (exposed)	Urethane or Silicone	Standard
Perimeter joints around frames of field painted metal frames	Acrylic (Paintable)	Standard
Perimeter joints around frames of prefinished metal doors and windows	Butyl	Match metal frames
Setting bed for flashing receivers	Butyl	Standard
Setting bed for thresholds & sills	Butyl	Standard
INTERIOR TRAFFIC JOINTS	SEALANT CHEMISTRY	COLOR
Control and expansion joints in concrete slabs (concealed)	None required	N/A
Control and expansion joints in standard gray concrete slabs (exposed)	Urethane	Standard
Control and expansion joints in tile (in toilet rooms and kitchens)	Mildew Resistant Silicone	Match grout
Control and expansion joints in tile (not in toilet rooms and kitchens)	Urethane	Match grout
INTERIOR NON - TRAFFIC JOINTS	SEALANT CHEMISTRY	COLOR
Control and expansion joints in cast-in-place concrete	Urethane	Standard
Control and expansion joints in decorative units masonry	Urethane	Match mortar
Control and expansion joints in cast stone	Urethane	Custom
Control and expansion joints in unit masonry (to be painted)	Urethane (paintable)	Standard
Control and expansion joints in unit masonry (unfinished)	Urethane	Standard
Control and expansion joints in tile (in toilet rooms and kitchens)	Mildew Resistant Silicone	Match grout
Control joints & gaps in acoustic walls and partitions	Acoustic (paintable)	Standard
Control joints in gypsum board ceilings and partitions	Acrylic (paintable)	As selected
Joints between plastic laminate casework items	Silicone	Match plastic laminate
Joints between wood casework and woodwork items (transparent finish)	Silicone	Custom

## JOINT SEALANT SCHEDULE

Perimeter joints around frames of field painted metal frames	Acrylic (Paintable)	Standard
Perimeter Joints around frames of pre-finish metal doors and windows	Urethane or Silicone	Match metal frames
Joints between plumbing fixtures & adjoining walls, floors, & counters	Mildew Resistant Silicone	As selected

Provide sealants as follows:

- A. Type:
  - 1. Provide Type M (multicomponent) sealants where required to achieve color match Indicated and where specifically indicated.
  - 2. Provide Type S (single component) or Type M (multicomponent) sealants elsewhere.
- B. Grade:
  - 1. Provide Grade P (pourable) or Grade NS (non-sag) sealants at horizontal joints.
  - 2. Provide Grade NS (non-sag) sealants at vertical and non-horizontal joints.
- C. Use Related To Exposure:
  - 1. Provide Use T (traffic) at horizontal traffic surfaces.
  - 2. Provide Use NT (nontraffic) at vertical and horizontal non-traffic surfaces.
- D. Colors of Exposed Joint Sealants:
  - 1. Where a color is indicated "standard," provide standard color as selected by Architect from manufacturers full range for this characteristic.
  - 2. Where color is indicated "custom" or to match a building component, provide a custom Color that complies with requirements and matches said building component. Standard colors will be considered provided the color match is accurate. Architect's decision will be final on whether a proposed product matches satisfactorily.

**SECTION 092600  
GYPSUM BOARD ASSEMBLIES**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Standard and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Interior gypsum wallboard.
  - 2. Fire rated gypsum wallboard.
  - 3. Non-load-bearing steel framing.

**1.3 DEFINITIONS**

- A. Gypsum Board Terminology: Refer to ASTM C 11 for definitions of terms for gypsum boards assemblies not defined in this Section or in other referenced standards.

**1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.
- C. Samples: For the following products:
  - 1. Trim Accessories: Full-size sample in 12-inch-long length for each trim accessory indicated.

**1.5 QUALITY ASSURANCE**

- A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
  - 1. Fire-Resistance-Rated Assemblies: Indicated by design designations from UL's "Fire Resistance Directory".

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

## 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

## PART 2 – PRODUCTS

### 2.1 MANUFACTURERS

- 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. Steel Framing and Furring:
    - a. Clark Steel Framing Systems.
    - b. Consolidated Systems, Inc.
    - c. Dale Industries, Inc. – Dale/Incor.
    - d. Dietrich Industries, Inc.
    - e. MarinoWare; Division of Ware Ind.
    - f. National Gypsum Company.
    - g. Unimast, Inc.
  - 2. Gypsum Boards and Related Products:
    - a. American Gypsum Co.
    - b. G-P Gypsum Corp.
    - c. National Gypsum Company.
    - d. United States Gypsum Co.

### 2.2 STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- A. Components, General: Comply with ASTM C 754 for conditions indicated.
- B. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch-diameter wire, or double strand of 0.0475-inch-diameter wire.
- C. Hanger Attachments to Concrete: As follows:

1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching hanger wires and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by a qualified independent testing agency.
    - a. Type: Postinstalled, expansion anchor.
  2. Power-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by a qualified independent testing agency.
- D. Hangers: As follows:
1. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.
  2. Rod Hangers: ASTM A 510, mild carbon steel.
    - a. Diameter: 7/32-inch.
    - b. Protective Coating: ASTM A 153/A 153M, hot-dip galvanized.
- E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base metal thickness of 0.0538 inch, a minimum 1/2-inch-wide flange, with ASTM A 653/A 653M, G60, hot-dip galvanized zinc coating.
1. Depth: 1-1/2-inches.
- F. Furring Channels (Furring Members): Commercial-steel sheet with ASTM A 653/A 653M, G60, hot-dip galvanized zinc coating.
1. Cold Rolled Channels: 0.0538-inch bare steel thickness, with minimum 1/2-inch-wide flange, 3/4 inch deep.
  2. Steel Studs: ASTM C 654.
    - a. Minimum Base Metal Thickness: 0.0312 inch.
    - b. Depth: As indicated.
  3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
    - a. Minimum Base Metal Thickness: 0.0312 inch.
  4. Resilient Furring Channels: 1/2-inch-deep members designed to reduce sound transmission.
    - a. Configuration: Asymmetrical, with face attached to single flange by a slotted leg (web).
- G. Grid Suspension system for Interior Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following.
    - a. Armstrong World Industries, Inc.; Furring Systems/Drywall.
    - b. Chicago Metallic Corporation; Drywall Furring 660 System.

- c. USG Interiors, Inc; Drywall Suspension System.

## 2.3 STEEL PARTITIONS

### A. Components, General: As follows:

- 1. Comply with ASTM C 754 for conditions indicated.
- 2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with ASTM A 653/A 653M, G60, hot-tip galvanized zinc coating.

### B. Steel Studs and Runners: ASTM C 645.

- 1. Minimum Base Metal Thickness: 0.0312 inch.
- 2. Depth: As indicated.

### C. Deep-Leg Deflection Track: ASTM C 645 top runner with 2-inch-deep flanges.

### D. Proprietary Deflection Track: Steel sheet top runner manufactured to prevent cracking of gypsum board applied to interior partitions resulting from deflection of structure above; in thickness indicated for studs and in width to accommodate depth of studs.

- 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Delta Star, Inc, Superior Metal Trim; Superior Flex Track System (SFT).
  - b. Metal-Lite, Inc.; Slotted Track.

### E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

- 1. Minimum Base Metal Thickness: 0.0312 inch.

### F. Cold-Rolled Channel Bridging: 0.0538-inch bare steel thickness, with minimum 1/2-inch-wide flange.

- 1. Depth: 1-1/2 inches.
- 2. Clip Angle: 1-1/2 by 1-1/2 inch, -.068-inch-thick, galvanized steel.

## 2.4 INTERIOR GYPSUM WALLBOARD

### A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

### B. Gypsum Wallboard: ASTM C 36.

- 1. Types:
  - a. Thickness: 5/8 inch.
  - b. Thickness: Moisture Resistant

- c. Long Edges: Tapered.
- d. Location: Vertical surfaces, unless otherwise indicated.

## 2.5 TRIM ACCESSORIES

### A. Interior Trim: ASTM C 1047.

- 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
- 2. Shapes:
  - a. Cornerbead: Use at outside corners.
  - b. Bullnose Bead: Use where indicated.
  - c. LC-Bead: J-shaped; exposed long flange receives joint compound; use at exposed panel edges.
  - d. L-Bead: L-shaped; exposed long leg receives joint compound; use where indicated.
  - e. U-Bead: J-shaped; exposed short flange does not receive joint compound; use where indicated.
  - f. Expansion (Control) Joint: Use where indicated.

### B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

- 1. Available Manufacturers: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Fry Reglet Corp.
  - b. Gordon, Inc.
  - c. MM Systems Corporation.
  - d. Pittcon Industries.
- 2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, alloy 6063-T5.
- 3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

## 2.6 JOINT TREATMENT MATERIALS

### A. General: Comply with ASTM C 475.

### B. Joint Tape:

- 1. Interior Gypsum Wallboard: Paper.

- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
  2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
    - a. Use setting-type compound for installing paper-faced metal trim accessories.
  3. Fill Coat: For second coat, use setting-type, sandable topping compound.
  4. Finish Coat: For third coat, use setting-type, sandable topping compound.

## 2.7 ACOUSTICAL SEALANT

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following.
1. Acoustical Sealant for Exposed and Concealed Joints:
    - a. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
    - b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.
  - B. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

## 2.8 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
- D. Isolation Strip at Exterior Walls:
1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
  2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.



## PART 3 – EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLING STEEL FRAMING, GENERAL

- A. Installation Standards: ASTM C 754, and ASTM C 840 requirements that apply to framing installation.
- B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, furnishings, or similar construction. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook".
- C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement.
  - 1. Isolate ceiling assemblies where they abut or are penetrated by building structure.
  - 2. Isolate partition framing and wall furring where it abuts structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assembly and laterally support assembly.
    - a. Use deep-leg deflection track where indicated.
    - b. Use proprietary deflection track where indicated.
    - c. Use proprietary firestop track where indicated.
- D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.

### 3.3 INSTALLING STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- A. Suspend ceiling hangers from building structure as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
  - 3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.

4. Secure hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  5. Do not support ceilings directly from permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
  6. Do not attach hangers to steel deck tabs.
  7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- B. Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within 1/8 inch in 12 feet measured lengthwise on each member and transversely between parallel members.
- C. Sway-brace suspended steel framing with hangers used for support.
- D. Wire-tie furring channels to supports, as required to comply with requirements for assemblies indicated.
- E. Install suspended steel framing components in sizes and spacings indicated, but not less than that required by the referenced steel framing and installation standards.
1. Hangers: 48 inches o.c.
  2. Carrying Channels (Main Runners): 48 inches o.c.
  3. Furring Channels (Furring Members): 16 inches o.c.
- F. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

### 3.4 INSTALLING STEEL PARTITIONS

- A. Install tracks (runners) at floors, ceilings, and structural walls and columns where gypsum board assemblies abut other construction.
1. Where studs are installed directly against exterior walls, install asphalt-free or foam-gasket isolation strip between studs and wall.
- B. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not more than 1/8 inch from the plane formed by the faces of adjacent framing.
- C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
1. Cut studs 1/2 inch short of full height to provide perimeter relief.
  2. For fire-resistance-rated and STC-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid-structure surfaces to obtain ratings, install framing around structural

and other members extending below floor/roof slabs and decks, as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure.

- a. Terminate partition framing at suspended ceilings where indicated.

D. Install steel studs and furring at the following spacings:

- 1. Single-Layer Construction: 16 inches o.c., unless otherwise indicated.
- 2. Multilayer Construction: 16 inches o.c., unless otherwise indicated.

E. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.

F. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

- 1. Install two studs at each jamb, unless otherwise indicated.
- 2. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint.
- 3. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.

G. Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

### 3.5 APPLYING AND FINISHING PANELS, GENERAL

A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.

B. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

F. Attach gypsum panels to framing provided at openings and cutouts.

G. Form control and expansion joints with space between edges of adjoining gypsum panels.

H. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
  2. Fit gypsum panels around ducts, pipes, and conduits.
  3. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.
- I. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch-wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- J. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.
1. Space screws a maximum of 12 inches o.c. for vertical applications.

### 3.6 PANEL APPLICATION METHODS

A. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
  - a. Stagger abutting end joints not less than one framing member in alternate courses of board.

B. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.

### 3.7 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

### 3.8 FINISHING GYPSUM BOARD ASSEMBLIES

- A. General: Treat gypsum boards joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:

1. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view, unless otherwise indicated.

END OF SECTION 09260

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**SECTION 095110**  
**ACOUSTICAL PANEL CEILINGS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Extent of acoustical ceilings is indicated on Drawings and schedules.
- B. Types of acoustical ceiling products include the following:
  - 1. Acoustical lay-in panels of the following types:
    - a. Humidity-Tolerant acoustic panels.
  - 2. Suspended grid systems, specialty trim and accessories.
  - 3. Finish Schedule: **Fine Fissured, Prelude Grid, Square Edge.**
  - 4. Grilles, registers, diffusers in existing locations.
  - 5. New lighting fixtures wired to existing power circuits.

**1.2 SUBMITTALS**

- A. Product Data: Submit manufacturer's literature, including certification by a recognized independent testing laboratory, indicating compliance with requirements.

**1.3 QUALITY ASSURANCE**

- A. Standards: Comply with the following:
  - 1. Acoustical Materials: ASTM E 1264.
  - 2. Suspension Systems: ASTM C 635 for materials; ASTM C 636 for installation.
  - 3. Surface Burning Characteristics: Flame spread: 25 or less; smoke developed: 50 or less; per ASTM E 84. UL listed and marked.
  - 4. Seismic Standard: Comply with Ceilings and Interior Systems Contractors Association (CISCA) "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings--Seismic Zones 0-2."
- B. Source Limitations: Obtain each type of acoustic panel and related grid system from one source and by a single manufacturer.

**1.4 PROJECT CONDITIONS**

- A. Do not install ceilings until ambient temperature and humidity conditions can be continuously maintained at values near those intended for final occupancy.
- B. Building areas to receive ceiling shall be free of construction dust and debris.

**PART 2 - PRODUCTS**

**2.3 2 X 2 FOOT ACOUSTIC PANELS – FIRECODE ULTIMA 1951.**

- A. Smooth textured surface, humidity-tolerant, mineral composition panels with washable surface, and as follows:
  - 1. Surface: Smooth Textured, soil resistant, humidity and mold /mildew resistant, non-perforated.
  - 2. Edges: Square Edge

3. Grid: 15/16
4. Size: 24 inches by 24 inches by 3/4 inch thick, beveled tegular.
5. LR: Not less than .86.
6. NRC: Not less than .70.
7. CAC: Not less than 35.
8. Color: White.
9. Manufacturer/Style: Provide one of the following:
  - a. Armstrong World Industries, Inc.
  - b. Celotex
  - c. U.S. Gypsum.
10. Related Suspension Grid: Panel Suspension System in compliance with requirements of "Suspension Systems" Article of this Section.
  - a. Provide specialty trim systems where indicated on Drawings and where required.

## **2.2 SUSPENSION SYSTEMS**

- A. Suspension Systems, General: As required to support acoustical units, electrical and mechanical fixtures and other components as indicated, including anchorages, hangers, runners, cross runners, splines, clips, moldings, fasteners and other members, devices and accessories. Comply with requirements of ASTM C 635.
  1. Hanger Wire: Not less than 12 gage (0.106 inch) galvanized steel.
  2. Type: Exposed Direct-Hung Steel Suspension System
  3. Structural Class: Medium-Duty System-Hold Down Clips.
- B. Moisture-Resistant 15/16-inch Panel Suspension System: Suspension system with G60 hot-dip galvanized exposed faces with rolled, painted, aluminum caps.
  1. Face Width: 15/16-inch wide.
  2. Product/Manufacturer: Provide the following:
    - a. "Prelude XL"; Armstrong World Industries, Inc.
    - b. "Protectone Aluminum Fire-Rated Capped System"; BPB-North America.
    - c. "Donn ZXLA"; U.S. Gypsum.
  3. Color: White.

## **2.3 ACOUSTICAL SEALANT**

- A. Available Products:
  1. Acoustical Sealant for Exposed and Concealed Joints:
    - a. Pecora Corp; AC-20 FTR Acoustical and Insulation Sealant.
    - b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.
    - c. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard non-sag, paintable, non-staining latex sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.



## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Comply with ASTM C636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Layout: Balance ceiling borders on opposite sides, using more-than-half width acoustical units, except where otherwise dimensioned or indicated.
  - 1. Tolerance: 1/8 inch in 12 feet level tolerance.
  - 2. Pattern Direction: One-way, align joints.
- C. Suspension System: Secure to building structure, free from contact with objects within the ceiling plenum, with hangers spaced 48 inches on center along supported members; provide hangers not more than 8 inches from ends of each member.
  - 1. Where interference with ducts or suspended equipment prevents direct connection of suspension elements to building structure, provide steel channel members (Unistrut or equivalent) hung from structural members with threaded rods with appropriate fasteners; and adequately sized for suspension system capacity. Secure suspension system to steel channels. Connection to ductwork or equipment is not permitted.
  - 2. Do not fasten ceiling suspension members to metal roof deck.
- D. Rabbeted Panels: Rabbet panel edges that have been field cut to fit non-modular suspension grid shapes at room perimeter, columns, and similar obstructions. Use router or other factory-approved rabbeting method.
- E. Edge Moldings: Secure to substrate with screw anchors spaced 16 inch on center. Set with concealed bead of acoustical sealant. Miter corner joints. Cope exposed flanges of intersecting suspension members for flush intersections.
- F. **Provide hold-down clips** at each acoustic panel in systems indicated for **office** application. Install in accordance with manufacturer's recommendations for an air pressure uplift-resistant installation.

### **3.2 SPECIALTY TRIM INSTALLATION**

- A. Exposed Edge and Perimeter Trim System: Install units in accordance with manufacturer's printed instructions for specific Project application.

### **3.3 CLEANING AND REPAIR**

- A. Clean suspension grid and panels. Remove and replace panels and grid that are defective, or that have been damaged.
- B. Touch-up paint field-cut edges of factory painted tile that are exposed to view in finished installation, including horizontal and vertical surfaces at perimeter of ceilings where panels are cut for rabbeted edge molding.

**END OF SECTION 095110**

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**SECTION 096510  
RESILIENT TILE FLOORING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies the installation of solid vinyl tile flooring, vinyl composition tile flooring and accessories.

**1.2 RELATED WORK**

- A. Color and pattern and location in room finish schedule: SCHEDULE FOR FINISHES.
- B. Resilient Base: Section 096530.

**1.3 SUBMITTALS**

- A. Submit in accordance with SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Description of each product.
  - 2. Resilient material manufacturers recommendations for adhesives, underlayment, primers and polish.
  - 3. Application and installation instructions.
- C. Samples:
  - 1. Tile: (12 inches by 12 inches) for each type, pattern and color.
  - 2. Edge Strips: (6 inches) long, each type.
  - 3. Feature Strips: (6 inches) long.
- D. Shop Drawings:
  - 1. Layout of patterns shown on the drawings.
  - 2. Edge strip locations showing types and detail cross sections.
- E. Test Reports:
  - 1. Abrasion resistance: Depth of wear for each tile type and color and volume loss of tile, certified by independent laboratory.
  - 2. Tested per ASTM F510.

**1.4 DELIVERY**

- A. Deliver materials to the site in original sealed packages or containers, clearly marked with the manufacturer's name or brand, type and color, production run number and date of manufacture.
- B. Materials from containers which have been distorted, damaged or opened prior to installation will be rejected.

**1.5 STORAGE**

- A. Store materials in weathertight and dry storage facility.
- B. Protect from damage from handling, water, and temperature.

## **1.6 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
  - D4078-02 (2008).....Water Emulsion Floor Finish
  - E648-10.....Critical Radiant Flux of Floor Covering Systems Using a Radiant Energy Source
  - E662-09.....Specific Optical Density of Smoke Generated by Solid Materials
  - E1155-96 (R2008).....Determining Floor Flatness and Floor Levelness Numbers
  - F510-93 (R 2008).....Resistance to Abrasion of Resilient Floor Coverings Using an Abrader with a Grit Feed Method
  - F710-08.....Preparing Concrete Floors to Receive Resilient Flooring
  - F1066-04 (R2010).....Vinyl Composition Floor Tile
  - F1344-10.....Rubber Floor Tile
  - F1700-04 (R2010).....Solid Vinyl Floor Tile
- C. Resilient Floor Covering Institute (RFCI):
  - IP #2.....Installation Practice for Vinyl Composition Tile (VCT)
- D. Federal Specifications (Fed. Spec.):
  - SS-T-312.....Tile Floor: Asphalt, Rubber, Vinyl and Vinyl Composition

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Furnish product type, materials of the same production run and meeting following criteria.
- B. Use adhesives, underlayment, primers and polish recommended by the floor resilient material manufacturer.
- C. Critical Radiant Flux: 0.45 watts per sq. cm or more, Class I, per ASTM E 648.
- D. Smoke density: Less than 450 per ASTM E662.
- E. Manufacturer's: Armstrong World Industries, Congoleum Tarkett, Kentile, Azrock Industries, and Mannington Commercial Resilient.
- F. Architect to select resilient floor from Manufacturer's standard colors. WSU standard will be basis of selection.

### **2.2 VINYL COMPOSITION TILE**

- A. ASTM F1066, Composition 1, //Class I (solid color)// Class 2 (through pattern) //, 300 mm (12 inches) square, 3 mm (1/8 inch) thick.
- B. Color and pattern uniformly distributed throughout thickness.

**2.3 SOLID VINYL-TILE**

- A. ASTM F1700, 300 mm (12 by 12 inches) square, 3 mm (1/8 inch) thick, homogenous throughout.
- B. Color and Pattern uniformly distributed throughout thickness.
- C. Where solid vinyl tiles are specified, seek products with recycled content.

**2.5 ADHESIVES**

- A. Comply with applicable regulations regarding toxic and hazardous materials Green Seal (GS-36) for commercial adhesive.
- B. Use low-VOC adhesive during installation. Water based is preferred over solvent based adhesives. Henry 430 is preferred WSU adhesive.

**2.6 PRIMER (FOR CONCRETE SUBFLOORS)**

As recommended by the adhesive and tile manufacturer.

**2.7 LEVELING COMPOUND (FOR CONCRETE FLOORS)**

- A. Provide cementitious products with latex or polyvinyl acetate resins in the mix.
- B. Determine the type of underlayment selected for use by the condition to be corrected.

**2.8 POLISH AND CLEANERS**

- A. Cleaners RFCI CL-1.
- B. Polish: ASTM D4078.

**2.9 EDGE STRIPS**

- A. 28 mm (1-1/8 inch) wide unless shown otherwise.
- B. Bevel from maximum thickness to minimum thickness for flush joint unless shown otherwise.
- C. Extruded aluminum, mill finish, mechanically cleaned:
  - 1. Drill and counter sink edge strip for flat head screws.
  - 2. Space holes near ends and approximately 225 mm (9 inches) on center between.
- D. Resilient Edge Strip or Reducer Strip: Fed. Specs. SS-T-312, Solid vinyl.

**2.10 SCREWS**

Stainless steel flat head screw.

**PART 3 - EXECUTION**

**3.1 PROJECT CONDITIONS**

- A. Maintain temperature of materials a minimum of 22 °C (70 °F,) for 48 hours before installation.
- B. Maintain temperature of rooms where work occurs between 21 °C and 27 °C (70 °F and 80 °F), for at least 48 hours, before, during and after installation.
- C. Do not install flooring until building is permanently enclosed and wet construction in or near areas to receive tile materials is complete, dry and cured.

### 3.2 SUBFLOOR PREPARATION

- A. Verify that concrete slabs comply with ASTM F710. At existing slabs, determine levelness by F-number method in accordance with ASTM E1155. Overall value shall not exceed as follows:  
FF30/FL20
- B. Correct conditions which will impair proper installation.
- C. Fill cracks, joints and other irregularities in concrete with leveling compound:
  - 1. Do not use adhesive for filling or leveling purposes.
  - 2. Do not use leveling compound to correct imperfections which can be corrected by spot grinding.
  - 3. Trowel to smooth surface free of trowel marks, pits, dents, protrusions, cracks or joints.
- D. Clean floor of oil, paint, dust, and deleterious substances: Leave floor dry and cured free of residue from existing curing or cleaning agents.
- E. Concrete Subfloor Testing:  
Determine Adhesion and dryness of the floor by bond and moisture tests as recommended by RFCI manual MRP.
- F. Perform additional subfloor preparation to obtain satisfactory adherence of flooring if subfloor test patches allows easy removal of tile.
- G. Prime the concrete subfloor if the primer will seal slab conditions that would inhibit bonding, or if priming is recommended by the tile or adhesive manufacturers.
- H. *Preparation of existing installation shall include the removal of existing resilient floor and existing adhesive. Do not use solvents to remove adhesives.*

### 3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions for application and installation unless specified otherwise.
- B. Mix tile from at least two containers. An apparent line either of shades or pattern variance will not be accepted.
- C. Tile Layout:
  - 1. If layout is not shown on drawings, lay tile symmetrically about center of room or space with joints aligned.
  - 2. No tile shall be less than 150 mm (6 inches) and of equal width at walls.
  - 3. Place tile pattern in the same direction; do not alternate tiles.
- D. Trim tiles to touch for the length of intersections at pipes and vertical projections, seal joints at pipes with waterproof cement.
- E. Application:
  - 1. Apply adhesive uniformly with no bare spots.

- a. Conform to RFC1-TM-6 for joint tightness and for corner intersection unless layout pattern shows random corner intersection.
- b. More than 5 percent of the joints not touching will not be accepted.
2. Roll tile floor with a minimum 45 kg (100 pound) roller. No exceptions.
3. The Resident Engineer may have test tiles removed to check for non-uniform adhesion, spotty adhesive coverage, and ease of removal. Install new tile for broken removed tile.
- F. Installation of Edge Strips:
  1. Locate edge strips under center line of doors unless otherwise shown.
  2. Set resilient edge strips in adhesive. Anchor metal edge strips with anchors and screws specified.
  3. Where tile edge is exposed, butt edge strip to touch along tile edge.
  4. Where thin set ceramic tile abuts resilient tile, set edge strip against floor file and against the ceramic tile edge.

### **3.4 CLEANING AND PROTECTION**

- A. Clean adhesive marks on exposed surfaces during the application of resilient materials before the adhesive sets. Exposed adhesive is not acceptable.
- B. Keep traffic off resilient material for a minimum 72 hours after installation.
- C. Clean and polish materials in the following order:
  1. For the first two weeks sweep and damp mopped only.
  2. After two weeks, scrub resilient materials with a minimum amount of water and a mild detergent. Leave surface clean and free of detergent residue.
  3. Apply polish to the floors in accordance with the polish manufacturer's instructions.
- D. When construction traffic occurs over tile, cover resilient materials with reinforced kraft paper properly secured and maintained until removal is directed by Resident Engineer. At entrances and where wheeled vehicles or carts are used, cover tile with plywood, hardboard, or particle board over paper, secured and maintained until removal is directed by Resident Engineer.
- E. When protective materials are removed and immediately prior to acceptance, replace any damage tile, re-clean resilient materials, lightly re-apply polish and buff floors.

### **3.6 LOCATION**

- A. Unless otherwise specified or shown, install tile flooring, on floor under areas where casework, laboratory and pharmacy furniture and other equipment occurs, except where mounted in wall recesses.
- B. Extend tile flooring for room into adjacent closets and alcoves.

**END OF SECTION 096510**

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**SECTION 096530**  
**RESILIENT WALL BASE AND ACCESSORIES**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including the Standard and Supplementary Conditions and other Division 1 Specification Sections, apply to this section.

**1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Resilient cove base (4 inches height).
- B. Related Sections include the following:
  - 1. At new wall locations and finishes.

**1.3 SUBMITTALS**

- A. Product Data: Product indicated.
- B. Samples: In manufacturer's standard sizes, but not less than 3 inches long, of each product color and pattern specified.

**1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: A qualifies installer who has specialized in installing resilient products similar to those required for this Project.
- B. Fire-test Response Characteristics: Provide product identical to those tested for fire-exposure behavior per test method indicated by a testing and inspecting agency acceptable to authorities having jurisdiction.
  - 1. Critical Radiant Flux: 0.45 W/sq cm or greater when tested per ASTM E 648.
  - 2. Smoke Density: Maximum specific optical density of 450 or less when tested per ASTM 662.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to Project site in manufacturer's original, unopened cartons and containers. Each bearing names product and manufacturer, Project identification, and shipping and handling instructions.
- B. Store products in dry spaces protected from the weather, with ambient temperature maintaining between 50 and 90 deg F.
- C. Move products into spaces where they will be installed at least 48 hours before installation.

**1.6 PROJECT CONDITIONS**

- A. Maintain a temperature of not less than 70 deg F or more than 95 deg F in spaces to receive resilient products for at least 48 hours before installation, during installation, and for at least 48 hours after installation. After post installation period, maintain a temperature of not less than 55 deg F or more than 95 deg F.

- B. Do not install products until they are at the same temperature as the space where they are to be installed.
- C. Coordinate resilient product installation with other construction to minimize possibility of damage and soiling during remainder of construction period. Install resilient products after other finishing operations, including painting, have been completed.

## PART 2 – PRODUCTS

### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements of WSU.

### 2.2 RESILIENT WALL BASE

- A. Resilient Cove Base: Products complying with FS AA-W-40, Type I and with requirements specified in the Resilient Wall Base and Accessory Schedule. (4 inch height). Color by Architect.

### 2.3 INSTALLATION ACCESSORIES

- A. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

## PART 3 – EXECUTION

### 3.1 PREPARATION

- A. General: Comply with manufacturer's written installation for preparing substrates indicated to receive resilient products.
- B. Clean substrates to be covered immediately before installing resilient products. Do not proceed with installation until conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Install resilient products according to manufacturer's written installation instructions.
- B. Apply resilient wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
  - 1. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned. Adhere tightly to surfaces.

END OF SECTION 096530

**SECTION 096800  
CARPET**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Standard and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. This Section includes vestibule carpet.
  - 1. Surface preparation of new slab on grade, preparing floor for new carpet finish.

**1.3 SUBMITTALS**

- A. Product Data: Include floor surface preparation materials.
  - 1. Submit product data, samples, warranty, maintenance data, and proposed seaming layout.
- B. Samples for Verification: Submit carpet samples and material to be installed.
- C. Qualification Data: For Applicator.

**1.4 QUALITY ASSURANCE**

- A. Applicator Qualifications: A firm or individual experienced in installing carpet.
- B. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- C. Performance: Fire performance meeting requirements of building code and authorities having jurisdiction.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
  - 1. Product name or title of material.
  - 2. Product description (generic classification).
  - 3. Manufacturer's stock number and date of manufacture.
  - 4. Color name and number.

1.6 PROJECT CONDITIONS

- A. Install carpet only in proper conditions and when floor surfaces have been properly prepared.

1.7 EXTRA MATERIALS

- A. Furnish extra carpet materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.
  - 1. Quantity: Furnish Owner with an additional 5 percent, as appropriate, of each carpet material and color.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work. Refer to Finish Schedule.
- B. Carpet: As indicated by manufacturer's designation in the Materials Data Sheet.
- C. Adhesives and Cements: As recommended by carpet manufacturer.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for carpet installation.
  - 1. Install carpet only after unsatisfactory conditions have been corrected and surfaces floor surfaces receiving carpet meet manufacturer's guidelines and standards.
  - 2. Start of installation of carpet will be construed as Installer's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections to ensure compatibility of the total system for various substrates.
  - 1. Notify Architect about anticipated problems when using the reviewing floor surface prepared by others.

3.2 PREPARATION

- A. General: Remove existing adhesives, objects from floor surface that will interfere with the installation of new carpet.
  - 1. After completing carpeting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

- B. Cleaning: Before installing carpet, clean substrates of substances that could impair bond of the various glues. Remove oil and grease before applying glue.

1. Schedule cleaning of existing and new floor surface so dust and other contaminants from the cleaning process do not fall on prepared floor surfaces.

- C. Surface Preparation: Clean and prepare surfaces according to manufacturer's written instructions for each particular substrate condition and as specified.

### 3.3 INSTALLATION

- A. General: Install carpet according to manufacturer's written instructions. Use techniques best suited for substrate and type of carpet material being installed.

1. Prepare surfaces per manufacturer's specifications and guidelines.
2. Do not install carpet over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to adhesion of carpet to floor surface.
3. Provide glues that are compatible with carpet and carpet backing used.

- B. Comply with CRI 104, Section 8, "Direct Glue-Down."

- C. Prepare surfaces and install materials in accordance with manufacturer's instructions and approved submittals. Clean, patch, and level substrate. Install materials in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.

1. Maintain uniformity of carpet direction and lay of pile. At doorway, center seams under door in closed position. Bind or seal cut edges as recommended by carpet manufacturer.
2. Install pattern parallel to walls and borders.

- D. Install resilient or stainless edge guards and/or reducer strips as required (refer to architectural drawings); clean and protect.

### 3.4 CLEANING

- A. Cleanup: At the end of each workday, remove empty glue cans, rags, rubbish, and other discarded carpet materials from Project site.

1. After completing carpet installation, clean carpet.

**END OF SECTION 096800**

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**SECTION 099120  
PAINTING**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Standard and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. This Section includes surface preparation and field painting of exposed interior items and surfaces.
  - 1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. New work to receive paint finish. Existing surfaces adjacent to new work to receive new paint finish.
- C. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
  - 1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, building steel frames and structural supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
- D. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
  - 1. Prefinished items include the following factory-finished components:
    - a. Architectural woodwork.
    - b. Finished mechanical and electrical equipment.
    - c. Light fixtures.
  - 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
    - a. Furred areas.
    - b. Ceiling plenums.
    - c. Pipe spaces.
    - d. Duct shafts.
  - 3. Finished metal surfaces include the following:
    - a. Anodized aluminum.

- b. Stainless steel.
  - c. Chromium plate.
  - d. Copper and copper alloys.
  - e. Bronze and brass.
4. Operating parts include moving parts of operating equipment and the following:
- a. Valve and damper operators.
  - b. Linkages.
  - c. Sensing devices.
  - d. Motor and fan shafts.
5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
- E. Related Sections include the following:
- 1. Division 5 Section "Metal Fabrications" for shop priming ferrous metal.
  - 2. Division 9 Section "Gypsum Board Assemblies" for surface preparation of gypsum board.

### 1.3 DEFINITIONS

- A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
- 1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 850degree meter.
  - 2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
  - 3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
  - 4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

### 1.4 SUBMITTALS

- A. Product Data: For each paint system indicated. Include block fillers and primers.
- 1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
  - 2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.



- B. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.
  - 1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
  - 2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.

- C. Qualification Data: For Applicator.

#### 1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
  - 1. Product name or title of material.
  - 2. Product description (generic classification or binder type).
  - 3. Manufacturer's stock number and date of manufacture.
  - 4. Contents by volume, for pigment and vehicle constituents.
  - 5. Thinning instructions.
  - 6. Application instructions.
  - 7. Color name and number.
  - 8. VOC content.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.
  - 1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

#### 1.7 PROJECT CONDITIONS

- A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.

- B. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F.
- C. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
  - 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

#### 1.8 EXTRA MATERIALS

- A. Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.
  - 1. Quantity: Furnish Owner with an additional 5 percent, but not less than 1 gal. or 1 case, as appropriate, of each material and color applied.

### PART 2 – PRODUCTS

#### 2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.
- B. Manufacturers' Names; Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
  - 1. Benjamin Moore & Co.
  - 2. ICI Paints (Devco Coatings and Dulux Paints).
  - 3. International Protective Coatings.
  - 4. O'Leary Paint Co.
  - 5. PPG Industries, Inc.
  - 6. Pratt & Lambert Paints.
  - 7. Sherwin-Williams Co.

#### 2.2 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
  - 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

- C. Colors: As indicated by manufacturer's designations.

## 2.3 INTERIOR PRIMERS

- A. Interior Gypsum Board Primer: Factory-formulated latex-based primer for interior application.
  - 1. Benjamin Moore; Moorcraft Super Spec Latex Enamel Undercoater & Primer Sealer No. 253: Applied at a dry film thickness of not less than 1.2 mils.
  - 2. Sherwin-Williams; PrepRite 200 Latex Wall Primer B28W200 Series: Applied at a dry film thickness of not less than 1.6 mils.
- B. Interior Ferrous-Metal Primer: Factory-formulated quick-drying rust-inhibitive alkyd-based metal primer.
  - 1. Benjamin Moore; Moore's IMC Alkyd Metal Primer No. M06: Applied at a dry film thickness of not less than 2.0 mils.
  - 2. Sherwin-Williams; Kem Kromik Universal Metal Primer B50NZ6/B50WZ1: Applied at a dry film thickness of not less than 3.0 mils.
- C. Interior Zinc-Coated Metal Primer: Factory-formulated galvanized metal primer.
  - 1. Benjamin Moore; Moore's IMC Acrylic Metal Primer No. M04: Applied at a dry film thickness of not less than 2.0 mils.
  - 2. Sherwin-Williams; Galvite HS B50WZ30: Applied at a dry film thickness of not less than 3.0 mils.

## 2.4 INTERIOR FINISH COATS

- A. Interior Flat Acrylic Paint: Factory-formulated flat acrylic-emulsion latex paint for interior application.
  - 1. Benjamin Moore; Moorcraft Super Spec Latex Flat No. 275: Applied at a dry film thickness of not less than 1.2 mils.
  - 2. Sherwin-Williams; ProMar 200 Interior Latex Flat Wall Paint B30W200 Series: Applied at a dry film thickness of not less than 1.4 mils.
- B. Interior Low-Luster Acrylic Enamel: Factory-formulated eggshell acrylic-latex interior enamel.
  - 1. Benjamin Moore; Moorcraft Super Spec Latex Eggshell Enamel No. 274: Applied at a dry film thickness of not less than 1.3 mils.
  - 2. Sherwin-Williams; ProMar 200 Interior Latex Egg-Shell Enamel B20W200 Series: Applied at a dry film thickness of not less than 1.6 mils.
- C. Interior Semigloss Acrylic Enamel: Factory-formulated semigloss acrylic-latex enamel for interior application.
  - 1. Benjamin Moore; Moorcraft Super Spec Latex Semi-Gloss Enamel No. 276: Applied at a dry film thickness of not less than 1.2 mils.
  - 2. Sherwin-Williams; ProMar 200 Interior Latex Semi-Gloss Enamel B31W200 Series: Applied at a dry film thickness of not less than 1.3 mils.
- D. Interior Full-Gloss Acrylic Enamel: Factory-formulated full-gloss acrylic-latex interior enamel.

1. Benjamin Moore; Moore's IMC Acrylic Gloss Enamel No. M28: Applied at a dry film thickness of not less than 2.0 mils.
  2. Sherwin-Williams; ProMar 200 Interior Latex Gloss Enamel B21W201: Applied at a dry film thickness of not less than 1.5 mils.
- E. Interior Semigloss Alkyd Enamel: Factory-formulated semigloss alkyd enamel for interior application.
1. Benjamin Moore; Moorcraft Super Spec Alkyd Semi-Gloss Enamel No. 271: Applied at a dry film thickness of not less than 1.4 mils.
  2. Sherwin-Williams; ProMar 200 Interior Alkyd Semi-Gloss Enamel B34W200 Series: Applied at a dry film thickness of not less than 1.7 mils.
- F. Interior Full-Gloss Alkyd Enamel for Wood and Metal Surfaces: Factory-formulated full-gloss alkyd interior enamel.
1. Benjamin Moore; Moore's IMC Urethane Alkyd Enamel No. M22: Applied at a dry film thickness of not less than 2.0 mils.
  2. Sherwin-Williams; ProMar 200 Alkyd Gloss Enamel B35W200 Series: Applied at a dry film thickness of not less than 1.6 mils.

### PART 3 – EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application. Comply with procedures specified in PDCA P4.
1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
  2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

#### 3.2 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.
2. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
  - a. Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No. 3.
  - b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
  - c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as shop coat.
3. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and stain material before using.
3. Use only thinners approved by paint manufacturer and only within recommended limits.

E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

### 3.3 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
3. Provide finish coats that are compatible with primers used.

4. The term “exposed surfaces” includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
  5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
  7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
  8. Sand lightly between each succeeding enamel or varnish coat.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer’s written instructions, sand between applications.
  2. Omit primer over metal surfaces that have been shop primed and touchup painted.
  3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
  4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer’s written instructions.
1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
  2. Rollers: Use rollers of carpet, velvet-back, or high pile sheep’s wool as recommended by manufacturer for material and texture required.
  3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer’s recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of entire system as recommended by manufacturer.
- E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in occupied spaces.
- F. Mechanical items to be painted include, but are not limited to, the following:

1. Uninsulated metal piping.
2. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
3. Duct, equipment, and pipe insulation having “all-service jacket” or other paintable jacket material.
4. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

G. Electrical items to be painted include, but are not limited to, the following:

1. Switchgear.
2. Panelboards.
3. Electrical equipment that is indicated to have a factory-primed finish for field painting.

H. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

I. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

J. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

### 3.4 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.

1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces

### 3.5 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

B. Provide “Wet Paint” signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.

1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

### 3.6 INTERIOR PAINT SCHEDULE

A. Concrete and Masonry (Other Than Concrete Unit Masonry): Provide the following paint systems over interior concrete and brick masonry substrates:

1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
  - a. Primer: Interior concrete and masonry primer.

- b. Finish Coats: Interior semigloss acrylic enamel.
- B. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:
  - 1. Flat Acrylic Finish: Two finish coats over a primer.
    - a. Primer: Interior gypsum board primer.
    - b. Finish Coats: Interior flat acrylic paint.
  - 2. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
    - a. Primer: Interior gypsum board primer.
    - b. Finish Coats: Interior semigloss acrylic enamel.
- C. Ferrous Metal: Provide the following finish systems over ferrous metal:
  - 1. Full-Gloss Acrylic-Enamel Finish: Two finish coats over a primer.
    - a. Primer: Interior ferrous-metal primer.
    - b. Finish Coats: Interior full-gloss acrylic enamel.
- D. Zinc-Coated Metal: Provide the following finish systems over interior zinc-coated metal surfaces:
  - 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
    - a. Primer: Interior zinc-coated metal primer.
    - b. Finish Coats: Interior semigloss acrylic enamel.
  - 2. Full-Gloss Acrylic-Enamel Finish: Two finish coats over a primer.
    - a. Primer: Interior zinc-coated metal primer.
    - b. Finish Coats: Interior full-gloss acrylic enamel.
- E. All-Service Jacket over Insulation: Provide the following finish system on cotton or canvas insulation covering:
  - 1. Flat Acrylic Finish: Two finish coats. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coats: Interior flat latex-emulsion size.

**END OF SECTION 099120**



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**SECTION 21 05 00**  
**BASIC FIRE SUPPRESSION REQUIREMENTS**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements applicable to all Division 21 Sections. Also refer to Division 1 - General Requirements.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 SCOPE OF WORK

- A. This Specification and the associated drawings govern the furnishing, installing, testing and placing into satisfactory operation the Mechanical Systems.
- B. Each Contractor shall provide all new materials indicated on the drawings and/or in these specifications, and all items required to make his portion of the Mechanical Work a finished and working system.
- C. Separate contracts will be awarded for the following work. The division of work listed below is for the contractors' convenience and lists a normal breakdown of the work. Please refer to the Construction Manager's scope statements for complete scope of work description.
- D. Scope of Work:
  - 1. Plumbing Work shall include, but is not necessarily limited to:
    - a. Furnish and install all items listed in the Plumbing Material List.
    - b. Furnish and Extend existing domestic water piping system including cold, hot, and hot water circulating piping within the building, to new plumbing fixtures. Insulate all piping as specified.
    - c. Furnish and install local instant water heaters where specified.
    - d. Furnish and install sanitary and vent piping for new plumbing fixtures and connect to existing building sanitary and vent system.
    - e. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.
  - 2. Heating Work shall include, but is not necessarily limited to:
    - a. Furnish and install reheat water piping including piping, insulation, air control equipment, specialties, and connections to new terminal heating coils. Connect reheat water piping to existing building heating hot water system.
    - b. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.

3. Air Conditioning and Ventilating Work shall include, but is not necessarily limited to:
  - a. Furnish and install supply air ductwork systems including all fittings, insulation, and outlets as shown on drawings.
  - b. Furnish and install return air ductwork systems including all fittings, insulation, and inlets as shown on drawings.
  - c. Furnish and install all terminal air boxes and reheat coils.
  - d. Furnish and install all temperature control systems as required on the drawings.
  - e. Furnish and install all fire dampers.
  - f. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.
4. Fire Protection Work shall include, but is not necessarily limited to:
  - a. Modify existing wet pipe sprinkler system for areas noted on the drawings and extend wet pipe to sound booth sprinkler connection.
  - b. Furnish and install all items listed on the Fire Protection Material List.
  - c. Furnish all hydraulic calculations and working sprinkler drawings.
  - d. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.
5. Testing, Adjusting, and Balancing Work shall include, but is not necessarily limited to:
  - a. Furnish complete testing, adjusting, and balancing as specified in Section 23 05 93, including, but not limited to, air systems, hydronic systems, plumbing systems, and verification of control systems.

### 1.3 OWNER FURNISHED PRODUCTS

- A. The Owner will supply the following items for installation and/or connection by This Contractor:
- B. This Contractor shall make all mechanical system connections shown on the drawings **or** as required for fully functional units.
- C. This Contractor is responsible for all damage to Owner furnished equipment caused during installation.

### 1.4 WORK SEQUENCE

- A. All work that will produce excessive noise or interference with normal building operations, as determined by the Owner, shall be scheduled with the Owner. It may be necessary to schedule such work during unoccupied hours. The Owner reserves the right to determine when restricted construction hours will be required.

## 1.5 COORDINATION DRAWINGS

### A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.
  - a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.
  - b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
  - c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
  - d. Maintenance clearances and code-required dedicated space shall be included.
  - e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.
2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

### B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.
2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.
  - a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.
3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. General:

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion but will not perform as a coordinator.
2. A plotted set of coordination drawings shall be available at the project site.
3. Coordination drawings are not shop drawings and shall not be submitted as such.
4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.
6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.
9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.
  - a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
  - b. Potential layout changes shall be made to avoid additional access panels.
  - c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.
  - d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.
  - e. When additional access panels are required, they shall be provided without additional cost to the Owner.
10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors prior to installing any of the components.
11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements or installed their work without proper coordination.
12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.6 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
2. The Contractor shall resolve all reported deficiencies with the Architect/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 Design Team will be done at the Contractor's risk.

B. Qualifications:

1. Only products of reputable manufacturers are acceptable.
2. All Contractors and subcontractors shall employ only workers skilled in their trades.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the City of Detroit Codes, Laws, Ordinances and other regulations having jurisdiction.
2. Conform to all State Codes.
3. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.
4. If the Contractor notes, at the time of bidding, any parts of the drawings or specifications that do not comply with the codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, he shall submit with his proposal a separate price to make the system comply with the codes and regulations.
5. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Owner.
6. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
7. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.

2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.
3. Pay all charges for permits or licenses.
4. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
5. Pay all charges arising out of required inspections by an authorized body.
6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.
7. Where applicable, all fixtures, equipment and materials shall be approved or listed by Underwriter's Laboratories, Inc.

**E. Examination of Drawings:**

1. The drawings for the fire protection work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pipes and ducts to best fit the layout of the job.
3. Scaling of the drawings is not sufficient or accurate for determining these locations.
4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.
6. If an item is either on the drawings or in the specifications, it shall be included in this contract.
7. Determination of quantities of material and equipment required shall be made by the Contractor from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater number shall govern.
8. Where used in fire protection documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.
  - a. Any item listed as furnished shall also be installed, unless otherwise noted.
  - b. Any item listed as installed shall also be furnished, unless otherwise noted.

**F. Field Measurements:**

1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any supports, pipes or ducts.

**G. Electronic Media/Files:**

1. Construction drawings for this project have been prepared utilizing Revit.



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 Contractor shall complete and return a signed "Electronic File Transmittal" form provided by IMEG.
4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
7. The use of these CAD 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 IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor's use of these documents.

#### 1.7 SUBMITTALS

- A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

<b><u>Referenced Specification</u></b>	
<b><u>Section</u></b>	<b><u>Submittal Item</u></b>
21 05 03	Fire Seal Systems
21 13 00	Sprinkler Systems

- B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:
  - a. Date
  - b. Project title and number
  - c. Contractor's name and address
  - d. Division of work (e.g., plumbing, heating, ventilating, etc.)
  - e. Description of items submitted and relevant specification number
  - f. Notations of deviations from the contract documents
  - g. Other pertinent data
2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:
  - a. Date
  - b. Project title and number
  - c. Architect/Engineer

- d. Contractor and subcontractors' names and addresses
  - e. Supplier and manufacturer's names and addresses
  - f. Division of work (e.g., plumbing, heating, ventilating, etc.)
  - g. Description of item submitted (using project nomenclature) and relevant specification number
  - h. Notations of deviations from the contract documents
  - i. Other pertinent data
  - j. Provide space for Contractor's review stamps
3. Composition:
- a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
  - b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
  - c. All sets shall contain an index of the items enclosed with a general topic description on the cover.
4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; electrical power wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
5. Contractor's Approval Stamp:
- a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
  - b. Unstamped submittals will be rejected.
  - c. The Contractor's review shall include, but not be limited to, verification of the following:
    - 1.) Only approved manufacturers are used.
    - 2.) Addenda items have been incorporated.
    - 3.) Catalog numbers and options match those specified.
    - 4.) Performance data matches that specified.
    - 5.) Electrical characteristics and loads match those specified.
    - 6.) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
    - 7.) Dimensions and service clearances are suitable for the intended location.
    - 8.) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
    - 9.) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).

- d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.
  - e. **The 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 deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.**
6. Submittal Identification and Markings:
- a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
  - b. The Contractor shall clearly indicate the size, finish, material, etc.
  - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
  - d. All marks and identifications on the submittals shall be unambiguous.
7. Schedule submittals to expedite the project. Coordinate submission of related items.
8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
9. Reproduction of contract documents alone is not acceptable for submittals.
10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
11. Submittals not required by the contract documents may be returned without review.
12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any equipment for manufacture or shipment.
14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.
- C. Electronic Submittal Procedures:
- 1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
  - 2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
  - 3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
  - a. Submittal file name: 21 XX XX.description.YYYYMMDD
  - b. Transmittal file name: 21 XX XX.description.YYYYMMDD
5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be transmitted via a pre-approved method.

#### 1.8 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

- A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.
- B. Keep all bearings properly lubricated and all belts properly tensioned and aligned.
- C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.
- D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate his/her work with other trades.

#### 1.9 NETWORK / INTERNET CONNECTED EQUIPMENT

- A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Owner.

#### 1.10 WARRANTY

- A. Provide one-year warranty, unless otherwise noted, to the Owner for all fixtures, equipment, materials, and workmanship.
- B. The warranty period for all work in this Division of the specifications shall commence on the date of final acceptance, unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.
- C. Warranty requirements shall extend to correction, without cost to the Owner, of all Work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from defects or nonconformance with contract documents.

#### 1.11 INSURANCE

- A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employee and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

1. materials and restored to original condition.

3.2 ARCHITECT/ENGINEER OBSERVATION OF WORK

- A. The Contractor shall provide seven (7) calendar days' notice to the Architect/Engineer prior to:

1. Installing hard or suspended ceilings and soffits.

- B. The Architect/Engineer will have the opportunity to review the installation and provide a written report noting deficiencies requiring correction. The Contractor's schedule shall account for these reviews and show them as line items in the approved schedule.

- C. Above-Ceiling Final Observation

1. All work above the ceilings must be complete prior to the Architect/Engineer's review. This includes, but is not limited to:
  - a. Pipe wall penetrations are sealed.
  - b. Pipe identification is installed.
  - c. Branch piping in the location of sprinklers shall be dropped to the ceiling.
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 Architect/Engineer finds the ceilings have been installed prior to this review and prior to 7 days elapsing, the Architect/Engineer may not recommend further payments to the contractor until such time as full access has been provided.

### 3.3 PROJECT CLOSEOUT

- A. The following paragraphs supplement the requirements of Division 1.
- B. Final Jobsite Observation:
  - 1. In order to prevent the Final Jobsite Observation from occurring too early, the Contractor is required to review the completion status of the project and certify that the job is ready for the final jobsite observation.
  - 2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review.
  - 3. Upon Contractor certification that the project is complete and ready for a final observation, the Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.
  - 4. It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineer's additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.
- C. Before final payment is authorized, this Contractor must submit the following:
  - 1. Operation and maintenance manuals with copies of approved shop drawings.
  - 2. Record documents including marked-up or reproducible drawings and specifications.
  - 3. A report documenting the instructions given to the Owner's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representatives.
  - 4. Inspection report by the State Fire Marshal of the fire protection system.
  - 5. Start-up reports on all equipment requiring a factory installation inspection or start-up.
  - 6. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site and place in location as directed; receipt by Architect/Engineer required prior to final payment approval.

### 3.4 OPERATION AND MAINTENANCE MANUALS

- A. General:
  - 1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.
  - 2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

**B. Electronic Submittal Procedures:**

1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
  - a. O&M file name: O&M.div21.contractor.YYYYMMDD
  - b. Transmittal file name: O&Mtransmittal.div21.contractor.YYYYMMDD
5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be divided into files that are clearly labeled as “1 of 2”, “2 of 2”, etc.
6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title “Operation and Maintenance Instructions”, title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
7. All text shall be searchable.
8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

**C. Operation and Maintenance Instructions shall include:**

1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
3. Copies of all final approved shop drawings and submittals. Include Architect’s/Engineer’s shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
4. Copy of final approved test and balance reports.
5. Copies of all factory inspections and/or equipment startup reports.
6. Copies of warranties.
7. Schematic electrical power/controls wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.

8. Dimensional drawings of equipment.
9. Capacities and utility consumption of equipment.
10. Detailed parts lists with lists of suppliers.
11. Operating procedures for each system.
12. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
13. Repair procedures for major components.
14. List of lubricants in all equipment and recommended frequency of lubrication.
15. Instruction books, cards, and manuals furnished with the equipment.

### 3.5 INSTRUCTING THE OWNER'S REPRESENTATIVES

- A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of all systems installed under this contract.
- B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.
- C. The instructions shall include:
  1. Explanation of all system flow diagrams.
  2. Maintenance of equipment.
  3. Description of emergency system operation.
- D. The Architect/Engineer shall be notified of the time and place instructions will be given to the Owner's representatives so he or his representative can attend if desired.
- E. Minimum hours of instruction for each item shall be:
  1. Sprinkler System(s) - 1 hours.
- F. Operating Instructions:
  1. Contractor is responsible for all instructions to the Owner's representatives for the fire protection and control 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 Architect/Engineer to perform these services.

### 3.6 SYSTEM STARTING AND ADJUSTING

- A. The fire protection systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final comfort adjustments as required.



3.7 RECORD DOCUMENTS

- A. The following paragraph supplements Division 1 requirements:

Contractor shall maintain at the job site a separate and complete set of fire protection drawings and specifications on which he shall clearly and permanently mark in complete detail all changes made to the fire protection systems.
- B. Mark drawings to indicate revisions to piping size and location, both exterior and interior; including locations of other control devices, and other units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items
- C. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.
- D. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.

3.8 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.
- B. Equipment in finished areas that will be painted to match the room decor 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 decor.
- C. Equipment cabinets, casings, covers, metal jackets, etc., in equipment rooms or concealed spaces, shall be furnished in standard or prime finish, free from scratches, abrasions, chips, etc.
- D. Equipment in occupied spaces, or if standard to the unit, shall have a baked primer with baked enamel finish coat free from scratches, abrasions, chips, etc. If color option is specified or is standard to the unit, this Contractor shall, before ordering, verify with the Architect/Engineer his color preference and furnish this color.
- E. Paint all equipment in unfinished areas such as boiler room, mechanical spaces, storage room, etc., furnished by this Contractor. Equipment furnished with a factory coat of paint and enamel 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 was factory applied.
- F. Paint all outdoor uninsulated steel piping the color selected by Owner or Architect/Engineer.
- G. After surfaces have been thoroughly cleaned and are free of oil, dirt, and other foreign matter; paint all pipes and equipment with the following:
  - 1. Bare Metal Surfaces - Apply one coat of primer suitable for the metal being painted. Finish with two coats of Alkyd base enamel paint.

2. Color of paint shall be per Owner & Architect

3.9 ADJUST AND CLEAN

- A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.
- B. Clean all areas where moisture is present. Immediately report any mold, biological growth, or water damage.
- C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.10 SPECIAL REQUIREMENTS

- A. Contractor shall coordinate the installation of all equipment, valves, etc., with other trades to maintain clear access area for servicing.
  - B. All equipment shall be installed in such a way to maximize access to parts needing service or maintenance. Review the final field location, placement, and orientation of equipment with the Owner's designated representative prior to setting equipment.
  - C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Owner's designated representative will result in removal and reinstallation of the equipment at the Contractor's expense.
  - D. Adhesives and Sealants: All sealers, adhesives, and sealants shall comply with the low emitting material limits of the following standards
- END OF SECTION

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

To prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. Penetrations fire sealed and labeled in accordance with specifications.
2. Fire protection system operational.
3. Pipes labeled.

Accepted by:

Prime Contractor \_\_\_\_\_

By \_\_\_\_\_ Date \_\_\_\_\_

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

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**SECTION 21 05 05**  
**FIRE SUPPRESSION DEMOLITION FOR REMODELING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Mechanical demolition.
- B. Cutting and Patching.

**PART 2 - PRODUCTS**

**2.1 MATERIALS AND EQUIPMENT**

- A. Materials and equipment shall be as specified in individual Sections.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. THE DRAWINGS ARE INTENDED TO INDICATE THE GENERAL SCOPE OF WORK AND DO NOT SHOW EVERY PIPE, DUCT, OR PIECE OF EQUIPMENT THAT MUST BE REMOVED. THE CONTRACTOR SHALL VISIT THE SITE AND VERIFY CONDITIONS PRIOR TO SUBMITTING A BID.
- B. Where walls, ceilings, etc., are shown as being removed on general drawings, the Contractor shall remove all mechanical equipment, devices, fixtures, piping, ducts, systems, etc., from the removed area.
- C. Where ceilings, walls, partitions, etc., are temporarily removed and replaced by others, This Contractor shall remove, store, and replace equipment, devices, fixtures, pipes, ducts, systems, etc.
- D. Verify that abandoned utilities serve only abandoned equipment or facilities. Extend services to facilities or equipment that shall remain in operation following demolition.
- E. Coordinate work with all other Contractors and the Owner. Schedule removal of equipment to avoid conflicts.
- F. This Contractor shall verify all existing equipment sizes and capacities where equipment is scheduled to be replaced or modified, prior to ordering new equipment.
- G. Bid submittal shall mean the Contractor has visited the project site and verified existing conditions and scope of work.

**3.2 PREPARATION**

- A. Disconnect fire protection systems in walls, floors, and ceilings scheduled for removal.
- B. Provide temporary connections to maintain existing systems in service during construction. When work must be performed on operating equipment, use personnel experienced in such operations.

3.3 DEMOLITION AND EXTENSION OF EXISTING MECHANICAL WORK

- A. Remove, relocate, and extend existing installations to accommodate new construction.
- B. Remove abandoned piping to source of supply and/or main lines.
- C. Remove exposed abandoned pipes, including abandoned pipes above accessible ceilings. Cut pipes above ceilings, below floors and behind walls. Cap remaining lines. Repair building construction to match original. Remove all clamps, hangers, supports, etc. associated with pipe and duct removal.
- D. Disconnect and remove mechanical devices and equipment serving equipment that has been removed.
- E. Repair adjacent construction and finishes damaged during demolition and extension work.
- F. Maintain access to existing mechanical installations which remain. Modify installation or provide access panels as appropriate.
- G. Extend existing installations using materials and methods compatible with existing installations, or as specified.

3.4 CUTTING AND PATCHING

- A. This Contractor is responsible for all penetrations of existing construction required to complete the work of this project. Refer to Section 21 05 29 for additional requirements.
- B. Penetrations in existing construction should be reviewed carefully prior to proceeding with any work.
- C. Penetrations shall be neat and clean with smooth and/or finished edges. Core drill where possible for clean opening.
- D. Repair existing construction as required after penetration is complete to restore to original condition. Use similar materials and match adjacent construction unless otherwise noted or agreed to by the Architect/Engineer prior to start of work.
- E. This Contractor is responsible for all costs incurred in repair, relocations, or replacement of any cables, conduits, or other services if damaged without proper investigation.

3.5 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment which remain or are to be reused.
- B. Clean all systems adjacent to project which are affected by the dust and debris caused by this construction.
- C. FIRE PROTECTION ITEMS REMOVED AND NOT RELOCATED REMAIN THE PROPERTY OF THE OWNER. CONTRACTOR SHALL PLACE ITEMS RETAINED BY THE OWNER IN A LOCATION COORDINATED WITH THE OWNER. THE CONTRACTOR SHALL DISPOSE OF MATERIAL THE OWNER DOES NOT WANT TO REUSE OR RETAIN FOR MAINTENANCE PURPOSES.

END OF SECTION

**SECTION 21 05 53**  
**FIRE SUPPRESSION IDENTIFICATION**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Identification of products installed under Division 21.

**1.2 REFERENCES**

- A. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems.  
B. ASTM B-1, B-3, and B-8 for copper conductors.  
C. ASTM D-1248 for Polyethylene Extrusion Materials, ICEA S-70-547 Weatherproof Resistant Polyethylene Conductors, ICEA S-61-402/NEMA WC5 Thermoplastic Insulated Wire & Cable, ICEA S-95-658/NEMA WC70 Non-Shielded 0 – 2kv Cables.  
D. UL 1581 Standard for Electrical Wires, Cables, and Flexible Cords.

**1.3 SUBMITTALS**

- A. Submit shop drawings under provisions of Section 21 05 00. Include list of items identified, wording, letter sizes, and color coding.  
B. Include valve chart and schedule listing valve tag number, location, function, and valve manufacturer's name and model number.

**PART 2 - PRODUCTS**

**2.1 ACCEPTABLE MANUFACTURERS**

- A. 3M, Bunting, Calpico, Craftmark, Emedco, Kolbi Industries, Seton, W.H. Brady, Marking Services.

**2.2 MATERIALS**

- A. All pipe markers (purchased or stenciled) shall conform to ANSI A13.1. Marker lengths and letter sizes shall be at least the following:

<u>OD of Pipe or insulation</u>	<u>Marker Length</u>	<u>Size of Letters</u>
Up to and including 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"
2-1/2" to 6"	12"	1-1/4
8" to 10"	24"	2-1/2"
Over 10"	32"	3-1/2"

Plastic tags may be used for outside diameters under 3/4".

- B. Plastic Nameplates: Laminated three-layer phenolic with engraved black, 1/4" minimum letters on light contrasting background.  
C. Plastic Tags: Minimum 1-1/2" square or round laminated three-layer phenolic with engraved, 1/4" minimum black letters on light contrasting background.  
D. Brass Tags: Brass background with engraved black letters. Tag size minimum 1-1/2" square or 1-1/2" round.

- E. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install all products per manufacturer's recommendations.
- B. Degrease and clean surfaces to receive adhesive for identification materials.
- C. Valves:
  - 1. All valves (except shutoff valves at equipment) shall have numbered tags.
  - 2. Provide or replace numbered tags on all existing valves that are connected to new systems or that have been revised.
  - 3. Provide all existing valves used to extend utilities to this project with numbered tags. Review tag numbering sequence with the Owner prior to ordering tags.
  - 4. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic straps.
  - 5. Attach to handwheel or around valve stem. On lever operated valves, drill the lever to attach tags.
  - 6. Number all tags and show the service of the pipe.
  - 7. Provide two sets of laminated 8-1/2" x 11" copies of a valve directory listing all valves, with respective tag numbers, uses, and locations. The directory shall be reviewed by the Owner and Architect/Engineer prior to laminating final copies. Laminated copies shall have brass eyelet in at least one corner for easy hanging.
- D. Pipe Markers:
  - 1. Adhesive Backed Markers: Use Brady Style 1, 2, or 3 on pipes 3" diameter and larger. Use Brady Style 4, 6, or 8 on pipes under 3" diameter. Similar styles by other listed manufacturers are acceptable. Secure all markers at both ends with a wrap of pressure sensitive tape completely around the pipe.
  - 2. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable.
  - 3. Apply markers and arrows in the following locations where clearly visible:
    - a. At each valve.
    - b. On both sides of walls that pipes penetrate.
    - c. At least every 20 feet along all pipes.
    - d. On each riser and each leg of each "T" joint.
    - e. At least once in every room and each story traversed.



E. Equipment:

1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an area remote from its function shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas.
2. Fasten nameplates or plastic tags with stainless steel self-tapping screws or permanently bonding cement.
3. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of ASHRAE 90.1.

3.2 SCHEDULE

- A. Pipes to be marked shall be labeled with the text as shown in the following table regardless of which method or material is used:

Pipe Service	Lettering Color	Background Color
FIRE PROTECTION WATER	White	Red
SPRINKLER WATER	White	Red

- B. All piping downstream of the fire protection backflow preventer, upstream of sprinkler zone valves, standpipe piping, and combination sprinkler standpipe piping shall be labeled Fire Protection Water. All piping downstream of sprinkler zone valves shall be labeled Sprinkler Water.

END OF SECTION

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**SECTION 21 13 00**  
**FIRE PROTECTION SYSTEMS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Pipe, Fittings, Valves, and Connections for Fire Protection System.
- B. Wet-Pipe Sprinkler System.

**1.2 QUALITY ASSURANCE**

- A. Equipment and Components: Bear UL label or marking.
- B. Valves: Bear UL label or marking. Provide manufacturer's name and pressure rating marked on valve body. Pressure rating shall match specified pipe system pressure rating. Remanufactured valves are not acceptable.
- C. Sprinkler design drawings submitted by the Contractor shall be prepared by a NICET Water-Based Fire Protection Systems Layout Level III or Level IV designer or PE, and signed and sealed by a Professional Engineer licensed in the state where the project is located.
- D. All work shall be in accordance with NFPA 13.

**1.3 REFERENCES**

- A. ANSI/ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
- B. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings, Class 150 and 300.
- C. ANSI/ASME B16.4 - Cast Iron Threaded Fittings, Class 125 and 250.
- D. ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings.
- E. ANSI/ASME B16.9 - Factory-made Wrought Steel Butt-Welding Fittings.
- F. ANSI/ASME B16.11 - Forged Steel Fittings, Socket-Welding and Threaded.
- G. ANSI/ASME B16.25 - Butt-Welding Ends.
- H. ANSI/ASME B36.10 - Welded and Seamless Wrought Steel Pipe.
- I. ANSI/ASME Section 9 - Welding and Brazing Qualifications.
- J. ANSI/ASTM A47 - Malleable Iron Castings.
- K. ANSI/ASTM A135 - Electric-Resistance-Welded Steel Pipe.
- L. ANSI/AWWA C110 - Ductile Iron and Gray Iron Fittings.
- M. ANSI/AWWA C151 - Ductile Iron Pipe, Centrifugally Cast.
- N. ASME - Boiler and Pressure Vessel Code - Section IX, Welding and Brazing Requirements.
- O. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-coated Welded and Seamless.
- P. AWS A5.8 - Brazing Filler Metal.
- Q. AWS B2.2 - Standard for Brazing Procedure and Performance Qualification.
- R. AWS D10.9 - Specifications for Qualification of Welding Procedures and Welders for Piping and Tubing.
- S. IBC - International Building Code.
- T. MSS SP-73 - Brazing Joints for Wrought and Cast Copper Alloy Solder Joint and Pressure Fittings.
- U. NFPA 101 - Life Safety Code,
- V. NFPA 13 - Installation of Sprinkler Systems.
- W. NFPA 25 - Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.
- X. UL - Underwriter's Laboratory Fire Protection Equipment Directory.

1.4 SUBMITTALS

- A. Submit shop drawings per Section 21 05 00. Indicate pipe materials, joining methods, supports, floor and wall penetration seals, sprinklers, equipment data and ratings, and hydraulic calculations.
- B. Submit detailed pipe and sprinkler layout and other calculations and forms as described in NFPA 13.
- C. Submit detailed working drawings and obtain review of them in the following order:
  - 1. State Fire Marshal/Authority Having Jurisdiction
  - 2. Local Fire Department
  - 3. Owner's Insurance Company
  - 4. Architect/Engineer

Begin construction after all approvals are received.
- D. Working drawings shall include piping and sprinkler layout, sprinkler types and ratings, sections and elevations at critical points. Show coordination with lighting, ductwork, and diffusers, and indicate basic flow and hydraulic design information, including main location and date that the test was taken.
- E. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.

1.5 EXTRA STOCK

- A. Provide extra sprinklers per NFPA 13 and applicable building code.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store valves and sprinklers in shipping containers, with labels in place.
- B. Provide temporary protective coating on iron and steel valves.
- C. Maintain temporary end caps and closures in place until installation.

1.7 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

- A. Furnish sleeves to General Contractor for placement in walls and floors. Sleeve location to be determined by the Fire Protection Contractor prior to construction. If additional sleeves are required, they shall be core drilled by the Fire Protection Contractor.

1.8 SYSTEM DESCRIPTION

- A. System shall cover building areas noted.
- B. System shall interface with building fire alarm system. Provide all required wiring.
- C. Provide wet pipe sprinkler system(s) to NFPA 13 and building code requirements as required by Owner's insurance company and as shown on the drawings.

1.9 REGULATORY REQUIREMENTS

- A. All material, equipment, and installation shall be approved by the Authorities Having Jurisdiction and the Owner's Insurance Company.

- B. The Authorities Having Jurisdiction and the Owner's Insurance Company shall have precedence over the drawings and specifications in case of discrepancies.
- C. The entire installation shall comply with all applicable codes.

1.10 SYSTEM DESIGN

- A. Design and install a hydraulically calculated wet-pipe sprinkler system for the area shown on the drawings.
- B. Provide all required equipment and accessories.
- C. Provide monitor switches on all shutoff valves.

1.11 COORDINATION DRAWINGS

- A. Reference Coordination Drawings article in Section 21 05 00 for required fire protection systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

1.12 OPERATION AND MAINTENANCE DATA

- A. Submit manufacturers' operation and maintenance data. Include written maintenance data on components of system, servicing requirements, and record drawings.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS - WET PIPE SPRINKLER SYSTEMS

- A. Piping – 2" and Under:
  - 1. Design Pressure: 175 psig
  - 2. Pipe: Schedule 40, black steel, ANSI/ASTM A53, ASTM A795, UL/FM. Inner wall shall be coated with an anti-MIC (microbiologically influenced corrosion) coating.
  - 3. Or Pipe: Lightweight Schedule 40 alternative, black steel, ASTM A135, ASTM A795. corrosion resistance ratio (CRR) shall be greater than 1.0 per UL Directory Listing, UL/FM. Inner wall shall be coated with an anti-MIC (Microbiologically Influenced Corrosion) coating.
  - 4. Joints: Threaded, or flanged.
  - 5. Fittings:
    - a. Threaded:
      - 1) Cast iron, Class 125, black, UL/FM, ANSI/ASME B16.4,
      - 2) Ductile iron, Class 150, black UL/FM, ANSI/ASME B16.3,
    - b. Flanged:
      - 1) Cast iron, Class 125, black, UL/FM, ANSI/ASME B16.1

6. Unions: Class 150 malleable iron, ANSI B16.39, ground joint with copper or copper alloy-to-iron seat.
- B. Piping – 2-1/2” and Above:
1. Design Pressure: 175 psig
  2. Pipe: Schedule 10, black steel, ASTM A135, ASTM A795, UL/FM. Inner wall shall be coated with an anti-MIC (microbiologically influenced corrosion) coating
  3. Or Pipe: Lightweight Schedule 10 alternate, black steel, ASTM A135, ASTM A795, UL/FM. Inner wall shall be coated with an anti-MIC (Microbiologically Influenced Corrosion) coating.
  4. Pipe: Schedule 40, black steel ANSI/ASTM A53, ASTM A795, UL/FM. Inner wall shall be coated with an anti-MIC (microbiologically influenced corrosion) coating.
    - a. Joints: flanged.
    - b. Fittings:
      - 1) Flanged:
        - a) Cast iron, Class 125, black, UL/FM, ANSI/ASME B16.1,
- C. Piping – All Sizes:
1. Tubing: Copper tube, Type L, ASTM B75, ASTM B88, ASTM B 251.
  2. Joints: Brazed
  3. Fittings: Wrought copper solder joint, ASME B16.22

## 2.2 FLEXIBLE FIRE SPRINKLER CONNECTIONS

- A. Flexible Connection: Stainless steel hose, 175 psig max working pressure, fully welded non-mechanical fittings, stainless steel braid, maximum of 6' hose length, leak-tested with a minimum 7/8" internal corrugated hose diameter made of 304 stainless steel, end fittings made of carbon or stainless steel. Outlet of end fittings shall be 1/2" or 3/4" to match sprinkler connection. UL/FM.
- B. Ceiling Bracket: G90 galvanized steel, direct attachment type, integrated snap-on clip ends, tamper resistance screws, removable attachment hub with set screw for attachment and adjustment of stainless steel hose.
- C. Acceptable Manufacturers: Flexhead Industries, Victaulic VicFlex, Sprinkflex, or approved equal.

## 2.3 EQUIPMENT

- A. Equipment shall be as scheduled on the drawings.

## PART 3 - EXECUTION

### 3.1 INSTALLATION - PIPING

#### A. General Installation Requirements:

1. Coordinate piping and sprinkler locations with all other trades. Ductwork, diffusers and light fixture locations shall have priority over sprinkler piping and sprinklers.
2. Ream pipe and tube ends to full inside diameter. Remove burrs. Remove scale and foreign material, inside and outside, before assembly.
3. Die cut screw joints with full cut standard taper pipe threads.
4. Coat threads with pipe joint compound or wrap with Teflon tape.
5. Locate piping to minimize obstruction of other work.
6. Route piping in concealed spaces above finished ceiling.
7. Use full and double lengths of pipe wherever possible.
8. Slope all piping for complete drainage. Install auxiliary drains for all trapped piping per NFPA 13.
9. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it.
10. Comply with manufacturer's installation instructions.

#### B. Steel Piping:

1. In steel piping, main sized saddle branch connections or direct connection of branches to main is permitted if main is one pipe size larger than the branch for up to 6" mains and if main is two pipe sizes larger than branch for 8" and larger mains. Do not project branch pipes into main pipes.

#### C. Wall/Floor Penetration:

1. Provide sleeves when penetrating floors and walls.
2. Seal pipes passing through exterior walls with a wall seal per Section 21 05 29. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe. Sleeves through floors shall extend minimum 1.5" above finished floor.
3. Fire seal all pipe and sleeve penetrations (both wall and floor) to maintain fire separation required without restraining pipe.

#### D. Installation Requirements in Electrical Rooms:

1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment. Fire protection equipment dedicated to the electrical equipment room or space may be installed above equipment if other alternatives are not available.

E. Hangers and Supports:

1. Provide hangers and supports as required by NFPA 13 and UL/FM, with the following exceptions:
  - a. Do not use powder driven devices, explosive devices, wooden plugs, or plastic inserts.
  - b. Do not install fasteners to carry the load in tension, unless absolutely necessary.

F. Exposed Piping:

1. Install chrome plated steel escutcheons where exposed pipes penetrate walls or floors.

3.2 INSTALLATION - EQUIPMENT

A. Coordinate piping and sprinkler locations with all other trades. Ductwork, diffusers and light fixture locations shall have priority over system equipment and sprinklers.

B. Sprinklers:

1. Locate sprinklers to clear lights, ducts and diffusers. Do not run sprinkler pipes through ducts. Ductwork has priority over sprinkler pipes. Offset pipes as needed.
2. Center sprinklers in two directions in ceiling tiles and provide offsets as required.
3. Do not allow concealed sprinkler cover plates to be painted. Sprinkler cover plates are to be factory painted only. Do not field paint.
4. Apply strippable or paper covers so concealed sprinkler cover plates do not receive field paint finish.

3.3 SYSTEMS CLEANING AND TESTING

A. General Requirement:

1. All water used for testing and remaining in the piping system shall be obtained from a potable water source.

B. Interior Piping:

1. Verify adequate water flow at the inspector's test connection.
2. Flush all interior piping to remove scale and other foreign material before placing system into service.
3. Hydrostatically test the entire interior piping system at a minimum of 200 psig or 50 psig more than the normal system working pressure for systems subjected to pressures more than 150 psig. Maintain test pressure for 2 hours without loss of pressure.



C. Fire Alarm System:

1. Test the alarm system by operating the inspector's test connection or the alarm test valves. Verify that the building fire alarm system activates.
2. Adjust all monitor switches for proper operation.

END OF SECTION

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**SECTION 22 05 00**  
**BASIC PLUMBING REQUIREMENTS**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements applicable to all Division 22 Sections. Also refer to Division 1 - General Requirements.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 SCOPE OF WORK

- A. This Specification and the associated drawings govern the furnishing, installing, testing and placing into satisfactory operation the Mechanical Systems.
- B. Each Contractor shall provide all new materials indicated on the drawings and/or in these specifications, and all items required to make his portion of the Mechanical Work a finished and working system.
- C. Separate contracts will be awarded for the following work. The division of work listed below is for the contractors' convenience and lists a normal breakdown of the work. Please refer to the Construction Manager's scope statements for complete scope of work description.

D. Scope of Work:

1. Plumbing Work shall include, but is not necessarily limited to:

- a. Furnish and install all items listed in the Plumbing Material List.
- b. Furnish and Extend existing domestic water piping system including cold, hot, and hot water circulating piping within the building to new plumbing fixtures. Insulate all piping as specified.
- c. Furnish and install local instant water heaters where specified.
- d. Furnish and install sanitary and vent piping for new plumbing fixtures and connect to existing building sanitary and vent system.
- e. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.
- f. **Alternates:** Furnish and install refrigerant piping, accessories, and final charge of refrigerant.
- g. **Alternates:** Furnish and install condensate drain piping from cooling related equipment such as air handlers and cooling coil drain pans.

2. Air Conditioning and Ventilating Work shall include, but is not necessarily limited to:

- a. **Alternates:** Furnish and install package indoor air handling units complete with dampers, filters, coils, fans, and motors. Furnish and install air-cooled condensing units and curbs.

- b. **Alternates:**
- c. Furnish and install supply air ductwork systems including all fittings, insulation, and outlets as shown on drawings.
- d. Furnish and install return air ductwork systems including all fittings, insulation, and inlets as shown on drawings.
- e. Furnish and install all terminal air boxes and reheat coils.
- f. Furnish and install all temperature control systems as required on the drawings.
- g. Furnish and install all fire dampers.
- h. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.

3. Testing, Adjusting, and Balancing Work shall include, but is not necessarily limited to:

- a. Furnish complete testing, adjusting, and balancing as specified in Section 23 05 93, including, but not limited to, air systems, hydronic systems, plumbing systems, and verification of control systems.

1.3 OWNER FURNISHED PRODUCTS

- A. The Owner will supply the following items for installation and/or connection by This Contractor:
- B. This Contractor shall make all plumbing system connections shown on the drawings **or** as required for fully functional units.
- C. This Contractor is responsible for all damage to Owner furnished equipment caused during installation.

1.4 WORK SEQUENCE

- A. All work that will produce excessive noise or interference with normal building operations, as determined by the Owner, shall be scheduled with the Owner. It may be necessary to schedule such work during unoccupied hours. The Owner reserves the right to determine when restricted construction hours will be required.

1.5 COORDINATION DRAWINGS

- A. Definitions:
  - 1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.
    - a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.

- b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
  - c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
  - d. Maintenance clearances and code-required dedicated space shall be included.
  - e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.
- 2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

**B. Participation:**

- 1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.
- 2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.
  - a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.
- 3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

**C. General:**

- 1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.
- 2. A plotted set of coordination drawings shall be available at the project site.
- 3. Coordination drawings are not shop drawings and shall not be submitted as such.
- 4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
- 5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.

6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.
9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.
  - a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
  - b. Potential layout changes shall be made to avoid additional access panels.
  - c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.
  - d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.
  - e. When additional access panels are required, they shall be provided without additional cost to the Owner.
10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors prior to installing any of the components.
11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements or installed their work without proper coordination.
12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

## 1.6 QUALITY ASSURANCE

### A. Contractor's Responsibility Prior to Submitting Pricing Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
2. The Contractor shall resolve all reported deficiencies with the Architect/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 Design Team will be done at the Contractor's risk.

**B. Qualifications:**

1. Only products of reputable manufacturers are acceptable.
2. All Contractors and subcontractors shall employ only workers skilled in their trades.

**C. Compliance with Codes, Laws, Ordinances:**

1. Conform to all requirements of the City of Detroit Codes, Laws, Ordinances and other regulations having jurisdiction.
2. Conform to all State Codes.
3. Conform to Federal Act S.3874 requiring the reduction of lead in drinking water.
4. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.
5. If the Contractor notes, at the time of bidding, any parts of the drawings or specifications that do not comply with the codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, he shall submit with his proposal a separate price to make the system comply with the codes and regulations.
6. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Owner.
7. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
8. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

**D. Permits, Fees, Taxes, Inspections:**

1. Procure all applicable permits and licenses.
2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.
3. Pay all charges for permits or licenses.
4. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
5. Pay all charges arising out of required inspections by an authorized body.
6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.
7. Where applicable, all fixtures, equipment and materials shall be approved or listed by Underwriter's Laboratories, Inc.

E. Examination of Drawings:

1. The drawings for the plumbing work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pipes and ducts to best fit the layout of the job.
3. Scaling of the drawings is not sufficient or accurate for determining these locations.
4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.
6. If an item is either on the drawings or in the specifications, it shall be included in this contract.
7. Determination of quantities of material and equipment required shall be made by the Contractor from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater number shall govern.
8. Where used in mechanical documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.
  - a. Any item listed as furnished shall also be installed, unless otherwise noted.
  - b. Any item listed as installed shall also be furnished, unless otherwise noted.

F. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any supports, pipes or ducts.

G. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.
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 Contractor shall complete and return a signed "Electronic File Transmittal" form provided by IMEG.
4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.



6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
7. The use of these CAD 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 IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor's use of these documents.

#### 1.7 SUBMITTALS

- A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals List:

**Referenced Specification**

**Section**

**Submittal Item**

22 10 00	Plumbing Piping Systems and Valves
22 10 30	Plumbing Specialties
22 30 00	Plumbing Equipment
22 40 00	Plumbing Fixtures

- B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:

- a. Date
- b. Project title and number
- c. Contractor's name and address
- d. Division of work (e.g., plumbing, heating, ventilating, etc.)
- e. Description of items submitted and relevant specification number
- f. Notations of deviations from the contract documents
- g. Other pertinent data

2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:

- a. Date
- b. Project title and number
- c. Architect/Engineer
- d. Contractor and subcontractors' names and addresses
- e. Supplier and manufacturer's names and addresses
- f. Division of work (e.g., plumbing, heating, ventilating, etc.)
- g. Description of item submitted (using project nomenclature) and relevant specification number
- h. Notations of deviations from the contract documents
- i. Other pertinent data
- j. Provide space for Contractor's review stamps

3. Composition:
  - a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
  - b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
  - c. All sets shall contain an index of the items enclosed with a general topic description on the cover.
4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; electrical power wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
5. Contractor's Approval Stamp:
  - a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
  - b. Unstamped submittals will be rejected.
  - c. The Contractor's review shall include, but not be limited to, verification of the following:
    - 1) Only approved manufacturers are used.
    - 2) Addenda items have been incorporated.
    - 3) Catalog numbers and options match those specified.
    - 4) Performance data matches that specified.
    - 5) Electrical characteristics and loads match those specified.
    - 6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
    - 7) Dimensions and service clearances are suitable for the intended location.
    - 8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
    - 9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).
  - d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.
  - e. **The 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 deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.**

6. Submittal Identification and Markings:
  - a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
  - b. The Contractor shall clearly indicate the size, finish, material, etc.
  - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
  - d. All marks and identifications on the submittals shall be unambiguous.
7. Schedule submittals to expedite the project. Coordinate submission of related items.
8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
9. Reproduction of contract documents alone is not acceptable for submittals.
10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
11. Submittals not required by the contract documents may be returned without review.
12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any equipment for manufacture or shipment.
14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
  - a. Submittal file name: 22 XX XX.description.YYYYMMDD
  - b. Transmittal file name: 22 XX XX.description.YYYYMMDD
5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be transmitted via a pre-approved method.

1.8 EQUIPMENT SUPPLIERS' INSPECTION

- A. Contractor shall arrange for and obtain supplier's on-site inspection(s) at proper time(s) to assure each phase of equipment installation and/or connection is in accordance with the manufacturer's instructions.
- B. Submit copies of start-up reports to the Architect/Engineer and include copies of Owner's Operation and Maintenance Manuals.

1.9 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

- A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.
- B. Keep all bearings properly lubricated and all belts properly tensioned and aligned.
- C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.
- D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate his/her work with other trades.

1.10 WARRANTY

- A. Provide one-year warranty, unless otherwise noted, to the Owner for all fixtures, equipment, materials, and workmanship.
- B. The warranty period for all work in this Division of the specifications shall commence on the date of final acceptance, unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.
- C. Warranty requirements shall extend to correction, without cost to the Owner, of all Work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from defects or nonconformance with contract documents.

1.11 INSURANCE

- A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

PART 2 - PRODUCTS

NOT APPLICABLE

## PART 3 - EXECUTION

### 3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employee and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

### 3.2 EXCAVATION, FILL, BACKFILL, COMPACTION

A. General:

1. Prior to the commencement of any excavation or digging, the Contractor shall verify all underground utilities with the regional utility locator. Provide prior notice to the locator before excavations. Contact information for most regional utility locaters can be found by calling 811.
2. The Contractor shall do all excavating, filling, backfilling and compacting associated with his work.

B. Excavation:

1. Make all excavations to accurate, solid, undisturbed earth, and to proper dimensions.
2. Where excavations are made in error below foundations, concrete of same strength as specified for the foundations or thoroughly compacted sand-gravel fill, as determined by the Architect/Engineer, shall be placed in such excess excavations. Place thoroughly compacted, clean, stable fill in excess excavations under slabs on grade, at the Contractor's expense.
3. Trim bottom and sides of excavations to grades required for foundations.
4. Protect excavations against frost and freezing.
5. Take care in excavating not to damage surrounding structures, equipment or buried pipe. Do not undermine footing or foundation.
6. Perform all trenching in a manner to prevent cave-ins and risk to workmen.
7. Where original surface is pavement or concrete, the surface shall be saw cut to provide clean edges and assist in the surface restoration.
8. Where satisfactory bearing soil for foundations is not found at the indicated levels, the Architect/Engineer or their representative shall be notified immediately, and no further work shall be done until further instructions are given by the Architect/Engineer or their representative.

C. Dewatering:

1. Contractor shall furnish, install, operate and remove all dewatering pumps and pipes needed to keep trenches and pits free of water.

D. Underground Obstructions:

1. Known underground piping, foundations, and other obstructions in the vicinity of construction are shown on the drawings. Use great care in making installations near underground obstruction.
2. If objects not shown on the drawings are encountered, remove, relocate, or perform extra work as directed by the Architect/Engineer.

E. Fill and Backfilling:

1. No rubbish or waste material is permitted for fill or backfill.
2. Provide all necessary sand for backfilling.
3. Dispose of the excess excavated earth as directed.
4. Backfill materials shall be suitable for required compaction, clean and free of perishable materials and stones greater than 4 inches in diameter. Water shall not be permitted to rise in unbackfilled trenches. No material shall be used for backfilling that contains frozen earth, debris or earth with a high void content.
5. Backfill all trenches and excavations immediately after installing pipes, or removal of forms, unless other protection is provided.
6. Around piers and isolated foundations and structures, backfill and fill shall be placed and consolidated simultaneously on all sides to prevent wedge action and displacement. Fill and backfill materials shall be spread in 6 inch uniform horizontal layers with each layer compacted separately to required density.
7. Lay all piping on a compacted bed of sand at least 3 inches deep. Backfill around pipes with sand, 6 inch layers, and compact each layer.
8. Use sand for backfill up to grade for all piping under slabs or paved areas. All other piping shall have sand backfill to 6 inches above the top of the pipe.
9. Place all backfill above the sand in uniform layers not exceeding 6 inches deep. Each layer shall be placed, then carefully and uniformly tamped, to eliminate lateral or vertical displacement.
10. Where the fill and backfill will ultimately be under a building, floor or paving, each layer of fill shall be compacted to 95% of the maximum density determined by AASHTO Designation T-99 or ASTM Designation D-698. Moisture content of soil at time of compaction shall not exceed plus or minus 2% of optimum moisture content determined by AASHTO T-99 or ASTM D-698 test.

F. Surface Restoration:

1. Where trenches are cut through graded, planted or landscaped areas, the areas shall be restored to the original condition. Replace all planting removed or damaged to its original

condition. A minimum of 6 inches of topsoil shall be applied where disturbed areas are to be seeded or sodded.

2. Concrete or asphalt type pavement, seal coat, rock, gravel or earth surfaces removed or damaged shall be replaced with comparable materials and restored to original condition.

### 3.3 ARCHITECT/ENGINEER OBSERVATION OF WORK

A. The Contractor shall provide seven (7) calendar days' notice to the Architect/Engineer prior to:

1. Placing fill over underground and underslab utilities.
2. Covering interior partitions and chases.
3. Installing hard or suspended ceilings and soffits.

B. The Architect/Engineer will have the opportunity to review the installation and provide a written report noting deficiencies requiring correction. The Contractor's schedule shall account for these reviews and show them as line items in the approved schedule.

C. Above-Ceiling Final Observation

1. All work above the ceilings must be complete prior to the Architect/Engineer's review. This includes, but is not limited to:
  - a. Pipe insulation is installed and fully sealed.
  - b. Pipe wall penetrations are sealed.
  - c. Pipe identification and valve tags are installed.
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 Architect/Engineer finds the ceilings have been installed prior to this review and prior to 7 days elapsing, the Architect/Engineer may not recommend further payments to the contractor until such time as full access has been provided.

### 3.4 PROJECT CLOSEOUT

A. The following paragraphs supplement the requirements of Division 1.

B. Final Jobsite Observation:

1. In order to prevent the Final Jobsite Observation from occurring too early, the Contractor is required to review the completion status of the project and certify that the job is ready for the final jobsite observation.
2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review.
3. Upon Contractor certification that the project is complete and ready for a final observation, the Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.
4. It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineer's additional time and expenses

will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

- C. Before final payment is authorized, this Contractor must submit the following:
1. Operation and maintenance manuals with copies of approved shop drawings.
  2. Record documents including marked-up or reproducible drawings and specifications.
  3. A report documenting the instructions given to the Owner's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representatives.
  4. Start-up reports on all equipment requiring a factory installation inspection or start-up.
  5. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site; receipt by Architect/Engineer required prior to final payment approval.

### 3.5 OPERATION AND MAINTENANCE MANUALS

- A. General:
1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.
  2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.
- B. Electronic Submittal Procedures:
1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.
  2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
  3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
  4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
    - a. O&M file name: O&M. div22.contractor.YYYYMMDD
    - b. Transmittal file name: O&Mtransmittal.div22. contractor.YYYYMMDD
  5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be divided into files that are clearly labeled as "1 of 2", "2 of 2", etc.
  6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with



the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.

7. All text shall be searchable.
8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

C. Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
4. Copy of final approved test and balance reports.
5. Copies of all factory inspections and/or equipment startup reports.
6. Copies of warranties.
7. Schematic electrical power/controls wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
8. Dimensional drawings of equipment.
9. Capacities and utility consumption of equipment.
10. Detailed parts lists with lists of suppliers.
11. Operating procedures for each system.
12. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
13. Repair procedures for major components.
14. List of lubricants in all equipment and recommended frequency of lubrication.
15. Instruction books, cards, and manuals furnished with the equipment.

3.6 INSTRUCTING THE OWNER'S REPRESENTATIVES

- A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of all systems installed under this contract.

- B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.
- C. The instructions shall include:
  - 1. Maintenance of equipment.
- D. The Architect/Engineer shall be notified of the time and place instructions will be given to the Owner's representatives so he or his representative can attend if desired.
- E. Minimum hours of instruction for each item shall be:
  - 1. Domestic Hot Water System - 1 hours.
- F. Operating Instructions:
  - 1. Contractor is responsible for all instructions to the Owner's representatives for the mechanical and control 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 Architect/Engineer to perform these services.

### 3.7 SYSTEM STARTING AND ADJUSTING

- A. The plumbing systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final adjustments as required.
- B. Complete all manufacturer-recommended startup procedures and checklists to verify proper motor rotation, electrical power voltage is within equipment limitations, equipment controls maintain pressures and temperatures within acceptable ranges, all filters and protective guards are in-place, acceptable access is provided for maintenance and servicing, and equipment operation does not pose a danger to personnel or property.
- C. Contractor shall adjust the plumbing systems and controls at season changes during the one-year warranty period, as required, to provide satisfactory operation and to prove performance of all systems in all seasons.
- D. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks, safety shutdowns, controls, and alarms.
- E. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, 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/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

### 3.8 RECORD DOCUMENTS

- A. The following paragraph supplements Division 1 requirements:
- Contractor shall maintain at the job site a separate and complete set of plumbing drawings and specifications on which he shall clearly and permanently mark in complete detail all changes made to the plumbing systems.
- B. Mark drawings to indicate revisions to piping size and location, both exterior and interior; including locations devices, requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located; Change Orders; concealed control system devices.
- C. Mark specifications to show approved substitutions; Change Orders, and actual equipment and materials used.
- D. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.
- E. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.

### 3.9 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.
- B. Equipment in finished areas that will be painted to match the room decor 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 decor.
- C. Equipment cabinets, casings, covers, metal jackets, etc., in equipment rooms or concealed spaces, shall be furnished in standard or prime finish, free from scratches, abrasions, chips, etc.
- D. Equipment in occupied spaces, or if standard to the unit, shall have a baked primer with baked enamel finish coat free from scratches, abrasions, chips, etc. If color option is specified or is standard to the unit, this Contractor shall, before ordering, verify with the Architect/Engineer his color preference and furnish this color.
- E. Paint all equipment in unfinished areas such as boiler room, mechanical spaces, storage room, etc., furnished by this Contractor. Equipment furnished with a factory coat of paint and enamel 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 was factory applied.
- F. Paint all outdoor uninsulated steel piping the color selected by Owner or Architect/Engineer.
- G. After surfaces have been thoroughly cleaned and are free of oil, dirt, and other foreign matter; paint all pipes and equipment with the following:
1. Bare Metal Surfaces - Apply one coat of primer suitable for the metal being painted. Finish with two coats of Alkyd base enamel paint.
  2. Insulated Surfaces - Paint insulation jackets with two coats of semi-gloss acrylic latex paint.

3. Color of paint shall be per the owner and the architect:

3.10 ADJUST AND CLEAN

- A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.
- B. Clean all areas where moisture is present. Immediately report any mold, biological growth, or water damage.
- C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

END OF SECTION

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

To prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. Penetrations fire sealed and labeled in accordance with specifications.
2. All pumps operating and balanced.
3. All plumbing fixtures installed and caulked.
4. Pipe insulation complete, pipes labeled and valves tagged.

Accepted by:

Prime Contractor \_\_\_\_\_

By \_\_\_\_\_ Date \_\_\_\_\_

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

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**SECTION 22 05 05**  
**PLUMBING DEMOLITION FOR REMODELING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Mechanical demolition.
- B. Cutting and Patching.

**PART 2 - PRODUCTS**

**2.1 MATERIALS AND EQUIPMENT**

- A. Materials and equipment shall be as specified in individual Sections.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. THE DRAWINGS ARE INTENDED TO INDICATE THE GENERAL SCOPE OF WORK AND DO NOT SHOW EVERY PIPE, DUCT, OR PIECE OF EQUIPMENT THAT MUST BE REMOVED. THE CONTRACTOR SHALL VISIT THE SITE AND VERIFY CONDITIONS PRIOR TO SUBMITTING A BID.
- B. Where walls, ceilings, etc., are shown as being removed on general drawings, the Contractor shall remove all mechanical equipment, devices, fixtures, piping, ducts, systems, etc., from the removed area.
- C. Where ceilings, walls, partitions, etc., are temporarily removed and replaced by others, This Contractor shall remove, store, and replace equipment, devices, fixtures, pipes, ducts, systems, etc.
- D. Verify that abandoned utilities serve only abandoned equipment or facilities. Extend services to facilities or equipment that shall remain in operation following demolition.
- E. Coordinate work with all other Contractors and the Owner. Schedule removal of equipment to avoid conflicts.
- F. This Contractor shall verify all existing equipment sizes and capacities where equipment is scheduled to be replaced or modified, prior to ordering new equipment.
- G. Bid submittal shall mean the Contractor has visited the project site and verified existing conditions and scope of work.

**3.2 PREPARATION**

- A. Disconnect plumbing systems in walls, floors, and ceilings scheduled for removal.
- B. Provide temporary connections to maintain existing systems in service during construction. When work must be performed on operating equipment, use personnel experienced in such operations.
- C. Existing Plumbing System: Maintain service to all plumbing fixtures until new piping is installed. Obtain permission from Owner at least 48 hours before shutting down system for any reason.

Make changeover to new piping with minimum outage. Do not disconnect any roof drainage piping until new piping is in place and operational.

### 3.3 DEMOLITION AND EXTENSION OF EXISTING MECHANICAL WORK

- A. Demolish and extend existing plumbing work under provisions of Division 2 and this Section.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned piping to source of supply and/or main lines.
- D. Remove exposed abandoned pipes, including abandoned pipes above accessible ceilings. Cut pipes above ceilings, below floors and behind walls. Cap remaining lines. Repair building construction to match original. Remove all clamps, hangers, supports, etc. associated with pipe and duct removal.
- E. Disconnect and remove mechanical devices and equipment serving equipment that has been removed.
- F. Repair adjacent construction and finishes damaged during demolition and extension work.
- G. Extend existing installations using materials and methods compatible with existing installations, or as specified.
- H. Remove unused sections of domestic water piping back to mains and cap. Capped pipe shall be less than 2 feet from main to prevent "dead legs".
- I. Temporarily cap all openings to the sanitary and vent system to prevent odor from entering the work area and building.

### 3.4 CUTTING AND PATCHING

- A. This Contractor is responsible for all penetrations of existing construction required to complete the work of this project. Refer to Section 22 05 29 for additional requirements.
- B. Penetrations in existing construction should be reviewed carefully prior to proceeding with any work.
- C. Penetrations shall be neat and clean with smooth and/or finished edges. Core drill where possible for clean opening.
- D. Repair existing construction as required after penetration is complete to restore to original condition. Use similar materials and match adjacent construction unless otherwise noted or agreed to by the Architect/Engineer prior to start of work.
- E. Floor slab is post-tensioned. All penetrations shall be x-rayed prior to cutting and/or drilling to avoid any tension cables or utilities encased in floor construction.
- F. Floor slabs may contain conduit systems. This Contractor is responsible for taking any measures required to ensure no conduits or other services are damaged. This includes x-ray or similar non-destructive means.
- G. This Contractor is responsible for all costs incurred in repair, relocations, or replacement of any cables, conduits, or other services if damaged without proper investigation.



3.5 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment which remain or are to be reused.
- B. Clean all systems adjacent to project which are affected by the dust and debris caused by this construction.
- C. PLUMBING ITEMS REMOVED AND NOT RELOCATED REMAIN THE PROPERTY OF THE OWNER. CONTRACTOR SHALL PLACE ITEMS RETAINED BY THE OWNER IN A LOCATION COORDINATED WITH THE OWNER. THE CONTRACTOR SHALL DISPOSE OF MATERIAL THE OWNER DOES NOT WANT TO REUSE OR RETAIN FOR MAINTENANCE PURPOSES.

END OF SECTION

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**SECTION 22 05 29**  
**PLUMBING SUPPORTS AND ANCHORS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Hangers, Supports, and Associated Anchors.
- B. Equipment Bases and Supports.
- C. Sleeves and Seals.
- D. Flashing and Sealing of Equipment and Pipe Stacks.
- E. Cutting of Openings.
- F. Escutcheon Plates and Trim.

**1.2 REFERENCES**

- A. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
- B. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
- C. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices
- D. MSS SP-127 – Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application

**1.3 SUBMITTALS**

- A. Submit shop drawings and product data under provisions of Section 22 05 00. Include plastic pipe manufacturers' support spacing requirements.

**1.4 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS**

- A. Furnish sleeves and hanger inserts to General Contractor for placement into formwork.

**PART 2 - PRODUCTS**

**2.1 PIPE AND STRUCTURAL SUPPORTS**

- A. General:
  - 1. Pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS SP-58, 69, 89, and 127 (where applicable).
  - 2. On all insulated piping, provide at each support an insert of same thickness and contour as adjoining insulation, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. Refer to insulation specifications for materials and additional information.
    - a. Insulation Couplings:
      - 1) Insulation Coupling: Molded thermoplastic, -65°F to 275°F, sizes up to 4-1/8" OD, and receive insulation thickness up to 1". Suitable for use indoors or outdoors with UV stabilizers. Vertical insulation riser clamps shall have a 1,000lb vertical load rating. On cold pipes operating below 60°F, cover joint and coupling with vapor barrier mastic to ensure continuous vapor barrier.

- 2) Horizontal Strut Mounted Insulated Pipe:
  - a) Acceptable Manufacturers: Klo-Shure or equal.
- 3) Vertical:
  - a) Acceptable Manufacturers: Klo-Shure Titan or equal.
3. Copper piping located in an exposed area, including indirect waste piping in janitor's closets, shall use split ring standoff hangers for copper tubing. Support shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, Erico Cushion Clamp or Cooper Vibra-Clamp. Use electro-galvanized or more corrosion resistant and threaded rod for floor applications. Use anchors applicable to the wall type with corrosion resistant threaded rod for wall applications.

Acceptable Products:

Erico/M-Co	Model #456
B-Line	Fig. 3198HCT
Anvil	Fig. CT138R
Nibco/Tolco	Fig. 301CT

B. Vertical Supports:

1. Support and laterally brace vertical pipes at every floor level in multi-story structures, unless otherwise noted by applicable codes, but never at intervals over 15 feet. Support vertical pipes with riser clamps installed below hubs, couplings, or lugs. Provide sufficient flexibility to accommodate expansion and contraction to avoid compromising fire barrier penetrations or stressing piping at fixed takeoff locations.

Acceptable Products:

Cooper/B-Line -	Fig B3373 Series
Erico -	510 Series
Nibco/Tolco -	Fig. 82

2. Place restrained neoprene mounts beneath vertical pipe riser clamps to prevent sweating of cold pipes. Select neoprene mounts based on the weight of the pipe to be supported. Insulate over mounts.

Acceptable Products: Mason RBA, RCA, or BR.

3. Wall supports shall be used where vertical height of structure exceeds minimum spacing requirements. Install wall supports at same spacing as hangers or strut supports along vertical length of pipe runs. Wall supports shall be coordinated with the Structural Engineer.
4. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts

C. Hangers and Clamps:

1. Oversize all hangers, clamps, and supports on insulated piping to allow insulation and jacket to pass through unbroken. This applies to both hot and cold pipes.

2. Hangers in direct contact with bare copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, Erico Cushion Clamp or Cooper Vibra-Clamp within their temperature limits of -65°F to +275°F.
3. On all insulated piping, provide a semi-cylindrical metallic shield and vapor barrier jacket.
4. Ferrous hot piping 2-1/2 inches and larger shall have steel saddles tack welded to the pipe at each support with a depth not less than specified for the insulation. Factory fabricated inserts may be used.

Acceptable Products:

Anvil - Fig. 160, 161, 162, 163, 164, 165  
Cooper/B-Line - Fig. 3160, 3161, 3162, 3163, 3164, 3165  
Erico - Model 630, 631, 632, 633, 634, 635  
Nibco/Tolco - Fig. 260-1, 261-1 1/2, 262-2, 263-2 1/2, 264-3, 265-4

5. As an alternative to separate pipe insulation insert and saddle, properly sized integral rigid insulation sections may be used.

Acceptable Products:

Cooper/B-Line - Fig. B3380 through B3384  
Pipe Shields - A1000, A2000  
Erico - Model 124, 127

6. Unless otherwise indicated, hangers shall be as follows:

a. Clevis Type:

Service: Bare Metal Pipe  
Rigid Plastic Pipe  
Insulated Cold Pipe  
Insulated Hot Pipe - 3 inches & Smaller

Acceptable Products:	Bare Steel, Plastic or Insulated Pipe	Bare Copper Pipe
Anvil	Fig. 260	
Cooper/B-Line	Fig. 3100	Fig. B3100C
Erico	Model 400	
Nibco/Tolco	Fig. 1	Fig. 81PVC

b. Roller Type:

Service: Insulated Hot Pipe - 4 inches and Larger

Acceptable Products:	4" through 6"	8" and Above
Anvil	Fig. 181, 271	Fig. 171, 271
Cooper/B-Line	Fig. 3110, 3117	Fig. 3114, 3117
Erico	Model 610	Model 605
Nibco/Tolco	Fig. 324, 327	Fig. 322, 327

7. Support may be fabricated from U-channel strut or similar shapes. Piping less than 4" in diameter shall be secured to strut with clamps of proper design and capacity as required to maintain spacing and alignment. Strut shall be independently supported from hanger drops or building structure. Size and support shall be per manufacturer's installation requirements for structural support of piping. Clamps shall not interrupt piping insulation.

- a. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.
- b. Strut used in damp areas listed in hanger rods shall have ASTM A123 hot-dip galvanized finish applied after fabrication.

8. Unless otherwise indicated, pipe supports for use with struts shall be as follows:

a. Clamp Type:

Service: Bare Metal Pipe  
Rigid Plastic Pipe  
Insulated Cold Pipe  
Insulated Hot Pipe - 3 inches and smaller

- 1) Clamps in direct contact with copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, Erico Cushion Clamp or Cooper Vibra-Clamp.
- 2) Pipes subject to expansion and contraction shall have clamps oversized to allow limited pipe movement.

Acceptable Products:	Bare Steel, Plastic or Insulated Pipe	Bare Copper Pipe
Unistrut	Fig. P1100 or P2500	
Cooper/B-Line	Fig. B2000 or B2400	Fig. BVT
Nibco/Tolco	Fig. A-14 or 2STR	

b. Roller Type:

Service: Insulated Hot Pipe - 4 inches and larger.

Acceptable Products:	4" through 6"	8" and Above
Unistrut	Fig. P2474	Fig. P2474-1
Cooper/B-Line	Fig. B218	Fig. B219
Nibco/Tolco	Fig. ROL-12	Fig. ROL-13

D. Upper (Structural) Attachments:

- 1. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:

a. Steel Structure Clamps

- 1) C-Type Wide Flange Beam Clamps (for use on top and/or bottom of wide flanges. Not permitted for use with bar-joists):

Acceptable Products:

Anvil	Fig. 92
Cooper/B-Line	Fig. B3033/B3034
Erico	Model 300
Nibco/Tolco	68

- 2) Scissor Type Beam Clamps (For use with bar-joists and wide flange):

Acceptable Products:

Anvil	Fig. 228, 292
Cooper/B-Line	Fig. B3054
Erico	Model 360
Nibco/Tolco	Fig. 329

b. Concrete

- 1) Concrete Anchors Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-05. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.
- 2) Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

c. Steel Structure Welding:

- 1) Unless otherwise noted, hangers, clips, and auxiliary support steel may be welded in lieu of bolting, clamping, or riveting to the building structural frame. Take adequate precautions during all welding operations for fire prevention and protecting walls and ceilings from smoke damage.

2.2 OPENINGS IN FLOORS, WALLS AND CEILINGS

- A. Exact locations of all openings for the installation of materials shall be determined by the Contractor and given to the General Contractor for installation or construction as the structure is built.
- B. Coordinate all openings with other Contractors.
- C. Hire the proper tradesman and furnish all labor, material and equipment to cut openings in or through existing structures, or openings in new structures that were not installed, or additional openings. Repair all spalling and damage to the satisfaction of the Architect/Engineer. Make saw cuts before breaking out concrete to ensure even and uniform opening edges.
- D. Said cutting shall be at the complete expense of each Contractor. Failure to coordinate openings with other Contractors shall not exempt the Contractor from providing openings at his expense.
- E. Do not cut structural members without written approval of the Architect or Structural Engineer.

2.3 SLEEVES AND LINTELS

- A. Each Contractor shall provide sleeves and lintels for all duct and pipe openings required for the Contractor's work in masonry walls and floors, unless specifically shown as being by others.
- B. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide continuous sleeve. Cut or split sleeves are not acceptable.
- C. Fabricate all lintels for masonry walls from structural steel shapes or as indicated on the drawings. Have all lintels approved by the Architect or Structural Engineer.

- D. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring closing floor plates.
- E. Sleeves shall not penetrate structural members or masonry walls without approval from the Structural Engineer. Sleeves shall then comply with the Architect/Engineer's design.
- F. 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.
- G. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.
- H. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" 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.
- I. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation wrapping.

#### 2.4 ESCUTCHEON PLATES AND TRIM

- A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of finished rooms.
- B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy spring clip, rigid hinge and latch.
- C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms. This includes pipe openings.

#### 2.5 PIPE PENETRATIONS

- A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material may be used.
- B. Seal fire rated wall and floor penetrations with fire seal system as specified.

#### 2.6 FINISH

- A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

### PART 3 - EXECUTION

#### 3.1 PLUMBING SUPPORTS AND ANCHORS

- A. General Installation Requirements:
  - 1. Install all items per manufacturer's instructions.
  - 2. Coordinate the location and method of support of piping systems with all installations under other Divisions and Sections of the Specifications.



3. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
4. Supports shall extend directly to building structure. Do not support piping from duct hangers. Do not allow lighting or ceiling supports to be hung from piping supports.

B. Supports Requirements:

1. Install roof pipe supports to resist wind movement per manufacturer's recommendations. Method of securing base to roof shall be compatible with roofing materials.
2. Where building structural steel is fireproofed, all hangers, clamps, auxiliary steel, etc., which attach to it shall be installed prior to application of fireproofing. Repair all fireproofing damaged during pipe installation.
3. Set all concrete inserts in place before pouring concrete.
4. Furnish, install and prime all auxiliary structural steel for support of piping systems that are not shown on the Drawings as being by others.
5. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts and required accessories.
6. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.

C. Pipe Requirements:

1. Support all piping and equipment, including valves, strainers, traps and other specialties and accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or building structure during erection, cleaning, testing and normal operation of the systems.
2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent proper movement due to expansion and contraction.
3. Support piping at equipment and valves so they can be disconnected and removed without further supporting the piping.
4. Piping shall not introduce strains or distortion to connected equipment.
5. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and hanger rods; otherwise, pipes shall be supported with individual hangers.
6. Trapeze hangers may be used where ducts interfere with normal pipe hanging.
7. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers, at equipment connections and heavy fittings.
8. Provide at least one hanger adjacent to each joint in grooved end steel pipe with mechanical couplings.

- D. Provided the installation complies with all loading requirements of truss and joist manufacturers, the following practices are acceptable:
1. Loads of 100 lbs. or less may be attached anywhere along the top or bottom chords of trusses or joists with a minimum 3' spacing between loads.
  2. Loads greater than 100 lbs. must be hung concentrically and may be hung from top or bottom chord, provided one of the following conditions is met:
    - a. The hanger is attached within 6" from a web/chord joint.
    - b. Additional L2x2x1/4 web reinforcement is installed per manufacturer's requirements.
  3. It is prohibited to cantilever a load using an angle or other structural component that is attached to a truss or joist in such a fashion that a torsional force is applied to that structural member.
  4. If conditions cannot be met, coordinate installation with truss or joist manufacturer and contact Architect/Engineer.
- E. After piping and insulation installation are complete, cut hanger rods back at trapeze supports so they do not extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.
- F. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.
- G. Do not exceed the manufacturer's recommended maximum load for any hanger or support.
- H. Spacing of Hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:

	<u>Pipe Material</u>	<u>Maximum Spacing</u>
1.	Steel (Std. Weight or Heavier – Liquid Service):	
	1-1/4" & under	7'-0"
	1-1/2"	9'-0"
	2"	10'-0"
	2-1/2"	11'-0"
	3"	12'-0"
	4" & larger	12'-0"
2.	Steel (Std. Weight or Heavier – Vapor Service):	
	1-1/4" and under	9'-0"
	1-1/2"	12'-0"
	2" & larger	12'-0"
3.	Hard Drawn Copper & Brass (Liquid Service):	
	3/4" and under	5'-0"
	1"	6'-0"
	1-1/4"	7'-0"
	1-1/2"	8'-0"
	2"	8'-0"
	2-1/2"	9'-0"

	<u>Pipe Material</u>	<u>Maximum Spacing</u>
	3"	10'-0"
	4"	12'-0"
	6"	12'-0"
4.	Hard Drawn Copper & Brass (Vapor Service):	
	3/4" & under	7'-0"
	1"	8'-0"
	1-1/4"	9'-0"
	1-1/2"	10'-0"
	2"	11'-0"
	2-1/2" & larger	12'-0"
5.	Flexible Plastic Pipe, Flexible Hose, and Soft Copper Tubing:	
	a. Continuous channel with hangers maximum 8'-0" OC.	
6.	Rigid Plastic Pipe:	
	a. Hangers shall be spaced based on the piping system manufacturers' instructions or, if no system instructions are available, space hangers at 4'-0" maximum centers.	
7.	Installation of hangers shall conform to MSS SP-58, 69, 89 and the applicable Plumbing Code.	

END OF SECTION

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**SECTION 22 05 53**  
**PLUMBING IDENTIFICATION**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Identification of products installed under Division 22.

**1.2 REFERENCES**

- A. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems.  
B. ASTM B-1, B-3, and B-8 for copper conductors.  
C. ASTM D-1248 for Polyethylene Extrusion Materials, ICEA S-70-547 Weatherproof Resistant Polyethylene Conductors, ICEA S-61-402/NEMA WC5 Thermoplastic Insulated Wire & Cable, ICEA S-95-658/NEMA WC70 Non-Shielded 0 – 2kV Cables.  
D. UL 1581 Standard for Electrical Wires, Cables, and Flexible Cords.

**1.3 SUBMITTALS**

- A. Submit shop drawings under provisions of Section 22 05 00. Include list of items identified, wording, letter sizes, and color coding.  
B. Include valve chart and schedule listing valve tag number, location, function, and valve manufacturer's name and model number.

**PART 2 - PRODUCTS**

**2.1 ACCEPTABLE MANUFACTURERS**

- A. 3M, Bunting, Calpico, Craftmark, Emedco, Kolbi Industries, Seton, W.H. Brady, Marking Services.

**2.2 MATERIALS**

- A. All pipe markers (purchased or stenciled) shall conform to ANSI A13.1. Marker lengths and letter sizes shall be at least the following:

<u>OD of Pipe or insulation</u>	<u>Marker Length</u>	<u>Size of Letters</u>
Up to and including 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"
2-1/2" to 6"	12"	1-1/4"
8" to 10"	24"	2-1/2"
Over 10"	32"	3-1/2"

Plastic tags may be used for outside diameters under 3/4".

- B. Plastic Nameplates: Laminated three-layer phenolic with engraved black, 1/4" minimum letters on light contrasting background.  
C. Plastic Tags: Minimum 1-1/2" square or round laminated three-layer phenolic with engraved, 1/4" minimum black letters on light contrasting background.  
D. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install all products per manufacturer's recommendations.
- B. Degrease and clean surfaces to receive adhesive for identification materials.
- C. Valves:
  - 1. All valves (except shutoff valves at equipment) shall have numbered tags.
  - 2. Provide or replace numbered tags on all existing valves that are connected to new systems or that have been revised.
  - 3. Provide all existing valves used to extend utilities to this project with numbered tags. Review tag numbering sequence with the Owner prior to ordering tags.
  - 4. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic straps.
  - 5. Attach to handwheel or around valve stem. On lever operated valves, drill the lever to attach tags.
  - 6. Number all tags and show the service of the pipe.
  - 7. Provide two sets of laminated 8-1/2" x 11" copies of a valve directory listing all valves, with respective tag numbers, uses, and locations. The directory shall be reviewed by the Owner and Architect/Engineer prior to laminating final copies. Laminated copies shall have brass eyelet in at least one corner for easy hanging.
- D. Pipe Markers:
  - 1. Adhesive Backed Markers: Use Brady Style 1, 2, or 3 on pipes 3" diameter and larger. Use Brady Style 4, 6, or 8 on pipes under 3" diameter. Similar styles by other listed manufacturers are acceptable. Secure all markers at both ends with a wrap of pressure sensitive tape completely around the pipe.
  - 2. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable.
  - 3. Apply markers and arrows in the following locations where clearly visible:
    - a. At each valve.
    - b. On both sides of walls that pipes penetrate.
    - c. At least every 20 feet along all pipes.
    - d. On each riser and each leg of each "T" joint.
    - e. At least once in every room and each story traversed.
- E. Equipment:
  - 1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an area remote from its function shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas.

2. Provide engraved plastic tags at all hydronic or steam system makeup water meters.
3. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of ASHRAE 90.1.

### 3.2 SCHEDULE

- A. Pipes to be marked shall be labeled with the text as shown in the following table regardless of which method or material is used:

Pipe Service	Lettering Color	Background Color
CONDENSATE DRAIN	Black	Yellow
DOMESTIC COLD WATER	White	Green
DOMESTIC HOT WATER	Black	Yellow
DOMESTIC HOT WATER CIRCULATING	Black	Yellow
SANITARY SEWER	Black	Yellow
VENT	Black	Yellow
STORM SEWER (PRIMARY AND SECONDARY)	White	Green

END OF SECTION

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**SECTION 22 07 19**  
**PLUMBING PIPING INSULATION**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Piping Insulation.
- B. Insulation Jackets.

**1.2 QUALITY ASSURANCE**

- A. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL 723 (where required).

**1.3 REFERENCES**

- A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- B. ANSI/ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.
- C. ANSI/ASTM C534 - Elastomeric Foam Insulation.
- D. ASTM C591 - Unfaced Preformed Rigid Cellular Polyisocyanurate Insulation.
- E. ASTM C1729 - Standard Specification for Aluminum Jacketing for Insulation.
- F. ASTM C1767 - Standard Specification for Stainless Steel Jacketing for Insulation.
- G. ASTM E84 - Surface Burning Characteristics of Building Materials.
- H. NFPA 255 - Surface Burning Characteristics of Building Materials.
- I. UL 723 - Surface Burning Characteristics of Building Materials.
- J. National Commercial & Industrial Insulation Standards - 1999 Edition - as published by Midwest Insulation Contractors Association and endorsed by National Insulation Contractors Association.

**1.4 SUBMITTALS**

- A. Submit shop drawings per Section 22 05 00. Include product description, list of materials and thickness for each service, and locations.

**PART 2 - PRODUCTS**

**2.1 INSULATION**

- A. Type A: Glass fiber; ANSI/ASTM C547; 0.24 maximum 'K' value at 75°F; non-combustible. All purpose, white Kraft jacket bonded to aluminum foil and reinforced with fiberglass yarn, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723).
- B. Type B: EPDM (NBR/PVC Blend is not permitted) elastomeric cellular foam; ANSI/ASTM C534; flexible plastic; 0.25 maximum 'K' value at 75°F, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723). Maximum 1" thick per layer where multiple layers are specified.

- C. Type E: Preformed rigid cellular polyisocyanurate insulation; ANSI/ASTM C591; maximum 'K' value of 0.19 at 75°F; moisture resistant; suitable for -297°F to +300°F.

## 2.2 VAPOR BARRIER JACKETS

- A. Kraft reinforced foil vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 50 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.
- B. Polyvinylidene Chloride (PVDC or Saran) film and tape: Durable and highly moisture and moisture vapor resistant. Please refer to manufacturer's recommended installation guidelines.

## 2.3 JACKET COVERINGS

- A. Aluminum Jackets: ASTM C1729; 0.016" thick (thicker where required by ASTM C1729); stucco embossed finish with Z edge seams and aluminum bands for outdoor use. Where colored jacket covers are called for, provide factory-applied hard film acrylic paint in color selected by Architect.
- B. Plastic Jackets and Fitting Covers: High impact, glossy white, 0.020" thick, self-extinguishing plastic. Suitable for use indoors or outdoors with ultraviolet inhibitors. Suitable for -40°F to 150°F. 25/50 maximum flame spread/smoke developed.

# PART 3 - EXECUTION

## 3.1 PREPARATION

- A. Install insulation after piping has been tested. Pipe shall be clean, dry and free of rust before applying insulation.

## 3.2 INSTALLATION

- A. General Installation Requirements:
  - 1. Install materials per manufacturer's instructions, building codes and industry standards.
  - 2. Continue insulation with vapor barrier through penetrations. This applies to all insulated piping. Maintain fire rating of all penetrations.
  - 3. On all insulated piping, provide at each support an insert of same thickness and contour as adjoining insulation, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. The insert shall be suitable for planned temperatures, be suitable for use with specific pipe material, and shall be a 180° cylindrical segment the same length as metal shields. Inserts shall be a cellular glass (for all temperature ranges) or molded hydrous calcium silicate (for pipe with operating temperatures above 70°F), with a minimum compressive strength of 50 psi. Factory fabricated inserts may be used. Rectangular blocks, plugs, or wood material are not acceptable. Temporary wood blocking may be used by the Piping Contractor for proper height; however, these must be removed and replaced with proper inserts by the Insulation Contractor. Refer to Supports and Anchors specification section for additional information.
  - 4. Neatly finish insulation at supports, protrusions, and interruptions.
  - 5. Install metal shields between all hangers or supports and the pipe insulation. Shields shall be galvanized sheet metal, half-round with flared edges. Adhere shields to insulation. On cold piping, seal the shields vapor-tight to the insulation as required to maintain the vapor

barrier, or add separate vapor barrier jacket.

6. Shields shall be at least the following lengths and gauges:

	Pipe Size	Shield Size
a.	1/2" to 3-1/2"	12" long x 18 gauge
b.	4"	12" long x 16 gauge
c.	5" to 6"	18" long x 16 gauge
d.	8" to 14"	24" long x 14 gauge
e.	16" to 24"	24" long x 12 gauge

7. All piping and insulation that does not meet 25/50 that is in an air plenum shall have written approval from the Authority Having Jurisdiction and the local fire department for authorization and materials approval. If approval has been allowed, the non-rated material shall be wrapped with a product that has passed ASTM E84 and/or NFPA 255 testing with a rating of 25/50 or below.
8. On 1" and smaller piping routed through metal wall studs, provide a plastic grommet to protect the piping. The piping shall be insulated between the wall studs, and the insulation shall butt up to each stud.

B. Insulated Piping Operating Below 60°F:

1. Insulate fittings, valves, unions, flanges, strainers, flexible connections, flexible hoses, and expansion joints. Seal all penetrations of vapor barrier.
2. On piping operating below 60°F in locations that are not mechanically cooled (e.g., penthouses, mechanical rooms, tunnels, chases at exterior walls, etc.), Type B insulation shall be used.
3. All balance valves with fluid operating below 60°F shall be insulated with a removable plug wrapped with vapor barrier tape to allow reading and adjusting of the valve.

C. Insulated Piping Operating Between 60°F and 140°F:

1. Do not insulate flanges and unions, but bevel and seal ends of insulation at such locations. Insulate all fittings, valves and strainers.

D. Exposed Piping:

1. Locate and cover seams in least visible locations.
2. Where exposed insulated piping extends above the floor, provide a sheet metal guard around the insulation extending 12" above the floor. Guard shall be 0.016" cylindrical smooth or stucco aluminum and shall fit tightly to the insulation.
3. On exposed piping serving kitchen equipment or plumbing fixtures, the piping does not need to be insulated if less than four feet in developed length. If piping is longer than four feet in developed length, the piping shall be insulated and have a plastic jacket.

### 3.3 INSULATION

A. Type A Insulation:

1. All Service Jackets: Seal all longitudinal joints with self-seal laps using a single pressure sensitive adhesive system. Do not staple.

2. Insulation without self-seal lap may be used if installed with Benjamin Foster 85-20 or equivalent Chicago Mastic, 3M or Childers lap adhesive.
3. Apply insulation with laps on top of pipe.
4. Fittings, Valve Bodies and Flanges: For 4" and smaller pipes, insulate with 1 lb. density insulation wrapped under compression to a thickness equal to the adjacent pipe insulation. For pipes over 4", use mitered segments of pipe insulation. Finish with preformed plastic fitting covers. Secure fitting covers with pressure sensitive tape at each end. Overlap tape at least 2" on itself. For pipes operating below 60°F, seal fitting covers with vapor retarder mastic in addition to tape.

B. Type B Insulation:

1. Elastomeric Cellular Foam: Where possible, slip insulation over the open end of pipe without slitting. Seal all butt ends, longitudinal seams, and fittings with adhesive. At elbows and tees, use mitered connections. Do not compress or crush insulation at cemented joints. Joints shall be sealed completely and not pucker or wrinkle. Paint the outside of outdoor insulation with two coats of latex enamel paint recommended by the manufacturer.
2. Self-seal insulation may be used on pipes operating below 170°F.

C. Type E Insulation:

1. Indoors, above grade or below grade, Polyvinylidene chloride (PVDC or Saran) vapor retarder film and tape: Seal all longitudinal joints with manufacturer approved adhesive. Secure butt joint strips in a similar manner. Refer to manufacturer's recommendations for installation guidelines.
2. Insulate pipe fittings with prefabricated insulation fittings.

### 3.4 JACKET COVER INSTALLATION

A. Metal Covering:

1. Provide vapor barrier as specified for insulation type. Cover with aluminum jacket covering with seams located on the bottom of horizontal piping. Include fittings, joints and valves.
2. Seal all interior and exterior butt joints with metal draw bands and sealant. Seal all exterior joints watertight.
3. Interior joints do not need to be sealed.
4. Use metal covering on the following pipes:
  - a. All exterior piping.
  - b. Cover insulation with aluminum jacketing.
  - c. All Type D insulation.

B. Plastic Covering:

1. Provide vapor barrier as specified for insulation type. Cover with plastic jacket covering. Position seams to shed water.
2. Solvent weld all joints with manufacturer recommended cement.

3. Overlap all laps and butt joints 1-1/2" minimum. Repair any loose ends that do not seal securely. Solvent weld all fitting covers in the same manner. Final installation shall be watertight.
4. Use plastic insulation covering on all exposed pipes including, but not limited to:
  - a. All exposed piping in areas noted on drawings.
  - b. All exposed piping in locker rooms.
  - c. All exposed piping below 8'-0" above floor.
  - d. All piping in mechanical rooms and/or tunnels that is subject to damage from normal operations. (Example: Piping that must be stepped over routinely.)
5. Elastomeric piping insulation may have two coats of latex paint instead of plastic jacket.

### 3.5 SCHEDULE

Piping System		Insulation Type/Thickness	
A.	Domestic Hot Water & Circulating - Potable and Non-Potable - up to 140°F		
	Up to 1-1/2" Pipe Size	A / 1"	OR E / 3/4"
	Above 1-1/2" Pipe Size	A / 1-1/2"	OR E / 1"
B.	Domestic Hot Water & Circulating - Potable and Non-Potable - over 140°F		
	Up to 1-1/2" Pipe Size	A / 1"	OR E / 3/4"
	Above 1-1/2" Pipe Size	A / 1-1/2"	OR E / 1"
C.	Domestic Cold Water - Potable and Non-Potable	A / 1"	OR E / 3/4"
D.	Plumbing Vents Within 10' from Roof Penetration	A / 1/2"	OR B / 1/2"
E.	Chilled Drinking Water	A / 1"	OR B / 1"
F.	Cooling Coil Condensate Drains & Dedicated Floor Drain Branch Piping, Sanitary and Indirect Waste Piping Conveying Fluids below 55°F	B / 1/2"	
G.	Insulation Inserts at hangers	E - Match pipe insulation thickness	

END OF SECTION

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**SECTION 22 10 00  
PLUMBING PIPING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Pipe and Pipe Fittings.
- B. Valves.
- C. Domestic Water Piping System.
- D. Sanitary Drainage and Vent Piping System.

**1.2 QUALITY ASSURANCE**

- A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.
- B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
- C. Welders Certification: In accordance with ANSI/ASME Sec 9 or ANSI/AWS D1.1.
- D. Piping, Fittings, Valves, and Flux for Potable Water Systems: All components shall be lead free per Federal Act S.3874, Reduction of Lead in Drinking Water Act.

**1.3 REFERENCES**

- A. ANSI/ASME A112.3.1 – Stainless Steel Drainage Systems for Sanitary DWV, Storm, and Vacuum Applications, Above and Below Ground.
- B. ASME A112.6.9 - Siphonic Drain Test; The American Society of Mechanical Engineers.
- C. ANSI/ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings.
- D. ANSI/ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.
- E. ANSI/ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
- F. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings Class 150 NS 300.
- G. ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings.
- H. ANSI/ASME B16.9 - Factory-Made Wrought Steel Butt Welding Fittings.
- I. ANSI/ASME Sec 9 - Welding and Brazing Qualifications.
- J. ANSI/ASTM B32 - Solder Metal.
- K. ANSI/AWS D1.1 - Structural Welding Code.
- L. ANSI/AWWA C110 - Ductile Iron and Gray Iron Fittings 3" through 48", for Water and Other Liquids.
- M. ANSI/AWWA C111 - Rubber-Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.
- N. ANSI/AWWA C151 - Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- O. ANSI/AWWA C153 – Compact Ductile Iron Fittings 3" through 48", for Water and Other Liquids.
- P. ASSE 1003 - Water Pressure Reducing Valves for Domestic Water Supply Systems.
- Q. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- R. ASTM A74 - Hub and Spigot Cast Iron Soil Pipe and Fittings.
- S. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- T. ASTM A312 – Standard for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
- U. ASTM A554 – Standard for Welded Stainless Steel Mechanical Tubing.

- V. ASTM A674 - Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids.
- W. ASTM A888 - Hubless Cast Iron Soil Pipe and Fittings.
- X. ASTM B88 - Seamless Copper Water Tube.
- Y. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- Z. ASTM C1540 - Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.
- AA. AWS A5.8 - Braze Filler Metal.
- BB. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.
- CC. CISPI 310 - Joints for Hubless Cast Iron Sanitary Systems.
- DD. FM 1680 - Couplings Used in Hubless Cast Iron Systems.
- EE. NSF - National Sanitation Foundation

#### 1.4 SUBMITTALS

- A. Submit shop drawings per Section 22 05 00.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers with labeling in place.

#### 1.6 COORDINATION DRAWINGS

- A. Reference Coordination Drawings article in Section 22 05 00 for required plumbing systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

### PART 2 - PRODUCTS

#### 2.1 COLD WATER - POTABLE AND NON-POTABLE HOT WATER - POTABLE AND NON-POTABLE TEMPERED WATER - POTABLE AND NON-POTABLE

- A. Design Pressure: 175 psi.  
Maximum Design Temperature: 200°F.
- B. Piping - All Sizes:
  - 1. Tubing: Type L hard drawn seamless copper tube, ASTM B88.
  - 2. Joints: Solder with 100% lead-free solder and flux, ASTM B32.
  - 3. Fittings: Wrought copper solder joint, ANSI B16.22.
- C. Shutoff Valves:
  - 1. Butterfly Valves:
    - a. BF-1:
      - 1) 2-1/2" thru 6", 175 psi CWP, elastomers rated for 20°F to 250°F at 125 psig, fully lugged end, ductile or cast iron body (not in contact with fluid); bronze, aluminum-bronze or EPDM coated ductile iron disc; EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to centerline of valve body (for pipe extension



without draining system), 10 position locking operator up to 6" size. Cv of at least 1580 in 6" size. Center Line Series 200, Keystone #222, Watts #DBF-03-121-1P, Stockham LD712-B&3-E, Nibco LD2000N Series, Milwaukee CL series, Hammond 5200 series.

- 2) 8" thru 12", 175# CWP, elastomers for 20°F to 225°F at 130 psi, fully lugged end, ductile or cast iron body (not in contact with fluid), bronze, EPDM coated ductile iron or aluminum-bronze disc, EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to the centerline of the valve body (to permit pipe extension without draining system), weatherproof gear operator. Center Line Series 200, Keystone #222, Watts #DBF-03-121-1G, Stockham LD722-B&3-E, Nibco LD2000N Series, Milwaukee CL series, Hammond 5200 series.

2. Ball Valves:

a. BA-1:

- 1) 3" and under, 150 psi saturated steam, 600 psi CWP, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and trim, Teflon seats and seals. Apollo #77C-140, Stockham #S-255-FB-P-UL BR1-R, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB.

NOTES:

- a) Provide extended shaft for all valves in insulated piping.
- b) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

D. Throttling/Shutoff Valves:

1. Globe Valves:

- a. GL-1: 2" and under, 150# saturated steam, 300# CWP, screwed, bronze. Crane #7TF, Stockham #B22T, Walworth #3095, Milwaukee #590, Hammond #IB413T, Watts #B-4010-T, Nibco T-235Y.
- b. GL-2: 2-1/2" thru 10", 125# steam @ 353°F, 200# CWP @ 150°F, flanged, iron body, bronze mounted. Crane #351, Hammond #IR116, Stockham #G-512, Walworth #8906F, Milwaukee #F2981, Watts #F-501, Nibco F-718B.

E. Check Valves:

1. CK-1: 2" and under, 125# steam @ 406°F, 200# CWP @ 150°F, screwed, bronze, horizontal swing. Crane #37, Hammond #IB904, Stockham #B319-Y, Walworth #3406, Milwaukee #509, Watts #G-5000, Nibco T-413B.
2. CK-14: 2-1/2" thru 12", 200# CWP, double disc wafer type, bronze or iron body, bronze trim, metal-to-metal or Viton seat, 316 SS shaft, Inconel 600 spring. Mission Duo Chek #12HPP (with Inconel springs), Mueller Steam Specialty Co. #71-AHB-K-W, Stockham #WG-961-EPDM or #WG-970-BUNA, Nibco w-920-W.

F. Strainers:

1. ST-1: Bronze body, screwed ends, screwed cover, 150 psi S @ 350°F, 200 psi CWP @ 150°F. Armstrong #F4SC, Metraflex #TS, Mueller Steam Specialty Co. #351, Sarco #BT, Watts #777.
2. ST-7: 2-1/2" thru 8", bronze body, flanged ends, flanged cover, 150# steam, 225# CWP. Mueller Steam Specialty Co. #851.

2.2 SANITARY DRAINAGE (ABOVE GROUND)  
SANITARY INDIRECT DRAINAGE (ABOVE GROUND)  
SANITARY VENT (ABOVE GROUND)  
STORM DRAINAGE (ABOVE GROUND)  
CONDENSATE DRAINAGE (ABOVE GROUND)

- A. Design Pressure: Gravity  
Maximum Design Temperature: 180°F

B. Piping - All Sizes:

1. Pipe and Fittings: Standard weight hub and spigot cast iron soil pipe, corrosion protective coating inside and outside, ASTM A74, NSF Certified, CISPI Trademark.
2. Restraints: Install pipe and fittings per the Cast Iron Soil Pipe Institute's Designation 3011. Restrain pipe and fittings using an engineered and tested product manufactured for restraining no-hub cast iron soil pipe. Install per manufacturer's recommendations.
3. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.

- C. Vent Flashing: Flash vents with 3# seamless sheet lead of sufficient size to extend 15" into roofing felts for built-up roofs or under shingles for wood sloped roofs.

2.3 SANITARY DRAINAGE (BELOW GROUND - INSIDE BUILDING)

- A. Design Pressure: Gravity  
Maximum Design Temperature: 180°F

B. Piping - All Sizes:

1. Pipe and Fittings: Standard weight hub and spigot cast iron soil pipe, corrosion protective coating inside and outside, ASTM A74, NSF certified, CISPI trademark.

2. Pipe and Fittings: Standard weight hub and spigot cast iron soil pipe, corrosion protective coating inside and outside, CISPI 301 or ASTM A888.
3. Joints: Compression gasket, ASTM C564.
4. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.

#### 2.4 CONDENSATE DRAINAGE

- A. Design Pressure: Gravity
- B. Piping: Same as specified for Sanitary Drainage (Above Ground).

#### 2.5 LOCK OUT TRIM

- A. Provide lock out trim for all quarter turn shutoff valves opening to atmosphere and installed in domestic water piping over 120°F, in compressed air piping, and as indicated on the drawings.

#### 2.6 VALVE OPERATORS

- A. Provide handwheels for gate valves and gear operators for butterfly valves.

#### 2.7 VALVE CONNECTIONS

- A. Provide all connections to match pipe joints. Valves shall be same size as pipe unless noted otherwise.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Install all products per manufacturer's recommendations.
- B. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- C. Remove scale and dirt, on inside and outside, before assembly.
- D. Connect to equipment with flanges or unions.
- E. Existing building sewers or building drains which are shown on the documents to be reused shall be inspected and recorded by closed circuit television for their condition. Report findings back to the Architect, Engineer, and Owner before proceeding with work so any necessary rework can take place if needed.

#### 3.2 TESTING PIPING

- A. Sanitary Drainage:  
Sanitary Vent:  
Storm Drainage:
  1. Test all piping with water to prove tight.

2. Test piping before insulation is applied.
3. Hydrostatically test all soil, waste, and vent piping inside of building with 10 feet head of water for 15 minutes. Inspect before fixtures are connected. If leaks appear, repair them and repeat the test.
4. Test force mains with water at 105% of the operating pump discharge pressure for 15 minutes.
5. Test pressures stated above shall be as listed or as required by the Authority Having Jurisdiction, whichever is most stringent.

B. Hot Water - Potable and Non-Potable:  
Cold Water - Potable and Non-Potable:

1. Test pipes underground or in chases and walls before piping is concealed.
2. Test all pipes before the insulation is applied. If insulation is applied before the pipe is tested and a leak develops which ruins the insulation, replace damaged insulation.
3. Test the pipe with 100 psig water pressure or equal inert gas such as nitrogen. Exception: Inert gas test shall not be used to test plastic piping.
4. Hold test pressure for at least 2 hours.
5. Test to be witnessed by the Architect/Engineer's representative, if requested by the Architect/Engineer.

C. All Other Piping:

1. Test piping at 150% of normal operating pressure.
2. Piping shall hold this pressure for one hour with no drop in pressure.
3. Test piping using water, nitrogen, or air as compatible with the final service of the pipe. Do not use combustible fluids.
4. Drain and clean all piping after testing is complete.

### 3.3 CLEANING PIPING

A. Assembly:

1. Before assembling pipe systems, remove all loose dirt, scale, oil and other foreign matter on internal or external surfaces by means consistent with good piping practice subject to approval of the Architect/Engineer's representative. Blow chips and burrs from machinery or thread cutting operation out of pipe before assembly. Wipe cutting oil from internal and external surfaces.
2. During fabrication and assembly, remove slag and weld spatter from both internal and external joints by peening, chipping and wire brushing.
3. Notify the Architect/Engineer's representative before starting any post erection cleaning in sufficient time to allow witnessing the operation. Consult with and obtain approval from the Architect/Engineer's representative regarding specific procedures and scheduling. Dispose of cleaning and flushing fluids properly.

4. Prior to blowing or flushing erected piping systems, disconnect all instrumentation and equipment, open wide all valves, and be certain all strainer screens are in place.

B. All Water Piping:

1. Flush all piping using faucets, flush valves, etc. until the flow is clean.
2. After flushing, thoroughly clean all inlet strainers, aerators, and other such devices.
3. If necessary, remove valves to clean out all foreign material.

3.4 INSTALLATION

A. General Installation Requirements:

1. Provide dielectric connections between dissimilar metals.
2. Route piping in orderly manner and maintain gradient. Install to conserve building space.
3. Group piping whenever practical at common elevations.
4. Install piping to allow for expansion and contraction without stressing pipe, joints, or equipment.
5. Slope water piping and arrange to drain at low points.
6. Install bell and spigot piping with bells upstream.
7. Where pipe supports are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
8. Seal pipes passing through exterior walls with a wall seal per Section 22 05 29. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe.
9. All non-potable outlets shall be clearly marked with a permanently affixed laminated sign with 3/8" high lettering saying "Non-Potable Water Not for Human Consumption." Sign shall have black lettering on a yellow background.
10. All vertical pipe drops to sinks or other equipment installed below the ceiling shall be routed within a wall cavity, unless specifically noted otherwise to be surface mounted. For renovation projects, this Contractor is responsible for opening and patching existing walls for installation of piping. Wall patching shall match existing condition.

B. Installation Requirements In Electrical Rooms:

1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment.

C. Valves/Fittings and Accessories:

1. Install shutoff valves that permit the isolation of equipment/fixtures in each room without isolating any other room or portion of the building. Individual fixture angle stops do not meet this requirement. Exception: Back-to-back rooms in no more than two adjacent rooms.

2. Provide clearance for installation of insulation and access to valves and fittings.
3. Provide access doors for concealed valves and fittings.
4. Install valve stems upright or horizontal, not inverted.
5. Provide one plug valve wrench for every ten plug valves 2" and smaller, minimum of one. Provide each plug valve 2-1/2" and larger with a wrench with set screw.
6. Install corrugated, stainless steel tubing system according to manufacturer's written instructions. Include striker plates to protect tubing from puncture where tubing is restrained and cannot move.
7. For all underground piping, provide a foundation (the layer below the bedding) if the trench bottom is unstable. Lay underground plastic piping on 4" to 6" of sand bedding. When the trench is in rock, lay underground metallic piping on 6" of sand bedding. Provide recessed areas for pipe bells and joints. After joints are made, any misalignment in elevation shall be corrected by tamping sand around the pipe. Backfill with sand in uniform layers not over 6" deep to the spring line of all underground pipes, and carefully compact each layer to 90 percent Standard Proctor density. Backfill with sand up to 6" above pipe for landscaped areas. Remaining backfill may be soil. Under paving and buildings, the remaining backfill shall be sand and compacted to 98 percent Standard Proctor density.
8. Exercise care in handling, storing and laying pipe to avoid damaging factory applied coatings. If any damage occurs, repair the coating to a condition equal to the original.
9. Field application of protective coatings to joints, fittings and to any damaged factory applied coatings shall be similar to factory applied coatings specified above and shall be done in strict accordance with recommendations of the supplier of pipe coatings.
10. After completion of the fabrication, laying and field coating of the joints and fittings, but prior to backfilling, inspect the entire line in the presence of the Architect/Engineer's representative with an electronic holiday detector. Any defects in the protective coatings shall be repaired in accordance with requirements for original coatings.
11. Coat flange bolts and nuts in pits and below ground at the time of installation with a corrosion protective coating.

D. Sanitary and Storm Piping:

1. Install all sanitary piping inside the building with a slope of at least the following:

<u>Pipe Size</u>	<u>Minimum Slope</u>
3" and under	- 0.25" per foot
4" and over	- 0.125" per foot

- a. All sanitary systems transporting grease laden waste shall be sloped a minimum of 0.25" per foot regardless of size.
2. Install horizontal offset at all connections to roof drains to allow for pipe expansion.
3. Starter fittings with internal baffles are not permitted.

### 3.5 PIPE ERECTION AND LAYING

- A. Carefully inspect all pipe, fittings, valves, equipment and accessories before installation. Any items that are unsuitable, cracked or otherwise defective shall be removed from the job immediately.
- B. All pipe, fittings, valves, equipment and accessories shall have factory applied markings, stampings, or nameplates with sufficient data to determine their conformance with specified requirements.
- C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not install any item that is not clean.
- D. Until system is fully operational, all openings in piping and equipment shall be kept closed except when actual work is being performed on that item or system. Closures shall be plugs, caps, blind flanges or other items specifically designed and intended for this purpose.
- E. Run pipes straight and true, parallel to building lines with minimum use of offsets and couplings. Provide only offsets required to provide needed headroom or clearance and to provide needed flexibility in pipe lines.
- F. Make changes in direction of pipes only with fittings or pipe bends. Changes in size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. All fittings shall be of the long radius type, unless otherwise shown on the drawings or specified.
- G. Provide flanges or unions at all final connections to equipment, traps and valves.
- H. Arrange piping and connections so equipment served may be totally removed without disturbing piping beyond final connections and associated shutoff valves.
- I. Use full and double lengths of pipe wherever possible.
- J. Unless otherwise indicated, install all piping, including shutoff valves and strainers, to coils, pumps and other equipment at line size with reduction in size being made only at control valve or equipment.
- K. Cut all pipe to exact measurement and install without springing or forcing except in the case of expansion loops where cold springing is indicated on the drawings.
- L. Underground pipe shall be laid in dry trenches maintained free of accumulated water. Provide and operate sufficient pumping equipment to maintain excavations, trenches and pits free of water. Dispose of pumped water so operation areas and other facilities are not flooded. Pipe laying shall follow excavating as closely as possible.
- M. Unless otherwise indicated, branch take-offs shall be from top of mains or headers at either a 45° or 90° angle from the horizontal plane for air lines, and from top, bottom or side for liquids.

### 3.6 DRAINING AND VENTING

- A. Unless otherwise indicated on the drawings, all horizontal water and compressed air lines, including branches, shall pitch 1" in 40 feet to low points for complete drainage, removal of condensate and venting.
- B. Maintain accurate grade where pipes pitch or slope for venting and drainage. No pipes shall have pockets due to changes in elevation.
- C. Provide drain valves at all low points of water piping systems for complete or sectionalized draining.

- D. Provide drip legs at low points and at the base of all risers in compressed air pipes. Drip legs shall be full line size on pipes through 4" and at least 4", but not less than half line size over 4". Drip legs shall be 12" minimum length, capped with a reducer to a drain valve.
- E. Use eccentric reducing fittings on horizontal runs when changing size of pipes for proper drainage and venting. Install compressed air and gravity drain pipes with bottom of pipe and eccentric reducers in a continuous line; all other liquid lines with top of pipe and eccentric reducers in a continuous line.
- F. Provide air vents at high points and wherever else required to eliminate air in all water piping systems.
- G. Install air vents in accessible locations. If necessary to trap and vent air in a remote location, install an 1/8" pipe from the tapping location to an accessible location and terminate with a venting device.
- H. All vent and drain piping shall be of same materials and construction for the service involved.

### 3.7 PLUMBING VENTS

- A. Vent as shown on the drawings and in accordance with all codes having jurisdiction.
- B. Extend the high side of the soil and waste stacks at least 12" above roof.
- C. Flash pipes at the roof with 3# lead sheet. Extend flashing under roofing 15" in all directions from pipe to be flashed. Extend a lead collar up on the outside of pipe to be flashed and extend 1" beyond the top of the pipe. The 1" excess length of collar shall be turned down into the top of the pipe where it shall fit tight to the inside of the pipe.
- D. Increase vent pipes through the roof two pipe sizes with long increasers located at least 12" below the roof.
- E. In no case shall the vent through the roof be less than 4" in diameter.
- F. Vent pipes through the roof shall be located a minimum of 15 feet from any air intake or exhaust opening on the roof.

### 3.8 BRANCH CONNECTIONS

- A. For domestic water and vent systems only, make branch connections with standard tee or cross fittings of the type required for the service.
- B. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it.
- C. Do not use double wye or double combination wye and eighth bend DWV fittings in horizontal piping.
- D. Branch connections from the headers and mains may be mechanically formed using an extraction device. The branch piping connection shall be brazed connection for the following services only:
  - 1. Domestic water piping above grade.
- E. Further limit use of mechanically formed fittings as follows:
  - 1. Must have at least same pressure rating as the main.
  - 2. Main must be type K or L copper tubing.



3. Permanent marking shall indicate insertion depth and orientation.
4. Branch pipe shall conform to the inner curve of the piping main.
5. Main must be 1" or larger.
6. Branch must be 3/4" or larger.

F. Forged weld-on fittings are limited as follows:

1. Must have at least same pressure rating as the main.
2. Main must be 2-1/2" or larger.
3. Branch line is at least two pipe sizes under main size.

### 3.9 JOINING OF PIPE

A. Threaded Joints:

1. Threads shall conform to ANSI B2.1 "Pipe Threads".
2. Ream pipe ends and remove all burrs and chips formed in cutting and threading.
3. Protect plated pipe and valve bodies from wrench marks when making up joints.
4. Apply thread lubricant to male threads as follows:

Vents and Roof Conductors:	Red graphite
All Other Services:	Teflon tape

B. Flanged Joints:

1. Steel pipe flanges shall conform to ANSI B16.5 "Steel Pipe Flanges and Flanged Fittings". Cast iron pipe flanges shall conform to ANSI B16.1 "Cast Iron Flanged and Flanged Fittings". Steel flanges shall be raised face except when bolted to flat face cast iron flange.
2. Bolting for services up to 500°F shall be ASTM A307 Grade B with square head bolts and heavy hexagonal nuts conforming to ANSI B18.2.1 "Square and Hex Bolts" and B18.2.2 "Square and Hex Nuts".
3. Set flange bolts beyond finger tightness with a torque wrench for equal tension in all bolts. Tighten bolts so those 180° apart are torqued in sequence.
4. Gaskets for flat face flanges shall be full face type. Gaskets for raised faced flanges shall conform to requirements for "Group I Gaskets" in ANSI B16.5. Unless otherwise specified gaskets shall meet the following requirements:
  - a. Gasket material and thickness approved by manufacturer for intended service, chemical compatibility, pipe system test pressure, and operating temperature range.
  - b. Maximum pressure rating of at least 250 psig.
  - c. Minimum temperature rating: -10°F.
  - d. Maximum temperature rating of at least 170°F for water systems operating 140°F and less.

C. Solder Joints:

1. Make up joints with 100% lead-free solder, ASTM B32. Cut tubing so ends are perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt and grease just prior to soldering. Apply flux evenly, but sparingly, over all surfaces to be joined. Heat joints uniformly so solder will flow to all mated surfaces. Wipe excess solder, leaving a uniform fillet around cup of fitting.
2. Flux shall be non-acid type.
3. Solder end valves may be installed directly in the piping system if the entire valve is suitable for use with 470°F melting point solder. Remove discs and seals during soldering if they are not suitable for 470°F.

D. Brazed Joints:

1. Make up joints with silver alloy brazing filler metal conforming to ASTM B260 "Brazing Filler Metal" BAg-1 or BAg-2. Cut copper tubing so ends are perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt and grease just prior to brazing. Apply non-corrosive flux of the type recommended by filler alloy manufacturer, evenly, but sparingly, over all surfaces to be joined. Heat joints uniformly using oxygen-acetylene torch with tip size recommended by fitting manufacturer. Wipe and brush joint clean after alloy has set.
2. Remove discs from solder end valves during brazing.

E. Welded Joints:

1. Welding of all pipe joints, both as to procedures and qualification of welders, shall be in accordance with Section IX, ASME "Boiler & Pressure Vessel Code" unless mandatory local codes take precedence.
2. Furnish to the Owner's Representative prior to start of work certificates qualifying each welder.
3. The Owner's Representative reserves the right to require qualifying demonstration, at the Contractor's expense, of any welders assigned to the job.
4. Ends of pipe and fittings to be joined by butt welding shall be beveled, cleaned to bare metal and internal diameters aligned before tack welding.

F. Mechanical Joints:

1. Joints shall conform to ANSI A21.11 "Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings". Gasket material shall be neoprene. The standard bolts and nuts of the pipe manufacturer shall be used and shall be coated at the factory with rust preventive lubricant after threading and tapping.
2. Final tightening of bolts shall be with a torque wrench to insure equal tension in all bolts.

G. Push-On Joints - Pressure Pipe:

1. Joints shall be single gasket type conforming to ANSI A21.11 "Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings". The bell shall have cast or machined gasket socket recesses, a tapered annular opening and flared socket design to provide deflections up to

5°. Plain spigot ends shall be suitably beveled for easy entry into bell, centering in gasket and compression of gasket.

2. The joint shall be liquid tight under all pressures from vacuum to 350 psig.
3. Furnish sufficient lubricant for a thin coat on each spigot end. Lubricant shall be non-toxic, impart no taste or odor to conveyed liquid, and have no deleterious effect on the rubber gasket. Lubricant shall be of such consistency that it can be easily applied to the pipe in hot and cold weather and shall adhere to either wet or dry pipe.

H. Compression Gasket Joints - Sanitary Pipe and Storm Pipe:

1. Joint shall be one-piece double seal compression type gasket made specifically for joining cast iron soil pipe. Gasket shall be neoprene, permitting joint to flex as much as 5 degrees without loss of seal. Gasket shall be extra heavy weight class, conforming to ASTM C-564.

I. Sleeve Gaskets (No-Hub) (Sanitary and Storm Pipe):

1. Gasket shall be heavy weight class, conforming to ASTM C564.
2. The gasket shall have an internal center stop.
3. The gasket shall be covered by a stainless steel band secured with a minimum of four stainless steel bands per fitting/joint.
4. Sleeve gaskets shall be installed in accordance with the manufacturer's installation instructions.

END OF SECTION

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**SECTION 22 10 30**  
**PLUMBING SPECIALTIES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Cleanouts.
- B. Traps.
- C. Strainers.
- D. Unions.
- E. Dielectric Fittings (Connections Between Dissimilar Metals).
- F. Air Vents.
- G. Drain Valves.
- H. Relief Valves.

**1.2 QUALITY ASSURANCE**

- A. Manufacturer: For each product specified, provide components by same manufacturer throughout.

**1.3 REFERENCES**

- A. ANSI 1011 - Hose Connection Vacuum Breakers; American Society of Sanitary Engineering.

**1.4 SUBMITTALS**

- A. Submit shop drawings under provisions of Section 22 05 00.
- B. Include sizes, rough-in requirements, service sizes, and finishes.

**PART 2 - PRODUCTS**

**2.1 CLEANOUTS**

- A. Provide cleanouts as shown and specified on the drawings as well as required by code.
- B. Cleanouts on exposed pipes shall be cast iron with heavy duty cast brass plug with raised head.
- C. Cleanout shall be same size as the pipe up to 6" and 6" for larger pipes.

**2.2 TRAPS**

- A. Provide all individual connections to the sanitary system with P-traps, except where such drains discharge directly into a properly trapped collection basin or sump. Unless otherwise specified or shown, traps shall be:
  - 1. Chromium plated cast brass when used with plumbing fixtures or when installed exposed in finished spaces.
  - 2. Insulated at accessible lavatories.
  - 3. Cast iron, deep-seal pattern where concealed above ceiling, below grade or in unfinished areas.

4. Deep-seal pattern of the same material and/or coating where drainage lines are of special materials or coatings such as polypropylene, PVDF, CPVC, etc.
- B. All traps shall have accessible, removable cleanouts, except where installed on floor drains with removable strainers.
- C. Each trap shall be completely filled with water at the end of construction but before building space turnover to the Owner. All floor drains, floor sinks, trench drains, etc. shall be filled with water and a 1/2" minimum layer of mineral oil.

## 2.3 STRAINERS

- A. Unless otherwise indicated, strainers shall be Y-pattern and have stainless steel screens with perforations as follows:

Pipe Size	1/4" - 2"	2-1/2" - 10"	12" - 18"
air	1/32"	3/64"	1/16"
water	3/64"	1/16"	1/8"
lube, hydraulic, No. 6 fuel and waste oils	3/16"	3/16"	3/16"

- B. Furnish pipe nipple with shutoff valve to blow down all strainer screens.
- C. Use bronze body strainers in copper piping and iron body strainers in ferrous piping.

## 2.4 UNIONS

- A. Copper pipe - wrought copper fitting - ground joint.
- B. Black Steel (Schedule 40) Pipe - malleable iron, ground joint, 150 psi, bronze to bronze seat.
- C. Galvanized Steel Pipe - galvanized malleable iron, ground joint, 150 psi, bronze to bronze seat.

## 2.5 DIELECTRIC FITTINGS (CONNECTIONS BETWEEN DISSIMILAR METALS)

- A. Connections between dissimilar metals shall be insulating dielectric types that provide a water gap between the connected metals, and that either allow no metal path for electron transfer or that provide a wide water gap lined with a non-conductive material to impede electron transfer through the water path.
- B. Joints shall be rated for the temperature, pressure, and other characteristics of the service in which they are used, including testing procedure.
- C. Aluminum, iron, steel, brass, copper, bronze, and stainless steel are commonly used and require isolation from each other with the following exceptions:
  1. Iron, steel, and stainless steel connected to each other.
  2. Brass, copper, and bronze connected to each other.
  3. Brass or bronze valves and specialties connected in closed systems with steel, iron, or stainless steel on both sides of the brass or bronze valves and specialties. Where two or more brass or bronze items occur together, they shall be connected with brass nipples. Brass or bronze valves and specialties cannot be used as a dielectric separation between pipe materials.
- D. Dielectric protection is required at connections to equipment of a material different than the piping.

E. Flanged Joints (any size):

1. Use 1/8" minimum thickness, non-conductive, full-face gaskets.
2. Employ one-piece molded sleeve-washer combinations to break the electrical path through the bolts.
3. Sleeve-washers are required on one side only, with sleeves minimum 1/32" thick and washers minimum 1/8" thick.
4. Install steel washers on both sides of flanges to prevent damage to the sleeve-washer.
5. Separate sleeves and washers may be used only if the sleeves are manufactured to exact lengths and installed carefully so the sleeves must extend partially past each steel washer when tightened.
6. Acceptable Manufacturers: EPCO, Central Plastics, Pipeline Seal and Insulator, F. H. Maloney, or Calpico.

2.6 AIR VENTS

- A. Provide means for venting air at all high points in the piping system and at all other points where air may be trapped.
- B. At end of main and other points where large volume of air may be trapped - Use 1/4" globe valve, angle type, 125 psi, Crane #89, attached to coupling in top of main, 1/4" discharge pipe turned down with cap.

2.7 DRAIN VALVES

- A. Drain valves shall be shutoff valves as specified for the intended service with added 3/4" male hose thread outlet and cap.

PART 3 - EXECUTION

3.1 INSTALLATION AND APPLICATION

- A. Coordinate construction to receive drains at required invert elevations.
- B. Install all items per manufacturer's instructions.
- C. Cleanouts:
  1. Provide cleanouts where shown on the drawings and as required by code, but in no case farther apart than 50 feet in pipe less than 6" size and 100 feet apart in 6" and larger pipes inside the building.
  2. Provide cleanouts at bases of all sanitary and storm risers as shown on the drawings and as required by code.
  3. Extend cleanouts to the floor with long sweep elbows.

END OF SECTION

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**SECTION 22 30 00  
PLUMBING EQUIPMENT**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Water Heaters.
- B. Water Softeners.
- C. Reverse Osmosis/Deionized Water System.
- D. Pressure Booster System.

**1.2 QUALITY ASSURANCE**

- A. Products and installation of specified products shall conform to recommendations and requirements of the following organizations:
  - 1. American Gas Association (AGA).
  - 2. National Sanitation Foundation (NSF).
  - 3. American Society of Mechanical Engineers (ASME).
  - 4. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
  - 5. National Electrical Manufacturers' Association (NEMA).
  - 6. Underwriters' Laboratories (UL).
- B. Perform work in accordance with State of California Plumbing Codes and municipality of local area standards.
- C. Water Heater Performance Requirements: Equipment efficiency not less than prescribed by ASHRAE 90.1 when tested in accordance with DOE 10 CFR, ANSI Z21.10.1 and ANSI Z21.10.3.
- D. Conform to ASME Section VIII for construction of water heaters and heat exchangers. Provide boilers registered with National Board of Boiler and Pressure Vessel Inspectors.

**1.3 REFERENCES**

- A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- B. ANSI/ASME Section 8D - Pressure Vessels.
- C. ANSI Section 21.10.1 or Section ANSI 21.10.3 - Gas Water Heaters Ratings 75,000 BTU per Hour and Less.
- D. ANSI/NFPA 30 - Flammable and Combustible Liquids Code.
- E. ANSI/NFPA 54 - National Fuel Gas Code.
- F. ANSI/NFPA 70 - National Electrical Code.
- G. ANSI/UL 1453 - Electric Booster and Commercial Storage Tank Water Heaters.
- H. ASSE 1005 - Water Heater Drain Valves, 3/4" Iron Pipe Size.
- I. UL 174 - Household Electric Storage Tank Water Heaters.

**1.4 SUBMITTALS**

- A. Submit shop drawings under provisions of Section 22 05 00.
- B. Include dimension drawings of water heaters indicating components and connections to other equipment and piping.
- C. Include heat exchanger dimensions, size of tapings, and performance data.

- D. Include dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.
- E. For equipment connected to an electric power source, submit short circuit rating (SCCR) of integrated unit.
- F. Submit manufacturer's installation instructions including control and electrical power/controls wiring diagrams.
- G. Submit manufacturer's certificate that pressure vessels meet or exceed specified requirements.
- H. Submit operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- I. Submit certification that water heaters, water softeners, pressure booster system, accessories, and components will withstand seismic forces defined in Section 22 05 50. Include the following:
  - 1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculation.
    - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
    - [ \* \* \* \* \* OR \* \* \* \* \* ]
    - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- J. Manufacturer shall provide special seismic certification per OSHPD CAN 2-1708a.5 with submittal. Submittals without certification will be returned and not reviewed.
- K. Submit a current water analysis from the actual water source serving the project site existing building for softening equipment verification before sending shop drawings to the Architect/Engineer.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

#### 1.6 REGULATORY REQUIREMENTS

- A. Water heaters shall conform to AGA, ANSI/NFPA 54, ANSI/NFPA 70, ANSI/UL 1453 as applicable.
- B. Conform to ANSI/ASME Section 8 Division 1 for fabrication of steel pressure vessels.
- C. Conform to ANSI/ASME Section 10 for manufacture of fiber-reinforced plastic pressure vessels.

PART 2 - PRODUCTS

2.1 WATER HEATERS

- A. All water heaters shall be as scheduled on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all items in accordance with manufacturer's instructions.

3.2 WATER HEATER INSTALLATION

- A. Install water heaters on concrete bases. Coordinate sizes and locations of concrete bases. Refer to Section 22 05 29.
- B. Install water heaters level and plumb, according to drawings, manufacturer's instructions, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend drain piping full size from relief valve and discharge by positive air gap onto closest floor drain. Discharge pipe material shall be same as domestic water piping.
- D. Install gas water heaters according to NFPA 54.

END OF SECTION

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**SECTION 22 40 00  
PLUMBING FIXTURES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. All plumbing fixtures.

**1.2 REFERENCES**

- A. ANSI A112.6.1M - Supports for Off-the-Floor Plumbing Fixtures for Public Use.
- B. ANSI A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings.
- C. ANSI A112.19.1M - Enameled Cast Iron Plumbing Fixtures.
- D. ANSI A112.19.2M - Vitreous China Plumbing Fixtures.
- E. ASME A112.19.4 - Porcelain Enameled Formed Steel Plumbing Fixtures.
- F. ANSI A112.19.5 - Trim for Water-Closet Bowls, Tanks, and Urinals.
- G. ASSE 1002 - Water Closet Flush Tank Ball Cocks.
- H. Americans with Disabilities Act (ADA), Title III.
- I. The Energy Policy Act (EPAct) of 2005.

**1.3 SUBMITTALS**

- A. Submit product data under provisions of Section 22 05 00. Submittals shall include fixture carriers for record purposes only. Architect/Engineer does not review or approve carriers except for manufacturer.
- B. Include fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- C. For fixtures and trim requiring electrical connections, submit product data indicating general assembly, components, electrical power/controls wiring diagrams, and service connections.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Wall Hung Fixture Carriers:
  - 1. Material: All Metal, ASME/ANSI A112.6.1M.
  - 2. Acceptable Manufacturers: Zurn, Smith, Wade, Josam, Watts, Mifab.
  - 3. Water closet carrier shall be rated to support 500 lbs. unless noted otherwise on the drawings.
- B. All fixtures shall be as scheduled on the drawings.
- C. All china shall be from the same manufacturer where possible.
- D. All lavatory and sink trim shall be from the same manufacturer where possible.
- E. All fixtures shall be lead free. Faucets, traps, stops, and other fixture accessories shall not contain more lead than allowed per the latest State or Federal Act.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

#### A. General Installation Requirements:

1. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.
2. Install each fixture with trap easily removable for servicing and cleaning. Use screwed tailpiece couplings. Connect fixture waste to stack with slip fitting.
3. Provide fixtures with chrome plated rigid or flexible supplies, loose key stops, reducers, and escutcheons.
4. Install components level and plumb.
5. Caulk joint between finish floor and floor mounted fixtures and between finish walls and wall mounted fixtures with silicon caulk. Caulk the joint, between rim and fixture where a fixture builds into a counter top, with caulking compound. Refer to DIVISION 7 for "Caulking" requirements. Color to match fixture.
6. Where there is a possibility of water following pipe brackets, etc., into a wall; caulk escutcheons, space around brackets, etc., to exclude water. Refer to DIVISION 7 for "Caulking" requirements.
7. Refer to Plumbing Material List architectural drawings for fixture mounting heights.
8. All non-potable outlets shall be clearly marked with a permanently affixed laminated sign with 3/8" high lettering saying "Non-Potable Water Not for Human Consumption." Sign shall have black lettering on a yellow background.

#### B. Wall-Mounted Fixture Requirements:

1. All wall-mounted fixtures shall have compatible carriers designed for their intended service and suitable for the space available and configuration of fixtures. All carriers shall extend to the floor and be anchored to the slab.

#### C. Floor-Mounted Fixture Requirements:

1. Where floor mounted fixtures are installed on a sloped floor, the open void below the fixture shall be grouted, leveled, and caulked to eliminate stress on the fixture and to prevent water migration to the floor below.

#### D. Exposed or Inside Accessible Cabinets Traps, Valve and Pipe Requirements:

1. All traps exposed under fixtures or inside accessible cabinets shall be chrome plated brass.
2. All water or waste piping for plumbing fixtures that is exposed or inside cabinets shall be chrome plated.
3. All exposed flush valves for water closets and urinals shall have a chrome plated hanger to anchor the piping to the wall.

4. All exposed water supply piping and fittings in a finished space to a shower valve, hose bibb, or other water outlet shall be chrome plated.

E. ADA Accessible Exposed Sink and Lavatory Trim:

1. All exposed sink and lavatory traps, piping and angle stops installed at accessible sink and lavatory locations shall include offset style drain tailpiece, p-trap installed near and parallel with back wall, and insulation kit specially manufactured for this installation. Armaflex with duct tape is not acceptable.

F. ADA Accessible Water Closet Requirements:

1. Handicapped accessible water closet flush valve handles shall face the center of the stall.
2. Coordinate flush valves in handicap accessible locations with grab bars installed by the General Contractor. Make modifications as necessary to flush valve piping to avoid conflict with grab bars. Common solutions include shortened or offset vacuum breaker tailpieces.

3.2 ADJUSTING AND CLEANING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.
- B. At completion, clean plumbing fixtures, equipment, and faucet aerator screens.

3.3 FIXTURE ROUGH-IN SCHEDULE

- A. Rough-in fixture piping connections in accordance with table on plumbing drawings of minimum sizes for particular fixtures.

END OF SECTION

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**SECTION 23 05 00**  
**BASIC HVAC REQUIREMENTS**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements applicable to all Division 23 Sections. Also refer to Division 1 - General Requirements.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 SCOPE OF WORK

- A. This Specification and the associated drawings govern the furnishing, installing, testing and placing into satisfactory operation the Mechanical Systems.
- B. Each Contractor shall provide all new materials indicated on the drawings and/or in these specifications, and all items required to make his portion of the Mechanical Work a finished and working system.
- C. Separate contracts will be awarded for the following work. The division of work listed below is for the contractors' convenience and lists a normal breakdown of the work. Please refer to the Construction Manager's scope statements for complete scope of work description.

D. Scope of Work:

- 1. Plumbing Work shall include, but is not necessarily limited to:
  - a. Furnish and install all items listed in the Plumbing Material List.
  - b. Furnish and Extend existing domestic water piping system including cold, hot, and hot water circulating piping within the building.to new plumbing fixtures. Insulate all piping as specified.
  - c. Furnish and install local instant water heaters where specified.
  - d. Furnish and install sanitary and vent piping for new plumbing fixtures and connect to existing building sanitary and vent system.
  - e. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.
  - f. Remount existing bathroom space heater and rework its associated heating hot water piping and controls.
  - g. Alternates: Furnish and install refrigerant piping, accessories, and final charge of refrigerant.
  - h. Alternates: Furnish and install condensate drain piping from cooling related equipment such as air handlers and cooling coil drain pans.
- 2. Air Conditioning and Ventilating Work shall include, but is not necessarily limited to:

- a. Alternates: Furnish and install package indoor air handling units complete with dampers, filters, coils, fans, and motors. Furnish and install air-cooled condensing units and curbs.
  - b. Alternates: Energy recovery ventilator HRV-1 and its associated ductwork, fittings, air diffusers/ grilles & louvers
  - c. Furnish and install supply air ductwork systems including all fittings, insulation, and outlets as shown on drawings.
  - d. Furnish and install return air ductwork systems including all fittings, insulation, and inlets as shown on drawings.
  - e. Furnish and install all terminal air boxes and reheat coils.
  - f. Furnish and install all temperature control systems as required on the drawings.
  - g. Furnish and install all fire dampers.
  - h. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.
3. Testing, Adjusting, and Balancing Work shall include, but is not necessarily limited to:
- a. Furnish complete testing, adjusting, and balancing as specified in Section 23 05 93, including, but not limited to, air systems, hydronic systems, plumbing systems, and verification of control systems.

### 1.3 WORK SEQUENCE

- A. All work that will produce excessive noise or interference with normal building operations, as determined by the Owner, shall be scheduled with the Owner. It may be necessary to schedule such work during unoccupied hours. The Owner reserves the right to determine when restricted construction hours will be required.

### 1.4 COORDINATION DRAWINGS

- A. Definitions:
  - 1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.
    - a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.
    - b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

- c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
  - d. Maintenance clearances and code-required dedicated space shall be included.
  - e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.
2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

**B. Participation:**

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.
2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.
  - a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.
3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

**C. General:**

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion but will not perform as a coordinator.
2. A plotted set of coordination drawings shall be available at the project site.
3. Coordination drawings are not shop drawings and shall not be submitted as such.
4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.
6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.

7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.
9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.
  - a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
  - b. Potential layout changes shall be made to avoid additional access panels.
  - c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.
  - d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.
  - e. When additional access panels are required, they shall be provided without additional cost to the Owner.
10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors prior to installing any of the components.
11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements or installed their work without proper coordination.
12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

## 1.5 QUALITY ASSURANCE

### A. Contractor's Responsibility Prior to Submitting Pricing Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
2. The Contractor shall resolve all reported deficiencies with the Architect/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 Design Team will be done at the Contractor's risk.

B. Qualifications:

1. Only products of reputable manufacturers are acceptable.
2. All Contractors and subcontractors shall employ only workers skilled in their trades.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the City of Detroit Codes, Laws, Ordinances and other regulations having jurisdiction.
2. Conform to all State Codes.
3. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.
4. If the Contractor notes, at the time of bidding, any parts of the drawings or specifications that do not comply with the codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, he shall submit with his proposal a separate price to make the system comply with the codes and regulations.
5. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Owner.
6. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
7. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.
3. Pay all charges for permits or licenses.
4. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
5. Pay all charges arising out of required inspections by an authorized body.
6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.
7. Where applicable, all fixtures, equipment and materials shall be approved or listed by Underwriter's Laboratories, Inc.

E. Examination of Drawings:

1. The drawings for the mechanical work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pipes and ducts to best fit the layout of the job.
3. Scaling of the drawings is not sufficient or accurate for determining these locations.
4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.
6. If an item is either on the drawings or in the specifications, it shall be included in this contract.
7. Determination of quantities of material and equipment required shall be made by the Contractor from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater number shall govern.
8. Where used in mechanical documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.
  - a. Any item listed as furnished shall also be installed, unless otherwise noted.
  - b. Any item listed as installed shall also be furnished, unless otherwise noted.

F. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any supports, pipes or ducts.

G. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.
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 Contractor shall complete and return a signed "Electronic File Transmittal" form provided by IMEG.
4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.

6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
7. The use of these CAD 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 IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor's use of these documents.

#### 1.6 SUBMITTALS

- A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

<b>Referenced Specification Section</b>	<b><u>Submittal Item</u></b>
23 05 93	Testing, Adjusting, and Balancing
23 09 00	Controls
23 33 00	Duct Silencers
23 33 00	Fire Dampers
23 33 00	Smoke Dampers
23 33 00	Combination Fire Smoke Dampers
23 36 00	Terminal Air Boxes
23 37 00	Grilles, Registers, and Diffusers
23 37 00	Louvers
23 62 13	Air Cooled Condensing Units
23 72 00	Energy Recovery Devices
23 81 26	Split System Air Conditioning Units

- B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:

- a. Date
- b. Project title and number
- c. Contractor's name and address
- d. Division of work (e.g., plumbing, heating, ventilating, etc.)
- e. Description of items submitted and relevant specification number
- f. Notations of deviations from the contract documents
- g. Other pertinent data

2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:

- a. Date
- b. Project title and number
- c. Architect/Engineer
- d. Contractor and subcontractors' names and addresses
- e. Supplier and manufacturer's names and addresses
- f. Division of work (e.g., plumbing, heating, ventilating, etc.)

- g. Description of item submitted (using project nomenclature) and relevant specification number
  - h. Notations of deviations from the contract documents
  - i. Other pertinent data
  - j. Provide space for Contractor's review stamps
3. Composition:
- a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
  - b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
  - c. All sets shall contain an index of the items enclosed with a general topic description on the cover.
4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; electrical power wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
5. Contractor's Approval Stamp:
- a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
  - b. Unstamped submittals will be rejected.
  - c. The Contractor's review shall include, but not be limited to, verification of the following:
    - 1) Only approved manufacturers are used.
    - 2) Addenda items have been incorporated.
    - 3) Catalog numbers and options match those specified.
    - 4) Performance data matches that specified.
    - 5) Electrical characteristics and loads match those specified.
    - 6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
    - 7) Dimensions and service clearances are suitable for the intended location.
    - 8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
    - 9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).
  - d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.



- e. **The 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 deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.**

6. Submittal Identification and Markings:

- a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
- b. The Contractor shall clearly indicate the size, finish, material, etc.
- c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
- d. All marks and identifications on the submittals shall be unambiguous.

7. Schedule submittals to expedite the project. Coordinate submission of related items.

8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.

9. Reproduction of contract documents alone is not acceptable for submittals.

10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.

11. Submittals not required by the contract documents may be returned without review.

12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.

13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any equipment for manufacture or shipment.

14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.

2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.

3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
  - a. Submittal file name: 23 XX XX.description.YYYYMMDD
  - b. Transmittal file name: 23 XX XX.description.YYYYMMDD
5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be transmitted via a pre-approved method.

#### 1.7 EQUIPMENT SUPPLIERS' INSPECTION

- A. The following equipment shall not be placed in operation until a competent installation and service representative of the manufacturer has inspected the installation and certified that the equipment is properly installed, adjusted and lubricated; that preliminary operating instructions have been given; and that the equipment is ready for operation:
  1. Air Cooled Condensers
  2. Condensing Units
- B. Contractor shall arrange for and obtain supplier's on-site inspection(s) at proper time(s) to assure each phase of equipment installation and/or connection is in accordance with the manufacturer's instructions.
- C. Submit copies of start-up reports to the Architect/Engineer and include copies of Owner's Operation and Maintenance Manuals.

#### 1.8 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

- A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.
- B. Keep all bearings properly lubricated and all belts properly tensioned and aligned.
- C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.
- D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate his/her work with other trades.

#### 1.9 WARRANTY

- A. Provide one-year warranty, unless otherwise noted, to the Owner for all fixtures, equipment, materials, and workmanship.
- B. The warranty period for all work in this Division of the specifications shall commence on the date of final acceptance, unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such

whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.

- C. Warranty requirements shall extend to correction, without cost to the Owner, of all Work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from defects or nonconformance with contract documents.

#### 1.10 INSURANCE

- A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

### PART 2 - PRODUCTS

NOT APPLICABLE

### PART 3 - EXECUTION

#### 3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employee and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

#### 3.2 EXCAVATION, FILL, BACKFILL, COMPACTION

- A. General:

1. Prior to the commencement of any excavation or digging, the Contractor shall verify all underground utilities with the regional utility locator. Provide prior notice to the locator before excavations. Contact information for most regional utility locaters can be found by calling 811.
2. The Contractor shall do all excavating, filling, backfilling and compacting associated with his work.

- B. Excavation:

1. Make all excavations to accurate, solid, undisturbed earth, and to proper dimensions.
2. Where excavations are made in error below foundations, concrete of same strength as specified for the foundations or thoroughly compacted sand-gravel fill, as determined by the Architect/Engineer, shall be placed in such excess excavations. Place thoroughly compacted, clean, stable fill in excess excavations under slabs on grade, at the Contractor's expense.
3. Trim bottom and sides of excavations to grades required for foundations.

4. Protect excavations against frost and freezing.
5. Take care in excavating not to damage surrounding structures, equipment or buried pipe. Do not undermine footing or foundation.
6. Perform all trenching in a manner to prevent cave-ins and risk to workmen.
7. Where original surface is pavement or concrete, the surface shall be saw cut to provide clean edges and assist in the surface restoration.
8. Where satisfactory bearing soil for foundations is not found at the indicated levels, the Architect/Engineer or their representative shall be notified immediately, and no further work shall be done until further instructions are given by the Architect/Engineer or their representative.

C. Dewatering:

1. Contractor shall furnish, install, operate and remove all dewatering pumps and pipes needed to keep trenches and pits free of water.

D. Underground Obstructions:

1. Known underground piping, foundations, and other obstructions in the vicinity of construction are shown on the drawings. Use great care in making installations near underground obstruction.
2. If objects not shown on the drawings are encountered, remove, relocate, or perform extra work as directed by the Architect/Engineer.

E. Fill and Backfilling:

1. No rubbish or waste material is permitted for fill or backfill.
2. Provide all necessary sand for backfilling.
3. Dispose of the excess excavated earth as directed.
4. Backfill materials shall be suitable for required compaction, clean and free of perishable materials and stones greater than 4 inches in diameter. Water shall not be permitted to rise in unbackfilled trenches. No material shall be used for backfilling that contains frozen earth, debris or earth with a high void content.
5. Backfill all trenches and excavations immediately after installing pipes, or removal of forms, unless other protection is provided.
6. Around piers and isolated foundations and structures, backfill and fill shall be placed and consolidated simultaneously on all sides to prevent wedge action and displacement. Fill and backfill materials shall be spread in 6-inch uniform horizontal layers with each layer compacted separately to required density.
7. Lay all piping on a compacted bed of sand at least 3 inches deep. Backfill around pipes with sand, 6 inch layers, and compact each layer.
8. Use sand for backfill up to grade for all piping under slabs or paved areas. All other piping shall have sand backfill to 6 inches above the top of the pipe.

9. Place all backfill above the sand in uniform layers not exceeding 6 inches deep. Each layer shall be placed, then carefully and uniformly tamped, to eliminate lateral or vertical displacement.
10. Where the fill and backfill will ultimately be under a building, floor or paving, each layer of fill shall be compacted to 95% of the maximum density determined by AASHTO Designation T-99 or ASTM Designation D-698. Moisture content of soil at time of compaction shall not exceed plus or minus 2% of optimum moisture content determined by AASHTO T-99 or ASTM D-698 test.

F. Surface Restoration:

1. Where trenches are cut through graded, planted or landscaped areas, the areas shall be restored to the original condition. Replace all planting removed or damaged to its original condition. A minimum of 6 inches of topsoil shall be applied where disturbed areas are to be seeded or sodded.
2. Concrete or asphalt type pavement, seal coat, rock, gravel or earth surfaces removed or damaged shall be replaced with comparable materials and restored to original condition.

3.3 ARCHITECT/ENGINEER OBSERVATION OF WORK

A. The Contractor shall provide seven (7) calendar days' notice to the Architect/Engineer prior to:

1. Placing fill over underground and underslab utilities.
2. Covering exterior walls, interior partitions and chases.
3. Installing hard or suspended ceilings and soffits.

B. The Architect/Engineer will have the opportunity to review the installation and provide a written report noting deficiencies requiring correction. The Contractor's schedule shall account for these reviews and show them as line items in the approved schedule.

C. Above-Ceiling Final Observation

1. All work above the ceilings must be complete prior to the Architect/Engineer's review. This includes, but is not limited to:
  - a. Pipe insulation is installed and fully sealed.
  - b. Pipe and duct wall penetrations are sealed.
  - c. Pipe identification and valve tags are installed.
  - d. Main, branch and flexible ducts are installed.
  - e. Diffusers, registers and grilles are installed and connected to ductwork.
  - f. Terminal air box reheat coil piping or wiring is complete.
  - g. Terminal air box control wiring is complete and all control boxes are closed.
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 Architect/Engineer finds the ceilings have been installed prior to this review and prior to 7 days elapsing, the Architect/Engineer may not recommend further payments to the contractor until such time as full access has been provided.

### 3.4 PROJECT CLOSEOUT

- A. The following paragraphs supplement the requirements of Division 1.
- B. Final Jobsite Observation:
  - 1. In order to prevent the Final Jobsite Observation from occurring too early, the Contractor is required to review the completion status of the project and certify that the job is ready for the final jobsite observation.
  - 2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review.
  - 3. Upon Contractor certification that the project is complete and ready for a final observation, the Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.
  - 4. It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineer's additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.
- C. Before final payment is authorized, this Contractor must submit the following:
  - 1. Operation and maintenance manuals with copies of approved shop drawings.
  - 2. Record documents including marked-up or reproducible drawings and specifications.
  - 3. A report documenting the instructions given to the Owner's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representatives.
  - 4. Start-up reports on all equipment requiring a factory installation inspection or start-up.
  - 5. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site and place in location as directed; receipt by Architect/Engineer required prior to final payment approval.

### 3.5 OPERATION AND MAINTENANCE MANUALS

- A. General:
  - 1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.
  - 2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.
- B. Electronic Submittal Procedures:
  - 1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.

2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
  - a. O&M file name: O&M.div23.contractor.YYYYMMDD
  - b. Transmittal file name: O&Mtransmittal.div23.contractor.YYYYMMDD
5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be divided into files that are clearly labeled as “1 of 2”, “2 of 2”, etc.
6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title “Operation and Maintenance Instructions”, title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
7. All text shall be searchable.
8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

C. Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
3. Copies of all final approved shop drawings and submittals. Include Architect’s/Engineer’s shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
4. Refer to Section 23 09 00 for additional requirements for Temperature Control submittals.
5. Copy of final approved test and balance reports.
6. Copies of all factory inspections and/or equipment startup reports.
7. Copies of warranties.
8. Schematic electrical power/controls wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
9. Dimensional drawings of equipment.

10. Capacities and utility consumption of equipment.
11. Detailed parts lists with lists of suppliers.
12. Operating procedures for each system.
13. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
14. Repair procedures for major components.
15. List of lubricants in all equipment and recommended frequency of lubrication.
16. Instruction books, cards, and manuals furnished with the equipment.

### 3.6 INSTRUCTING THE OWNER'S REPRESENTATIVES

- A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of all systems installed under this contract.
- B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.
- C. Contractor shall make a DVD video recording of instructions to the Owner while explaining the system so additional personnel may view the instructions at a later date. The video recording shall be the property of the Owner.
- D. The instructions shall include:
  1. Explanation of all unitary air handling systems.
  2. Temperature control system operation including calibration, adjustment and proper operating conditions of all sensors.
  3. Maintenance of equipment.
  4. Explanation of seasonal system changes.
- E. The Architect/Engineer shall be notified of the time and place instructions will be given to the Owner's representatives so he or his representative can attend if desired.
- F. Minimum hours of instruction for each item shall be:
  1. Air terminal units -   1   hours.
  2. Unitary air heat pump System(s) -   4   hours.
  3. Energy Recovery System -   2   hours.
- G. Operating Instructions:
  1. Contractor is responsible for all instructions to the Owner's representatives for the mechanical and control 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 Architect/Engineer to perform these services.



### 3.7 SYSTEM STARTING AND ADJUSTING

- A. The mechanical systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final comfort adjustments as required.
- B. Complete all manufacturer-recommended startup procedures and checklists to verify proper motor rotation, electrical power voltage is within equipment limitations, equipment controls maintain pressures and temperatures within acceptable ranges, all filters and protective guards are in-place, acceptable access is provided for maintenance and servicing, and equipment operation does not pose a danger to personnel or property.
- C. Operate all HVAC systems continuously for at least one week prior to occupancy to bring construction materials to suitable moisture levels. Areas with mechanical cooling shall be maintained below 60% RH.
- D. Contractor shall adjust the mechanical systems and controls at season changes during the one year warranty period, as required, to provide satisfactory operation and to prove performance of all systems in all seasons.
- E. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks, safety shutdowns, controls, and alarms.
- F. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, 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/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

### 3.8 RECORD DOCUMENTS

- A. The following paragraph supplements Division 1 requirements:

Contractor shall maintain at the job site a separate and complete set of mechanical drawings and specifications on which he shall clearly and permanently mark in complete detail all changes made to the mechanical systems.
- B. Mark drawings to indicate revisions to piping and ductwork, size and location, both exterior and interior; including locations of coils, dampers, other control devices, filters, and other units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (e.g., traps, strainers, expansion compensators, tanks, etc.); Change Orders; concealed control system devices.
- C. Refer to Section 23 09 00 for additional requirements for Temperature Control documents.
- D. Before completion of the project, a set of reproducible mechanical drawings will be given to the Contractor for transfer of all as-built conditions from the paper set maintained at the job site. All marks on reproducibles shall be clear and permanent.

- E. Mark specifications to show approved substitutions; Change Orders, and actual equipment and materials used.
- F. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.
- G. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.

### 3.9 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.
- B. Equipment in finished areas that will be painted to match the room decor 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 decor.
- C. Equipment cabinets, casings, covers, metal jackets, etc., in equipment rooms or concealed spaces, shall be furnished in standard or prime finish, free from scratches, abrasions, chips, etc.
- D. Equipment in occupied spaces, or if standard to the unit, shall have a baked primer with baked enamel finish coat free from scratches, abrasions, chips, etc. If color option is specified or is standard to the unit, this Contractor shall, before ordering, verify with the Architect/Engineer his color preference and furnish this color.
- E. Paint all equipment in unfinished areas such as boiler room, mechanical spaces, storage room, etc., furnished by this Contractor. Equipment furnished with a factory coat of paint and enamel 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 was factory applied.

### 3.10 ADJUST AND CLEAN

- A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.
- B. Clean all drain pans and areas where moisture is present. Immediately report any mold, biological growth, or water damage.
- C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

### 3.11 SPECIAL REQUIREMENTS

- A. Contractor shall coordinate the installation of all equipment, valves, dampers, operators, etc., with other trades to maintain clear access area for servicing.
- B. All equipment shall be installed in such a way to maximize access to parts needing service or maintenance. Review the final field location, placement, and orientation of equipment with the Owner's designated representative prior to setting equipment.
- C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Owner's designated representative will result in removal and reinstallation of the equipment at the Contractor's expense.

## END OF SECTION

**SECTION 23 05 05**  
**HVAC DEMOLITION FOR REMODELING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Mechanical demolition.
- B. Cutting and Patching.

**PART 2 - PRODUCTS**

**2.1 MATERIALS AND EQUIPMENT**

- A. Materials and equipment shall be as specified in individual Sections.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. THE DRAWINGS ARE INTENDED TO INDICATE THE GENERAL SCOPE OF WORK AND DO NOT SHOW EVERY PIPE, DUCT, OR PIECE OF EQUIPMENT THAT MUST BE REMOVED. THE CONTRACTOR SHALL VISIT THE SITE AND VERIFY CONDITIONS PRIOR TO SUBMITTING A BID.
- B. Where walls, ceilings, etc., are shown as being removed on general drawings, the Contractor shall remove all mechanical equipment, devices, fixtures, piping, ducts, systems, etc., from the removed area.
- C. Where ceilings, walls, partitions, etc., are temporarily removed and replaced by others, This Contractor shall remove, store, and replace equipment, devices, fixtures, pipes, ducts, systems, etc.
- D. Verify that abandoned utilities serve only abandoned equipment or facilities. Extend services to facilities or equipment that shall remain in operation following demolition.
- E. Coordinate work with all other Contractors and the Owner. Schedule removal of equipment to avoid conflicts.
- F. This Contractor shall verify all existing equipment sizes and capacities where equipment is scheduled to be replaced or modified, prior to ordering new equipment.
- G. Bid submittal shall mean the Contractor has visited the project site and verified existing conditions and scope of work.

**3.2 PREPARATION**

- A. Disconnect mechanical systems in walls, floors, and ceilings scheduled for removal.
- B. Provide temporary connections to maintain existing systems in service during construction. When work must be performed on operating equipment, use personnel experienced in such operations.
- C. Existing Heating System: Maintain existing system in service until new system is complete and ready for service. Drain system only to make switchovers and connections. Obtain permission

from the Owner at least 48 hours before partially or completely draining system. Minimize outage duration.

### 3.3 DEMOLITION AND EXTENSION OF EXISTING MECHANICAL WORK

- A. Demolish and extend existing mechanical work under provisions of Division 2 and this Section.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned ducts and piping to source of supply and/or main lines.
- D. Remove exposed abandoned pipes and ducts, including abandoned pipes and ducts above accessible ceilings. Cut ducts flush with walls and floors, cap duct that remains, and patch surfaces. Cut pipes above ceilings, below floors and behind walls. Cap remaining lines. Repair building construction to match original. Remove all clamps, hangers, supports, etc. associated with pipe and duct removal.
- E. Disconnect and remove mechanical devices and equipment serving equipment that has been removed.
- F. Repair adjacent construction and finishes damaged during demolition and extension work.
- G. Maintain access to existing mechanical installations which remain. Modify installation or provide access panels as appropriate.
- H. Remove unused sections of supply and return air ductwork back to mains. Patch opening with sheet metal and seal airtight. Patch existing insulation to match existing. Where existing ductwork is to be capped and reused, locate the end cap within 6" of the last branch. End caps shall be 3" pressure class and seal class "A".
- I. Extend existing installations using materials and methods compatible with existing installations, or as specified.
- J. Properly reclaim and dispose of all refrigerant in demolished equipment and as required for extension of existing equipment.

### 3.4 CUTTING AND PATCHING

- A. This Contractor is responsible for all penetrations of existing construction required to complete the work of this project. Refer to Section 23 05 29 for additional requirements.
- B. Penetrations in existing construction should be reviewed carefully prior to proceeding with any work.
- C. Penetrations shall be neat and clean with smooth and/or finished edges. Core drill where possible for clean opening.
- D. Repair existing construction as required after penetration is complete to restore to original condition. Use similar materials and match adjacent construction unless otherwise noted or agreed to by the Architect/Engineer prior to start of work.
- E. Floor slab is post-tensioned. All penetrations shall be x-rayed prior to cutting and/or drilling to avoid any tension cables or utilities encased in floor construction.

- F. Floor slabs may contain conduit systems. This Contractor is responsible for taking any measures required to ensure no conduits or other services are damaged. This includes x-ray or similar non-destructive means.
- G. This Contractor is responsible for all costs incurred in repair, relocations, or replacement of any cables, conduits, or other services if damaged without proper investigation.

3.5 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment which remain or are to be reused.
- B. Clean all systems adjacent to project which are affected by the dust and debris caused by this construction.
- C. MECHANICAL ITEMS REMOVED AND NOT RELOCATED REMAIN THE PROPERTY OF THE OWNER. CONTRACTOR SHALL PLACE ITEMS RETAINED BY THE OWNER IN A LOCATION COORDINATED WITH THE OWNER. THE CONTRACTOR SHALL DISPOSE OF MATERIAL THE OWNER DOES NOT WANT TO REUSE OR RETAIN FOR MAINTENANCE PURPOSES.

END OF SECTION

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**SECTION 23 05 53**  
**HVAC IDENTIFICATION**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Identification of products installed under Division 23.

**1.2 REFERENCES**

- A. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems.  
B. ASTM B-1, B-3, and B-8 for copper conductors.  
C. ASTM D-1248 for Polyethylene Extrusion Materials, ICEA S-70-547 Weatherproof Resistant Polyethylene Conductors, ICEA S-61-402/NEMA WC5 Thermoplastic Insulated Wire & Cable, ICEA S-95-658/NEMA WC70 Non-Shielded 0 – 2kV Cables.  
D. UL 1581 Standard for Electrical Wires, Cables, and Flexible Cords.

**1.3 SUBMITTALS**

- A. Submit shop drawings under provisions of Section 23 05 00. Include list of items identified, wording, letter sizes, and color coding.  
B. Include valve chart and schedule listing valve tag number, location, function, and valve manufacturer's name and model number.

**PART 2 - PRODUCTS**

**2.1 ACCEPTABLE MANUFACTURERS**

- A. 3M, Bunting, Calpico, Craftmark, Emedco, Kolbi Industries, Seton, W.H. Brady, Marking Services.

**2.2 MATERIALS**

- A. All pipe markers (purchased or stenciled) shall conform to ANSI A13.1. Marker lengths and letter sizes shall be at least the following:

<u>OD of Pipe or insulation</u>	<u>Marker Length</u>	<u>Size of Letters</u>
Up to and including 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"
2-1/2" to 6"	12"	1-1/4"
8" to 10"	24"	2-1/2"
Over 10"	32"	3-1/2"

Plastic tags may be used for outside diameters under 3/4".

- B. Plastic Nameplates: Laminated three-layer phenolic with engraved black, 1/4" minimum letters on light contrasting background.  
C. Plastic Tags: Minimum 1-1/2" square or round laminated three-layer phenolic with engraved, 1/4" minimum black letters on light contrasting background.  
D. Brass Tags: Brass background with engraved black letters. Tag size minimum 1-1/2" square or 1-1/2" round.

- E. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install all products per manufacturer's recommendations.
- B. Degrease and clean surfaces to receive adhesive for identification materials.
- C. Valves:
  - 1. All valves (except shutoff valves at equipment) shall have numbered tags.
  - 2. Provide or replace numbered tags on all existing valves that are connected to new systems or that have been revised.
  - 3. Provide all existing valves used to extend utilities to this project with numbered tags. Review tag numbering sequence with the Owner prior to ordering tags.
  - 4. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic straps.
  - 5. Attach to handwheel or around valve stem. On lever operated valves, drill the lever to attach tags.
  - 6. Number all tags and show the service of the pipe.
  - 7. Provide two sets of laminated 8-1/2" x 11" copies of a valve directory listing all valves, with respective tag numbers, uses, and locations. The directory shall be reviewed by the Owner and Architect/Engineer prior to laminating final copies. Laminated copies shall have brass eyelet in at least one corner for easy hanging.
- D. Pipe Markers:
  - 1. Adhesive Backed Markers: Use Brady Style 1, 2, or 3 on pipes 3" diameter and larger. Use Brady Style 4, 6, or 8 on pipes under 3" diameter. Similar styles by other listed manufacturers are acceptable. Secure all markers at both ends with a wrap of pressure sensitive tape completely around the pipe.
  - 2. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable.
  - 3. Apply markers and arrows in the following locations where clearly visible:
    - a. At each valve.
    - b. On both sides of walls that pipes penetrate.
    - c. At least every 20 feet along all pipes.
    - d. On each riser and each leg of each "T" joint.
    - e. At least once in every room and each story traversed.



E. Equipment:

1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an area remote from its function such as air handling units, exhaust fans, filters, reheat coils, dampers, etc.; shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas.
2. Fasten nameplates or plastic tags with stainless steel self-tapping screws or permanently bonding cement.
3. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of ASHRAE 90.1.

F. Miscellaneous:

1. Attach self-adhesive vinyl labels at all duct access doors used to reset fusible links or actuators on fire, fire/smoke, or smoke dampers. Lettering shall be a minimum of 1/2" high. Labels shall indicate damper type.
2. Provide engraved plastic tags at all hydronic or steam system make-up water meters.

3.2 SCHEDULE

- A. Pipes to be marked shall be labeled with the text as shown in the following table regardless of which method or material is used:

Pipe Service	Lettering Color	Background Color
HEATING WATER SUPPLY	Black	Yellow
HEATING WATER RETURN	Black	Yellow

END OF SECTION

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**SECTION 23 05 93**  
**TESTING, ADJUSTING, AND BALANCING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Testing, adjusting, and balancing of air systems.
- B. Testing, adjusting, and balancing of heating systems.
- C. Testing, adjusting, and balancing of cooling systems.
- D. Testing, adjusting, and balancing of energy recovery systems.
- E. Measurement of final operating condition of HVAC systems.

**1.2 QUALITY ASSURANCE**

- A. Agency shall be a company specializing in the adjusting and balancing of systems specified in this section with minimum three years' experience. Perform work under supervision of AABC Certified Test and Balance Engineer, NEBB Certified Testing, Balancing and Adjusting Supervisor, SMARTA Certified Air and Hydronic Balancer, or TABB Certified Supervisor.
- B. Work shall be performed in accordance with the requirements of the references listed at the start of this section.

**1.3 REFERENCES**

- A. AABC - National Standards for Total System Balance, 2002.
- B. ADC – Test Code for Grilles, Registers, and Diffusers.
- C. AMCA – Publication 203-90; Field Performance Measurement of Fan Systems.
- D. ASHRAE - 2003 HVAC Applications Handbook; Chapter 37, Testing, Adjusting and Balancing.
- E. ASHRAE/ANSI - Standard 111-1988; Practices for Measurement, Testing, Adjusting and Balancing of Building HVAC&R Systems.
- F. NEBB - Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems, Sixth Edition, 1998.
- G. SMACNA - HVAC Systems; Testing, Adjusting and Balancing, Third Edition, 2002.
- H. TABB – International Standards for Environmental Systems Balance.

**1.4 SUBMITTALS**

- A. Submit copies of report forms, balancing procedures, and the name and qualifications of testing and balancing agency for approval within 30 days after award of Contract.
- B. Electronic Copies:
  - 1. Submit a certified copy of test reports to the Architect/Engineer for approval. Electronic copies shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Copies that are not legible will be returned to the Contractor for resubmittal. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
  - 2. Electronic file size shall be limited to a maximum of 10MB. Larger files shall be divided into files that are clearly labeled as “1 of 2”, “2 of 2”, etc.
  - 3. All text shall be searchable.

4. Bookmarks shall be used. All bookmark titles shall be an active link to the index page and index tabs.

#### 1.5 REPORT FORMS

- A. Submit reports on AABC, SMACNA or NEBB forms. Use custom forms approved by the Architect/Engineer when needed to supply specified information.
- B. Include in the final report a schematic drawing showing each system component, including balancing devices, for each system. Each drawing shall be included with the test reports required for that system. The schematic drawings shall identify all testing points and cross-reference these points to the report forms and procedures.
- C. Refer to PART 4 for required reports.

#### 1.6 WARRANTY/GUARANTEE

- A. The TAB Contractor shall include an extended warranty of 90 days after owner receipt of a completed balancing report, during which time the Owner may request a recheck of terminals, or resetting of any outlet, coil, or device listed in the test report. This warranty shall provide a minimum of 4 manhours of onsite service time. If it is determined that the new test results are not within the design criteria, the balancer shall rebalance the system according to design criteria.
- B. Warranty/Guarantee must meet one of the following programs: TABB International Quality Assurance Program, AABC National Project Performance Guarantee, NEBB's Conformance Certification.

#### 1.7 SCHEDULING

- A. Coordinate schedule with other trades. Provide a minimum of seven days' notice to all trades and the Architect/Engineer prior to performing each test.

### PART 2 - PRODUCTS

NOT APPLICABLE

### PART 3 - EXECUTION

#### 3.1 GENERAL REQUIREMENTS

- A. All procedures must conform to a published standard listed in the References article of this section. All equipment shall be adjusted in accordance with the manufacturer's recommendations. Any system not listed in this specification but installed under the contract documents shall be balanced using a procedure from a published standard listed in the References article.
- B. The Balancing Contractor shall incorporate all pertinent documented construction changes (e.g. submittals/shop drawings, change orders, RFIs, ASIs, etc.) and include in the balancing report.
- C. Recorded data shall represent actual measured or observed conditions.
- D. 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 is complete, close probe holes and patch insulation with new materials as specified. Restore vapor barrier and finish as specified.

- E. Permanently mark setting of valves, dampers, and other adjustment devices allowing for settings to be restored. Set and lock memory stops.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, plugging test holes, and restoring thermostats to specified settings.
- G. The Balancing Contractor shall measure terminal air box air flow, and the TCC shall adjust DDC readout to match. Refer to Section 23 09 00 for additional information.
- H. Installations with systems consisting of multiple components shall be balanced with all system components operating.

### 3.2 EXAMINATION

- A. Before beginning work, verify that systems are complete and operable. Ensure the following:
  - 1. General Equipment Requirements:
    - a. Equipment is safe to operate and in normal condition.
    - b. Equipment with moving parts is properly lubricated.
    - c. Temperature control systems are complete and operable.
    - d. Proper thermal overload protection is in place for electrical equipment.
    - e. Direction of rotation of all fans and pumps is correct.
    - f. Access doors are closed, and end caps are in place.
  - 2. Duct System Requirements:
    - a. All filters are clean and in place. If required, install temporary media.
    - b. Duct systems are clean and free of debris.
    - c. Fire/smoke and manual volume dampers are in place, functional and open.
    - d. Air outlets are installed and connected.
    - e. Duct system leakage has been minimized.
  - 3. Pipe System Requirements:
    - a. Coil fins have been cleaned and combed.
    - b. Hydronic systems have been cleaned, filled, and vented.
    - c. Strainer screens are clean and in place.
    - d. Shutoff, throttling and balancing valves are open.
- B. Report any defects or deficiencies to Architect/Engineer.
- C. Promptly report items that are abnormal or prevent proper balancing.
- D. If, for design reasons, system cannot be properly balanced, report as soon as observed.
- E. Beginning of work means acceptance of existing conditions.

### 3.3 PREPARATION

- A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to the Architect/Engineer for spot checks during testing.
- B. Instruments shall be calibrated within six months of testing performed for project, or more recently if recommended by the instrument manufacturer.

### 3.4 INSTALLATION TOLERANCES

- A.  $\pm 10\%$  of scheduled values:
  - 1. Adjust air inlets and outlets to  $\pm 10\%$  of scheduled values.
  - 2. Adjust piping systems to  $\pm 10\%$  of design values.
- B. Adjust supply, return, and exhaust air-handling systems to  $+10\%$  /  $-5\%$  of scheduled values.

### 3.5 ADJUSTING

- A. After adjustment, take measurements to verify balance has not been disrupted or that disruption has been rectified.
- B. Once balancing of systems is complete, at least one damper or valve must be 100% open.
- C. After testing, adjusting and balancing are complete, operate each system and randomly check measurements to verify system is operating as reported in the report. Document any discrepancies.
- D. Contractor responsible for each motor shall also be responsible for replacement sheaves. Coordinate with contractor.
- E. Contractor responsible for pump shall trim impeller to final duty point as instructed by this contractor on all pumps not driven by a VFD. Coordinate with contractor.

### 3.6 SUBMISSION OF REPORTS

- A. Fill in test results on appropriate forms.

## PART 4 - SYSTEMS TO BE TESTED, ADJUSTED AND BALANCED

### 4.1 VERIFICATION OF EXISTING SYSTEMS

- A. Perform a pre-balance of systems serving the area of construction prior to the start of any other work. Do not make adjustments to the systems. If the systems are not operating at maximum capacity, temporarily drive system to maximum and take readings for the system. Return the system to its original state when measurements are complete.
  - 1. Air Terminal (Inlet or Outlet):
    - a. Room number/location.
    - b. Terminal type and size.
    - c. Velocity.
    - d. Flow rate (cfm)
    - e. Percent of design flow rate.
  - 2. Air Terminal Unit (Terminal Air Box) Data:
    - a. General Requirements:
      - 1) Drawing symbol.
      - 2) Location.
      - 3) Manufacturer and model.
      - 4) Size.
      - 5) Type: constant, variable, single, dual duct.

- b. Flow Rate:
  - 1) Cooling maximum flow rate (cfm).
  - 2) Heating maximum flow rate (cfm).
  - 3) Minimum flow rate (cfm).
  - 4) Water flow rate (gpm).
- c. Temperature:
  - 1) Entering air temperature.
  - 2) Leaving air temperature (in heating mode).
  - 3) Entering water temperature.
  - 4) Leaving water temperature.

B. Report findings to Architect/Engineer on standard forms. Provide **four (4)** copies of report.

#### 4.2 GENERAL REQUIREMENTS

A. Title Page:

- 1. Project name.
- 2. Project location.
- 3. Project Architect.
- 4. Project Engineer (IMEG Corp.).
- 5. Project General Contractor.
- 6. TAB Company name, address, phone number.
- 7. TAB Supervisor's name and certification number.
- 8. TAB Supervisor's signature and date.
- 9. Report date.

B. Report Index

C. General Information:

- 1. Test conditions.
- 2. Nomenclature used throughout report.
- 3. Notable system characteristics/discrepancies from design.
- 4. Test standards followed.
- 5. Any deficiencies noted.
- 6. Quality assurance statement.

D. Instrument List:

- 1. Instrument.
- 2. Manufacturer, model, and serial number.
- 3. Range.
- 4. Calibration date.

#### 4.3 AIR SYSTEMS

A. Air Terminal (Inlet or Outlet):

- 1. Drawing symbol.
- 2. Room number/location.
- 3. Terminal type and size.
- 4. Velocity: specified and actual.
- 5. Flow rate (cfm): specified and actual.
- 6. Percent of design flow rate.

B. Air Terminal Unit (Terminal Air Box) Data:

1. General Requirements:
  - a. Drawing symbol.
  - b. Location.
  - c. Manufacturer and model.
  - d. Size.
  - e. Type: constant, variable, single, dual duct.
2. Flow Rate:
  - a. Cooling maximum flow rate (cfm): specified and actual.
  - b. Heating maximum flow rate (cfm): specified and actual.
  - c. Minimum flow rate (cfm): specified and actual.
  - d. Water flow rate (gpm): specified and actual.
3. Temperature:
  - a. Entering air temperature: specified and actual.
  - b. Leaving air temperature (in heating mode): specified and actual.
  - c. Entering water temperature: specified and actual.
  - d. Leaving water temperature: specified and actual.
4. Pressure Drop and Pressure:
  - a. Inlet static pressure during testing (maximum and minimum).
  - b. Coil air pressure drop: specified and actual.
  - c. Water pressure drop: specified and actual.

4.4 HEATING SYSTEMS

A. Heating Coils:

1. General Requirements:
  - a. Drawing symbol.
  - b. Service.
  - c. Location.
  - d. Manufacturer and model.
  - e. Size.
2. Flow Rate:
  - a. Flow rate (cfm): specified and actual.
  - b. Water flow rate: specified and actual.
3. Temperature:
  - a. Entering air temperature: specified and actual.
  - b. Leaving air temperature: specified and actual.
  - c. Entering water temperature: specified and actual.
  - d. Leaving water temperature: specified and actual.
4. Pressure Drop and Pressure:
  - a. Air pressure drop: specified and actual.
  - b. Steam pressure after valve: specified and actual.
  - c. Water pressure drop: specified and actual.
5. Energy:
  - a. Air Btuh (cfm x temp rise x 1.09).
  - b. Water Btuh (gpm x temp drop x 500). Repeat tests if not within 10% of air Btuh.

B. Terminal Heat Transfer Units:

1. General Requirement:
  - a. Drawing symbol.
  - b. Location.



- c. Manufacturer and model.
  - d. Include air data only for forced air units.
- 2. Flow Rate:
  - a. Flow rate (cfm): specified and actual.
  - b. Water flow rate (gpm): specified and actual.
- 3. Temperature:
  - a. Entering air temperature: specified and actual.
  - b. Leaving air temperature: specified and actual.
  - c. Entering water temperature: specified and actual.
  - d. Leaving water temperature: specified and actual.
- 4. Energy:
  - a. Air Btuh (cfm x temperature rise x 1.09).
  - b. Water Btuh (gpm x temperature drop x 500). Repeat tests if not within 10% of air Btuh.

#### 4.5 COOLING SYSTEMS

##### A. Electric Motors:

- 1. Drawing symbol of equipment served.
- 2. Manufacturer, Model, Frame.
- 3. Nameplate: HP, phase, service factor, RPM, operating amps, efficiency.
- 4. Measured: Amps for each phase.

##### B. Terminal Heat Transfer Units:

- 1. General Requirements:
  - a. Drawing symbol.
  - b. Location.
  - c. Manufacturer and model.
  - d. Include air data only for forced air units.
- 2. Temperature:
  - a. Entering air DB temperature: specified and actual.
  - b. Leaving air DB temperature: specified and actual.
  - c. Entering water temperature: specified and actual.
  - d. Leaving water temperature: specified and actual.
- 3. Flow rate:
  - a. Flow rate (cfm): specified and actual.
  - b. Air Btuh (cfm x temperature rise x 1.09).
  - c. Water Btuh (gpm x temperature drop x 500). Repeat tests if not within 10% of air Btuh.

#### 4.6 ENERGY RECOVERY SYSTEMS

##### A. Air Systems - Air energy recovery devices shall be tested at ambient temperatures of less than 40°F or greater than 85°F.

- 1. Energy Recovery unit:
  - a. General Requirements:
    - 1) Drawing Symbol.
    - 2) Location.
    - 3) Wheel RPM.

- b. Primary Air:
  - 1) Primary Entering Air Temperature.
  - 2) Primary Leaving Air Temperature.
  - 3) Primary Air Pressure Drop.
  - 4) Primary Air Flow Rate (cfm).
- c. Secondary Air:
  - 1) Secondary Entering Air Temperature.
  - 2) Secondary Leaving Air Temperature.
  - 3) Secondary Air Pressure Drop.
  - 4) Secondary Air Flow Rate (cfm).

END OF SECTION

**SECTION 23 07 13**  
**DUCTWORK INSULATION**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Ductwork Insulation.
- B. Insulation Jackets.

**1.2 QUALITY ASSURANCE**

- A. Applicator: Company specializing in ductwork insulation application with five years minimum experience. When requested, installer shall submit manufacturer's certificate indicating qualifications.
- B. Materials: UL listed in Category HNKT; flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL 723.
- C. Adhesives: UL listed, meeting NFPA 90A/90B requirements.

**1.3 REFERENCES**

- A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- B. ANSI/ASTM C553 - Mineral Fiber Blanket and Felt Insulation.
- C. ANSI/ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.
- D. ASTM E84 - Surface Burning Characteristics of Building Materials.
- E. ASTM E136 - Standard Test Method for the Behavior of Materials in a Vertical Tube Furnace at 750°C.
- F. ASTM E814 - Fire Tests of Through Penetrations Firestops.
- G. National Commercial & Industrial Insulation Standards - 1999 Edition - as published by Midwest Insulation Contractors Association and endorsed by National Insulation Contractors Association.
- H. NFPA 255 - Surface Burning Characteristics of Building Materials.
- I. UL - XHEZ - Through Penetration Firestop Systems.
- J. UL 263 - Full Scale External Fire Tests with Hose Stream.
- K. UL 723 - Surface Burning Characteristics of Building Materials.
- L. UL 1479 - Fire Tests of Through Penetrations Firestops.

**1.4 SUBMITTALS**

- A. Submit shop drawings per Section 23 05 00. Include product description, list of materials and thickness for each service, and location.
- B. Submit manufacturer's installation instructions.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Type A: Flexible Fiberglass - Outside Wrap; ANSI/ASTM C553; commercial grade; 0.280.040 W/(m K) / 0.260.036 W/(m K) (Out-Of-Package/Installed-Compressed 25%) maximum 'K' value at 75°F/24°C; foil scrim Kraft facing, 1.0 lb./cu. ft. 16 kg/m3 density. Submit both "Out of Package" and "Installed-Compressed 25%" K and R-values.

- B. Type B: Semi-rigid Fiberglass Board Wrap - Outside Application; ANSI/ASTM C612, Class 1; 0.250.036 W/(m K) maximum 'K' value at 75°F24°C; foil scrim Kraft facing, 3 lb./cu. ft.48 kg/m3 density.
- C. Type C: Flexible Fiberglass Liner; ANSI/ASTM C1071; 0.280.040 W/(m K) maximum 'K' value at 75°F24°C; 1.5 lb/cu ft24 kg/m3 minimum density; coated air side for 4000 fpm20.3 m/s air velocity.
- D. Type G: Preformed rigid fiberglass acoustical liner. ANSI/ASTM C1071; 0.230.033 W/(m K) maximum 'K' value at 75°F24°C mean temperature; Noise Reduction Coefficient (NRC) per ASTM C423 Type "A" mounting of 0.70 for 1"25 mm thickness, 0.90 for 1.5"40 mm thickness. Liner shall be factory coated with an anti-microbial agent to prevent fungus and bacteria growth per ASTM G-21 and G-22. Max flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL 723.

## 2.2 JACKETS

- A. Vapor Barrier Jackets: Kraft reinforced foil scrim vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 25 units. Tensile strength: 35 psi240 kPa minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.

## 2.3 JACKET COVERINGS

- A. Aluminum Jackets: ASTM B209; 0.016"0.4 mm thick; smooth or embossed stucco finish with Z edge seams and aluminum bands for outdoor use. Where colored jacket covers are called for, provide factory-applied hard film acrylic paint in color selected by Architect.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions, codes, and industry standards.
- B. Install materials after ductwork has been tested.
- C. Clean surfaces for adhesives.
- D. Provide insulation with vapor barrier when air conveyed may be below ambient temperature.
- E. Exterior Duct Wrap - Flexible, Type A:
  - 1. Apply with edges tightly butted.
  - 2. Cut slightly longer than perimeter of duct to insure full thickness at corners. Do not wrap excessively tight.
  - 3. Seal joints with adhesive backed tape.
  - 4. Apply so insulation conforms uniformly and firmly to duct.
  - 5. Provide high-density insulation inserts at trapeze duct hangers and straps to prevent crushing of insulation. Maintain continuous vapor barrier through the hanger.
  - 6. Seal all penetrations of the vapor barrier by strap hangers or slip cable hangers with adhesive backed tape.

7. Tape all joints with Royal Tapes #RT 350 (216-439-7229), Venture Tape 1525CW, or Compac Type FSK. No substitutions will be accepted without written permission from the Architect/Engineer.
8. Press tape tightly to the duct covering with a squeegee for a tight continuous seal. Fish mouths and loose tape edges are not acceptable.
9. Staples may be used, but must be covered with tape.
10. Vapor barrier must be continuous.
11. Mechanically fasten on 12"300 mm centers at bottom of ducts over 24"600 mm wide and on all sides of vertical ducts.

F. Semi Rigid Fiberglass Board Wrap - Type B (Indoor Use):

1. Impale on pins welded to the duct and secured with speed clips. Clip pins off close to speed clips.
2. Space pins as needed to hold insulation firmly against duct, but not less than one pin per square foot one pin per 0.1 square meters. Pins must be long enough to avoid compressing the insulation.
3. Seal all joints and speed clips with glass fabric set in adhesive or a 3"80 mm wide strip of Royal Tapes #RT 350 (216-439-7229), Venture Tape 1525CW, or Compac Type FSK facing tape.
4. For small areas, secure insulation with adhesive over the entire surface of the duct. Use adhesive in addition to pins as needed to prevent sagging on horizontal surfaces.

G. Interior Insulation - Flexible Duct Liner, Type C:

1. Observation of Duct Lining:
  - a. After installation of ductwork, Architect/Engineer may select random observation points in each system.
    - 1) At each observation point, cut and remove an 18"450 mm x 18"450 mm section of ductwork and liner for verification of installation.
    - 2) Random observation points based on one opening per 75 lineal ft.23 lineal meters of total duct run.
  - b. When any of the observation points shows non-compliance, additional points will be designated by the Architect/Engineer, and observation repeated.
  - c. If 20% of points observed do not comply, remove and replace all lined ducts and repeat tests. Where replacement is not required, correct all non-compliances.
  - d. At end of observation, repair all duct lining and observation holes by installing standard, insulated, hinged access doors per Section 23 33 00.
  - e. Paint or finish to match adjacent duct surfaces.
2. Impale on spindle anchors welded or mechanically fastened to the duct. Adhesive or glue fastened anchors are not acceptable. Maximum anchor spacing per SMACNA Duct

Construction Standards or manufacturer's recommendations, whichever is more restrictive. Locate pins less than 3"80 mm from corners and at intervals not over 6"150 mm around the perimeter at leading and trailing edges. Locate pins within 3"80 mm of transverse joints and at intervals not over 16"400 mm long the length of the duct. Pins must be long enough to prevent compressing the insulation.

3. In addition to anchors, secure liner with UL listed adhesive covering over 90% of the duct surface.
4. Install per the latest edition of the SMACNA Manual.
5. Leading edges shall be covered as follows:
  - a. For duct velocities below 3000 fpm15 m/s, coat leading edges with adhesive. Neatly butt liner without gaps at transverse joints. Cut liner flush with end of the duct section for tight joints with no exposed duct. If adhesive is shop installed, field apply additional adhesive to the end of each duct section for complete adhesion of the liner. Protect edges from dirt and debris.
  - b. For duct velocities above 3000 fpm15 m/s, cover leading edges with metal nosing. Use nosing on upstream edges of each section of duct. If the duct can be installed in either direction, provide nosing on each end or clearly mark the duct to allow visual verification after installation. Verify duct velocities based on the scheduled air flow rates and determine where metal nosing is required.
  - c. Install metal nosing in the following locations (regardless of velocity):
    - 1) The first three fittings downstream of all fans.
    - 2) At all duct liner interruptions. This includes fire dampers, access doors, branch connections, and all other locations where the edge of the liner is exposed.
    - 3) Trailing edges of transverse joints do not require metal nosings.
6. Overlap liner at longitudinal joints. Make longitudinal joints at corners of the duct unless the duct size does not allow this. Coat longitudinal joints with adhesive at velocities over 2500 fpm13 m/s.
7. Seal all damaged duct liner with adhesive and glass cloth. Do not damage duct liner surface coatings.
8. Duct dimensions given are net inside dimensions. Increase sheet metal to allow for insulation thickness.

H. Preformed Fiberglass Acoustical Liner, Rigid - Type G:

1. Cut and secure duct liner inside duct.
2. Install insulation pins or adhesives in locations as recommended by the manufacturer.
3. Seal all damaged duct liner and fill all gaps with manufacturer approved sealant. Do not damage duct liner surface coatings.
4. Where edges show evidence of delamination, the damaged areas shall be secured by manufacturer approved sealant.

- 5. Duct dimensions given are net inside dimensions. Increase sheet metal to allow for insulation thickness.
  - I. Continue insulation with vapor barrier through penetrations unless code prohibits.
  - J. Provide 2"50 mm wide, 24"600 mm high, 26 gauge (0.55 mm), galvanized sheet metal corner protection angles for all externally insulated ductwork extending to a floor or curb.
- 3.2 SCHEDULE
- A. Refer to Section 23 31 00 for scheduling of insulation.

END OF SECTION

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**SECTION 23 07 19**  
**HVAC PIPING INSULATION**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Piping Insulation.
- B. Insulation Jackets.

**1.2 QUALITY ASSURANCE**

- A. Applicator: Company specializing in piping insulation application with five years minimum experience.
- B. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL 723 (where required).

**1.3 REFERENCES**

- A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- B. ANSI/ASTM C195 - Mineral Fiber Thermal Insulation Cement.
- C. ANSI/ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.
- D. ANSI/ASTM C534 - Elastomeric Foam Insulation.
- E. ANSI/ASTM C547 - Mineral Fiber Preformed Pipe Insulation.
- F. ANSI/ASTM C552 - Cellular Glass Block and Pipe Thermal Insulation.
- G. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.
- H. ASTM C591 - Unfaced Preformed Rigid Cellular Polyisocyanurate Insulation.
- I. ASTM C578 - Preformed Cellular Polystyrene Thermal Insulation.
- J. ASTM C1729 - Standard Specification for Aluminum Jacketing for Insulation.
- K. ASTM C1767 - Standard Specification for Stainless Steel Jacketing for Insulation.
- L. ASTM E84 - Surface Burning Characteristics of Building Materials.
- M. NFPA 255 - Surface Burning Characteristics of Building Materials.
- N. UL 723 - Surface Burning Characteristics of Building Materials.
- O. National Commercial & Industrial Insulation Standards - 1999 Edition - as published by Midwest Insulation Contractors Association and endorsed by National Insulation Contractors Association.

**1.4 SUBMITTALS**

- A. Submit shop drawings per Section 23 05 00. Include product description, list of materials and thickness for each service, and locations.

**PART 2 - PRODUCTS**

**2.1 INSULATION**

- A. Type A: Glass fiber; ANSI/ASTM C547; 0.24 maximum 'K' value at 75°F; non-combustible. All purpose, white Kraft jacket bonded to aluminum foil and reinforced with fiberglass yarn, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723).
- B. Type B: EPDM (NBR/PVC Blend is not permitted) elastomeric cellular foam; ANSI/ASTM C534; flexible plastic; 0.25 maximum 'K' value at 75°F, 25/50 flame spread/smoke developed rating when

tested in accordance with ASTM E84 (UL 723). Maximum 1" thick per layer where multiple layers are specified.

- C. Type C: Molded rigid cellular glass; ANSI/ASTM C-552; 0.35 maximum 'K' value at 75°F; moisture resistant, non-combustible; suitable for -100°F to +900°F. For below grade installations use asphaltic mastic paper vapor barrier jacket. Use self-seal all-purpose white Kraft jacket for above grade installations.
- D. Type G: Rigid Mineral Fiber Blocks; ANSI/ASTM C612; 0.625 maximum 'K' value at 800°F. Suitable for 1900°F.

## 2.2 VAPOR BARRIER JACKETS

- A. Kraft reinforced foil vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 50 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.
- B. Polyvinylidene Chloride (PVDC or Saran) film and tape: Durable and highly moisture and moisture vapor resistant. Please refer to manufacturer's recommended installation guidelines.

## 2.3 JACKET COVERINGS

- A. Aluminum Jackets: ASTM C1729; 0.016" thick (thicker where required by ASTM C1729); stucco embossed finish with Z edge seams and aluminum bands for outdoor use. Where colored jacket covers are called for, provide factory-applied hard film acrylic paint in color selected by Architect.
- B. Plastic Jackets and Fitting Covers: High impact, glossy white, 0.020" thick, self-extinguishing plastic. Suitable for use indoors or outdoors with ultraviolet inhibitors. Suitable for -40°F to 150°F. 25/50 maximum flame spread/smoke developed.

## 2.4 REMOVABLE INSULATION JACKETS

- A. Removable insulation jackets shall consist of outer covering, interstitial insulation material, and inner covering.
- B. Inner and outer covering shall be constructed from a minimum 16.5 oz./yd<sup>2</sup> PTFE fiberglass composite and suitable for insulating surface temperatures up to 550°F.
- C. Interstitial insulation blanket shall be minimum 1-1/2" thick and shall consist of either:
  - 1. Silica and glass-fiber insulation felts and blankets – minimum 6 lb./ft<sup>3</sup> density.
  - 2. E-type glass-fiber felts and blankets – minimum 6 lb./ft<sup>3</sup> density.
- D. Construction: Inner and outer covering with interstitial insulation material shall be joined into a single assembly using a double sewn lock stitch with 4-6 stitches/inch. The thread used shall be able to withstand minimum 550°F surface temperatures without degradation. The use of hog rings, staples, and wires for closure of assembly are not acceptable. The interstitial insulation shall be sewn as an integral part of the inner and outer coverings to prevent shifting of the insulation. Insulation pins are not an allowable method of preventing the insulation from shifting and shall not be used.
- E. No raw cut jacket edges shall be exposed.
- F. Jackets shall be fastened to equipment and piping components using hook and loop (Velcro) straps and minimum 1" slide buckles.

- G. Jacket coverings shall have an inner covering edge with a continuous strip of hook & loop closure (Velcro) that is parallel to the seam and overlaps the outer covering by a minimum of 2 inches.
- H. Acceptable Manufacturers: Firwin Corp, Lewco Specialty Products, ThermaXX Jackets LLC or approved equivalent.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Install insulation after piping has been tested. Pipe shall be clean, dry and free of rust before applying insulation.

### 3.2 INSTALLATION

- A. General Installation Requirements:

1. Install materials per manufacturer's instructions, building codes and industry standards.
2. Continue insulation with vapor barrier through penetrations. This applies to all insulated piping. Maintain fire rating of all penetrations.
3. On all insulated piping, provide at each support an insert of same thickness and contour as adjoining insulation, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. The insert shall be suitable for planned temperatures, be suitable for use with specific pipe material, and shall be a 180° cylindrical segment the same length as metal shields. Inserts shall be a cellular glass (for all temperature ranges) or molded hydrous calcium silicate (for pipe with operating temperatures above 70°F, with a minimum compressive strength of 50 psi. Factory fabricated inserts may be used. Rectangular blocks, plugs, or wood material are not acceptable. Temporary wood blocking may be used by the Piping Contractor for proper height; however, these must be removed and replaced with proper inserts by the Insulation Contractor. Refer to Supports and Anchors specification section for additional information.
4. Neatly finish insulation at supports, protrusions, and interruptions.
5. Install metal shields between all hangers or supports and the pipe insulation. Shields shall be galvanized sheet metal, half-round with flared edges. Adhere shields to insulation. On cold piping, seal the shields vapor-tight to the insulation as required to maintain the vapor barrier, or add separate vapor barrier jacket.
6. Shields shall be at least the following lengths and gauges:

	Pipe Size	Shield Size
a.	1/2" to 3"	12" long x 18 gauge
b.	4"	12" long x 16 gauge
c.	5" to 6"	18" long x 16 gauge
d.	8" to 14"	24" long x 14 gauge
e.	16" to 24"	24" long x 12 gauge

7. All piping and insulation that does not meet 25/50 that is in an air plenum shall have written approval from the Authority Having Jurisdiction and the local fire department for authorization and materials approval. If approval has been allowed, the non-rated material

shall be wrapped with a product that has passed ASTM E84 and/or NFPA 255 testing with a rating of 25/50 or below.

- B. Insulated Piping Operating Below 60°F:
1. Insulate fittings, valves, unions, flanges, strainers, flexible connections, flexible hoses, and expansion joints. Seal all penetrations of vapor barrier.
  2. On piping operating below 60°F in locations that are not mechanically cooled (e.g., penthouses, mechanical rooms, tunnels, chases at exterior walls, etc.), Type B insulation shall be used.
  3. All balance valves with fluid operating below 60°F shall be insulated with a removable plug wrapped with vapor barrier tape to allow reading and adjusting of the valve.
- C. Insulated Piping Operating Between 60°F and 140°F:
1. Do not insulate flanges and unions, but bevel and seal ends of insulation at such locations. Insulate all fittings, valves and strainers.
- D. Insulated Piping Operating Above 140°F:
1. Insulate fittings, valves, flanges, float & thermostatic steam traps, and strainers. On gate valves, the insulation shall be extended to cover the entire valve bonnet, leaving only the portion of the stem that is above the bonnet and valve operator exposed.
  2. All balance valves with fluid operating above 140°F shall be insulated and an opening shall be left in the insulation to allow for reading and adjusting the valve.
  3. The use of removable insulation jackets is acceptable for insulating large and non-cylindrical shaped piping components (e.g., check valves, pressure regulating valves, calibrated balance valves, gate valve bonnets, F&T traps, strainers, line sets, and the like).
- E. Refrigerant Piping:
1. On refrigerant piping (25°F and above) and **not** required to meet the 25/50 flame/smoke, provide at each strut or clevis support an insulation coupling to support pipe and to accept insulation thickness of adjoining insulation, to prevent insulation from sagging and crushing. The coupling shall be suitable for planned temperatures, use with specified pipe material, and shall be a 360°, one-piece cylindrical segment. Use mechanical fasteners where coupling cannot be installed on pipe during installation. Contractor shall apply adhesive to ends of insulation entering insulation coupling to maintain vapor barrier.
- F. Exposed Piping:
1. Locate and cover seams in least visible locations.
  2. Where exposed insulated piping extends above the floor, provide a sheet metal guard around the insulation extending 12" above the floor. Guard shall be 0.016" cylindrical smooth or stucco aluminum and shall fit tightly to the insulation.

### 3.3 INSULATION

#### A. Type A Insulation:

1. All Service Jackets: Seal all longitudinal joints with self-seal laps using a single pressure sensitive adhesive system. Do not staple.
2. Insulation without self-seal lap may be used if installed with Benjamin Foster 85-20 or equivalent Chicago Mastic, 3M or Childers lap adhesive.
3. Apply insulation with laps on top of pipe.
4. Fittings, Valve Bodies and Flanges: For 4" and smaller pipes, insulate with 1 lb. density insulation wrapped under compression to a thickness equal to the adjacent pipe insulation. For pipes over 4", use mitered segments of pipe insulation. Finish with preformed plastic fitting covers. Secure fitting covers with pressure sensitive tape at each end. Overlap tape at least 2" on itself. For pipes operating below 60°F, seal fitting covers with vapor retarder mastic in addition to tape.

#### B. Type B Insulation:

1. Elastomeric Cellular Foam: Where possible, slip insulation over the open end of pipe without slitting. Seal all butt ends, longitudinal seams, and fittings with adhesive. At elbows and tees, use mitered connections. Do not compress or crush insulation at cemented joints. Joints shall be sealed completely and not pucker or wrinkle. Paint the outside of outdoor insulation with two coats of latex enamel paint recommended by the manufacturer.
2. Self-seal insulation may be used on pipes operating below 170°F.

#### C. Type C Insulation:

1. Seal all longitudinal joints with manufacturer approved adhesive. Secure butt joint strips in a similar manner.
2. Insulate fittings with prefabricated fittings.

#### D. Type G Insulation:

1. Apply with edges tightly butted, joints broken.
2. Secure with 16 gauge galvanized, annealed steel wire or 1/2" x 0.015" galvanized steel bands, 12" maximum centers.
3. Install welding studs, clips and angles where required to anchor wires and bands.

### 3.4 JACKET COVER INSTALLATION

#### A. Metal Covering:

1. Provide vapor barrier as specified for insulation type. Cover with aluminum jacket covering with seams located on the bottom of horizontal piping. Include fittings, joints and valves.
2. Seal all interior and exterior butt joints with metal draw bands and sealant. Seal all exterior joints watertight.
3. Interior joints do not need to be sealed.

4. Use metal covering on the following pipes:
  - a. All exterior piping.
  - b. Engine exhaust piping (interior).
  - c. Cover insulation with aluminum jacketing.
  - d. All Type E, F, G and H insulation.

B. Plastic Covering:

1. Provide vapor barrier as specified for insulation type. Cover with plastic jacket covering. Position seams to shed water.
2. Solvent weld all joints with manufacturer recommended cement.
3. Overlap all laps and butt joints 1-1/2" minimum. Repair any loose ends that do not seal securely. Solvent weld all fitting covers in the same manner. Final installation shall be watertight.
4. Use plastic insulation covering on all exposed pipes including, but not limited to:
  - a. All exposed piping in areas noted on drawings.
  - b. All exposed piping in locker rooms.
  - c. All exposed piping below 8'-0" above floor.
  - d. All piping in mechanical rooms and/or tunnels that is subject to damage from normal operations. (Example: Piping that must be stepped over routinely.)
  - e. All kitchen areas.
5. Elastomeric piping insulation may have two coats of latex paint instead of plastic jacket.

3.5 SCHEDULE

Piping System		Insulation Type/Thickness
A.	Cooling Coil Condensate Drains below 55°F	B / 1/2"
B.	Heating Water Supply & Return;	
	Under 1-1/2"	A / 1-1/2"
	1-1/2" and above	A / 2"
C.	Refrig. Hot Gas Lines	
	Up to 1-1/4"	B / 1/2"
	1-1/2" and up	B / 1"
D.	Refrigeration Suction Lines	
	1/2" thru 1" pipe size	C / 1-1/2"
	1-1/4" thru 5" pipe size	C / 2"
	6" thru 10" pipe size	C / 2-1/2"
E.	Insulation Inserts at hangers	C - Match pipe insulation thickness

END OF SECTION

**SECTION 23 21 00  
HYDRONIC PIPING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Pipe and Pipe Fittings.
- B. Valves.
- C. Heating Water Piping System.

**1.2 QUALITY ASSURANCE**

- A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.
- B. Welding Materials, Procedures, and Operators: Conform to ASME Section 9, ANSI/AWS D1.1, and applicable state labor regulations.

**1.3 REFERENCES**

- A. ANSI/AWS D1.1 - Structural Welding Code.
- B. ANSI/AWWA C104/A21.4 - Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water.
- C. ANSI/AWWA C110 - Ductile Iron and Gray Iron Fittings 3" through 48", for Water and Other Liquids.
- D. ANSI/AWWA C111/A21.11 - Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
- E. ANSI/AWWA C150/A21.50 - Thickness Design of Ductile Iron Pipe.
- F. ANSI/AWWA C151 - Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- G. ANSI/AWWA C153/A21.51 - Ductile Iron Compact Fittings, Centrifugally Cast for Water or Other Liquids.
- H. ASME - Boiler and Pressure Vessel Code.
- I. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
- J. ASME B16.3 - Malleable Iron Threaded Fittings Class 150 and 300.
- K. ASME B16.4 - Cast Iron Threaded Fittings, Class 125 and 250.
- L. ASME B16.5 - Pipe Flanges and Flanged Fittings.
- M. ASME B16.9 - Factory-Made Wrought Steel Butt Welding Fittings.
- N. ASME B16.12 - Cast Iron Threaded Drainage Fittings.
- O. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings
- P. ASME B16.21 - Nonmetallic Flat Gaskets for Pipes Flanges.
- Q. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- R. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings (DWV).
- S. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
- T. ASME B18.2.1 - Square and Hex Bolts and Screws, Inch Series.
- U. ASME B18.2.2 - Square and Hex Nuts, Inch Series.
- V. ASME B31.9 - Building Services Piping.
- W. ASME Section 9 - Welding and Brazing Qualifications.
- X. ASTM A126 - Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings.
- Y. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- Z. ASTM A181 - Forgings, Carbon Steel for General Purpose Piping.
- AA. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

- BB. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- CC. ASTM A733 - Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless-Steel Pipe Nipples.
- DD. ASTM B32 - Standard Specification for Solder Metal.
- EE. ASTM B88 - Seamless Copper Water Tube.
- FF. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube.
- GG. ASTM D1599 - Standard Test Method for Short-Time Hydraulic Failure Pressure of Plastic Tubing and Fittings.
- HH. ASTM D2105 - Standard Test Method for Longitudinal Tensile Properties of Fiberglass Pipe and tube.
- II. ASTM D2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate loading.
- JJ. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping.
- KK. ASTM D2992 – Standard Practice for Obtaining Hydrostatic Design Basis for Fiberglass pipe and fittings.
- LL. ASTM D2996 - Standard Specification for Filament Wound Fiberglass Pipe.
- MM. ASTM D4024 - Standard Reinforced Thermosetting Resin Flanges.
- NN. ASTM D5685 - Standard for Fiberglass Pressure Pipe Fittings.
- OO. ASTM E90-02 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions
- PP. ASTM E413-87 - Classification for Rating Sound Insulation
- QQ. ASTM F2389 – Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems.

#### 1.4 SUBMITTALS

- A. Submit product data under provisions of Section 23 05 00. Include data on pipe materials, fittings, valves, and accessories. Include manufacturers' support spacing requirements for plastic piping.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store and protect piping to prevent entrance of foreign matter into pipe and to prevent exterior corrosion.
- B. Deliver and store valves in shipping containers with labeling in place.

#### 1.6 COORDINATION DRAWINGS

- A. Reference Coordination Drawings article in Section 23 05 00 for required hydronic systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

### PART 2 - PRODUCTS

#### 2.1 HEATING WATER

- A. Design Pressure: 125 psig.  
Maximum Design Temperature: 225°F. (230°F for grooved couplings)
- B. Piping - 2" and Under:
  - 1. Pipe: Standard weight black steel, threaded and coupled, ASTM A53; Type E, F, or S; Grade B.



2. Joints: Screwed.
3. Fittings: Class 125 cast iron, ASTM A126, ASME B16.4; or Class 150 malleable iron, ASTM A197, ASME B16.3.
4. Unions: Class 150 malleable iron, ANSI B16.39, ground joint with copper or copper alloy-to-iron seat.

C. Shutoff Valves:

1. Ball Valves:

- a. BA-1: 3" and under, 125 psi saturated steam, 600 psi WOG, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and stem, Teflon seats and seals. Apollo #77C-140, Stockham #S-206 BR1-R, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB.

NOTES:

- 1) Provide extended shaft for all valves in insulated piping.
- 2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

D. Throttling Valves:

1. Ball Valves:

- a. BA-9: 2" and under, 125 psi saturated steam, 600 psi WOG, standard port, screwed (solder ends are acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body and ball of copper alloy containing less than 15% zinc, chrome plated or stainless-steel ball, Teflon seats and seals with memory stop. Apollo #70-120, Stockham #S-216BR-R, Milwaukee #BA-100, Watts #B-6000, Hammond #8501, Nibco #580-70.

NOTE: Provide extended shaft with operating handle of non-thermal conductive material and protective sleeve that allows operation of valve, adjustment of the packing, and adjustment of the memory stop without breaking the vapor seal or disturbing the insulation for all valves in insulated piping.

E. Check Valves:

1. CK-1: 2" and under, 125 psi S @ 353°F, 200 psi WOG @ 150°F, screwed, bronze, horizontal swing. Crane #37, Hammond #IB904, Stockham #B319, Walworth #406, Milwaukee #509, Watts #B-5000, or NIBCO #T-413.
2. CK-13: 2-1/2" thru 12", 200# WOG, double disc wafer type, iron body, bronze or aluminum-bronze discs, 316SS shaft and spring, Viton, EPDM or BUNA-N, Cv of at least 700 in 6" size. Mueller Steam Specialty Co. #71-AHB-6-H, Stockham #WG-961, NIBCO W-920-W, Crane, Victaulic #716/716H.

F. Strainers:

1. ST-1: Bronze body, screwed ends, screwed cover, 125 psi S @ 353°F, 200 psi WOG @ 150°F. Armstrong #F4SC, Metraflex #TS, Mueller Steam Specialty Co. #351, Sarco #BT, Watts #777, NIBCO T-122-A.
2. ST-2: Cast iron body, 125 lb. flanged ends, bolted cover, 125 psi S @ 353°F, 175 psi WOG @ 150°F. Armstrong #A1FL, Metraflex #TF, Mueller Steam Specialty Co. #758, Sarco #CI-125, Watts #77F-D, Victaulic #732 or #W732, NIBCO F-721-A.

2.2 HEATING WATER

A. Design Pressure: 125 psig.  
Maximum Design Temperature: 225°F.

B. Piping - All Sizes:

1. Tubing: Type L drawn temper seamless copper tube, ASTM B88.
2. Joints: Solder with Type 95-5 solder. 50-50 solder is not acceptable.
3. Fittings: Wrought copper solder joint, ASME B16.22.

C. Piping All Size (Contractor's Option):

1. Tubing: Type L hard drawn seamless copper tube, ASTM B88.
2. Joints: Mechanical press connection.
3. Fittings: Copper, ANSI B-16.22, with embedded EPDM O-ring, NSF-61.
4. Acceptable Manufacturers: Viega ProPress, Elkhart Xpress, NIBCO Press System Fittings and Valves, Mueller Streamline PRS.

D. Shutoff Valves:

1. Ball Valves:
  - a. BA-1: 3" and under, 125 psi saturated steam, 600 psi WOG, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and trim, Teflon seats and seals. Apollo #77C-140, Stockham #S-206 BR1-R, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB.

NOTES:

- 1) Provide extended shaft with operating handle of non-thermal conductive material and protective sleeve that allows operation of valve, adjustment of the packing, and adjustment of the memory stop without breaking the vapor seal or disturbing the insulation for all valves in insulated piping.
- 2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and

gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

E. Throttling Valves:

1. Ball Valves:

- a. BA-9: 2" and under, 125 psi saturated steam, 600 psi WOG, standard port, screwed (solder ends are acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body and ball of copper alloy containing less than 15% zinc, chrome plated or stainless-steel ball, Teflon seats and seals with memory stop. Apollo #70-120, Stockham #S-216BR-R, Milwaukee #BA-100, Watts #B-6000, Hammond #8501, Nibco #580-70.

NOTE: Provide solid extended shaft with operating handle of non-thermal conductive material and protective sleeve that allows operation of valve, adjustment of the packing, and adjustment of the memory stop without breaking the vapor seal or disturbing the insulation for all valves in insulated piping.

F. Check Valves:

1. CK-1: 2" and under, 125 psi S @ 406°F, 200 psi WOG @ 150°F, screwed, bronze, horizontal swing. Crane #37, Hammond #IB904, Stockham #B319, Walworth #406, Milwaukee #509, Watts #B-5000, NIBCO #T-413.
2. CK-4: 2" and under, 200 psi WOG @ 150°F, solder, bronze, horizontal swing. Crane #1342, Hammond #IB912, Stockham #B309, Walworth #406SJ, Milwaukee #1509, Watts #B-5001, NIBCO #S-413.

G. Strainers:

1. ST-1: Bronze body, screwed ends, screwed cover, 125 psi S @ 353°F, 200 psi WOG @ 150°F. Armstrong #F4SC, Metraflex #TS, Mueller Steam Specialty Co. #351, Sarco #BT, Watts #777, NIBCO T-122.

2.3 AUTOMATIC AIR VENTS

- A. Low capacity automatic air vent (for bladder tank anti-thermosyphon loops). Maximum operating pressure and temperature of at least 240°F and 125 psi, 1/2" or 3/4" inlet. B&G #87, Armstrong, Spirotherm, Taco, or Watts.
- B. High/low capacity automatic air vent (for air separator connection). Maximum operating pressure and temperature of at least 240°F and 125 psi, 3/4" inlet, 3/8" minimum outlet. B&G #107, Armstrong, Spirotherm, Taco, or Watts.

2.4 STRAINERS

- A. Unless otherwise indicated, strainers shall be Y-pattern and have stainless steel screens with perforations as follows:

Pipe Size	1/4" - 2"	2-1/2" - 8"	10" and Up
Air and Gases	1/32"	3/64"	1/16"
Water and Glycol/Water	1/32"	1/16"	1/8"

- B. Furnish pipe nipple with ball valve, threaded hose connection, and cap to blow down all strainer screens.
- C. Use bronze body strainers in copper piping and iron body strainers in ferrous piping.

## 2.5 BALANCING VALVE

- A. Rated for 125 psi working pressure and 250°F operating temperature, taps for determining flow with a portable meter, positive shutoff valves for each meter connection, memory feature, tight shutoff, and a permanent pressure drop between 1' and 2' water column at full flow with valve 100% open. Furnish with molded, removable insulation covers.
- B. Provide a nomograph to determine flow from meter reading (and valve position on units which sense pressure across a valve). Graph shall extend below the specified minimum flow.
- C. Furnish one meter kit equivalent to Bell & Gossett Model RO-5 meeting the following requirements:
  - 1. Carrying case with handle.
  - 2. Pressure gauge with 0-25 feet of head scale with 3.0% full scale accuracy.
  - 3. High and low side hoses with 5 feet length and 250 psig pressure rating, equipped with shutoff valves, vent valves, and probes for insertion into pressure and temperature plugs.
- D. Valves in copper piping shall be brass or bronze.
  - 1. Quarter-Turn Ball Valve Style:
    - a. Bell & Gossett "Circuit Setter Plus",
  - 2. Quarter-Turn Venturi Style:
    - a. Presso "B+"
    - b. Griswold "Quickset"
    - c. Gerand "BALVALVE Venturi"
    - d. HCI "Terminator B"
    - e. Nexus Valve "UltraXB Orturi"
    - f. MI Hydronic Engineering "Accusetter"
- E. Valves in ferrous piping 2" or smaller shall have threaded ends and steel, brass or bronze construction. Option to balancing valves noted above are flow sensors specified in Section 23 09 00 with a specified throttling valve.
  - 1. Quarter-Turn Ball Valve Style:
    - a. Bell & Gossett "Circuit Setter Plus"
  - 2. Quarter-Turn Venturi Style:
    - a. Presso "B+"
    - b. Gerand "BALVALVE Venturi"
    - c. HCI "Terminator B"

- d. Nexus Valve "UltraXB Orturi"
    - e. IMI Hydronic Engineering "Accusetter"
  - F. Balancing valves in ferrous piping over 2" size shall have flanged or grooved ends and steel or cast-iron construction. Option to balancing valves noted above are flow sensor specified in Section 23 09 00 with a specified throttling valve
    - 1. Quarter-Turn Ball Valve Style:
      - a. B&G "Circuit Setter"
    - 2. Quarter-Turn Venturi Style:
      - a. Presso "B+",
      - b. Taco "Accu-flo",
      - c. HCI "Terminator G"
      - d. Nexus Valve "Nextrol NXFB",
      - e. IMI Hydronic Engineering "Accusetter",
  - G. Balancing valves in ferrous piping over 2" size shall consist of flow sensors as specified in Section 23 09 00 combined with specified throttling valves.
  - H. Manufacturer shall size balancing valves for the scheduled flow rate. Flow rate shall be measurable on manufacturer's standard meters.
- 2.6 AUTOMATIC FLOW CONTROL VALVES (AUTOMATIC BALANCING VALVES)
- A. The GPM for the automatic flow control valves shall be factory set and shall automatically limit the rate of flow to within  $\pm 10\%$  of the specified GPM over at least 95 percent of the control range.
  - B. Pump Head Requirements:
    - 1. The permanent pressure loss added to the pump head shall not exceed 7 feet.
  - C. Each valve shall have two P/T ports.
  - D. Five-year product warranty and first year cartridge exchange, up to 10 percent.
  - E. The internal wear surfaces of the valve cartridge shall be stainless steel or polyphenylsulfone orifice with an elastomeric diaphragm.
  - F. The internal flow cartridge shall be permanently marked with the GPM and spring range.
  - G. Valve body shall be brass on all valves 2" and under and ductile iron on all valves 2-1/2" and larger.
  - H. All valves shall be factory leak tested at 100 psi air under water.
  - I. A differential pressure test kit shall be supplied to verify flow and measure over-heading. The kit shall consist of a 4-1/2" diaphragm gauge equipped with 10 foot hoses and P/T adapters all housed in a vinyl case. Calibration shall be 0-35 PSID for 2-32 PSI spring range or 0-65 PSID for 5-60 PSI range.
  - J. Acceptable Manufacturers: Griswold, Autoflow, Versa Flow, Nexus, B&G, Victaulic, Hays Fluid Controls.

- K. Complete integral piping package, which integrate shutoff valves, automatic flow control valves, vents, strainers and drains, are acceptable.

## 2.7 DRAIN VALVES AND BLOWDOWN VALVES

- A. Drain valve and blowdown valve shall mean a shutoff valve as specified for the intended service with added 3/4" male hose thread outlet, cap, and retaining chain.

## 2.8 CONNECTIONS BETWEEN DISSIMILAR METALS

- A. Connections between dissimilar metals shall be insulating dielectric types that provide a water gap between the connected metals, and that either allow no metal path for electron transfer or that provide a wide water gap lined with a non-conductive material to impede electron transfer through the water path.
- B. Joints shall be rated for the temperature, pressure, and other characteristics of the service in which they are used, including testing procedure.
- C. Aluminum, iron, steel, brass, copper, bronze, and stainless steel are commonly used and require isolation from each other with the following exceptions:
  - 1. Iron, steel, and stainless steel connected to each other.
  - 2. Brass, copper, and bronze connected to each other.
  - 3. Brass or bronze valves and specialties connected in closed systems with steel, iron, or stainless steel on both sides of the brass or bronze valves and specialties. Where two or more brass or bronze items occur together, they shall be connected with brass nipples. Brass or bronze valves and specialties cannot be used as a dielectric separation between pipe materials.
- D. Dielectric protection is required at connections to equipment of a material different than the piping.
- E. Screwed Joints (acceptable up to 2" size):
  - 1. Dielectric waterway rated for 300 psi CWP and 225°F.
  - 2. Acceptable Manufacturers: Elster Group ClearFlow fittings, Victaulic Series 647, Grinnell Series 407, Matco-Norca.
- F. Flanged Joints (any size):
  - 1. Use 1/8" minimum thickness, non-conductive, full-face gaskets.
  - 2. Employ one-piece molded sleeve-washer combinations to break the electrical path through the bolts.
  - 3. Sleeve-washers are required on one side only, with sleeves minimum 1/32" thick and washers minimum 1/8" thick.
  - 4. Install steel washers on both sides of flanges to prevent damage to the sleeve-washer.
  - 5. Separate sleeves and washers may be used only if the sleeves are manufactured to exact lengths and installed carefully so the sleeves must extend partially past each steel washer when tightened.

6. Acceptable Manufacturers: EPCO, Central Plastics, Pipeline Seal and Insulator, F. H. Maloney, or Calpico.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Ream pipe and tube ends, remove burrs, bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Connect to all equipment with flanges or unions.
- D. After completion, fill, clean, and treat systems. Refer to Section 23 25 00 for treatment.

#### 3.2 TESTING PIPING

- A. Heating Water:
  1. Test pipes underground or in chases and walls before piping is concealed.
  2. Complete testing before insulation is applied. If insulation is applied before pipe is tested and a leak ruins the insulation, replace all damaged insulation.
  3. Test the pipe with water at 100 psig pressureHold pressure for at least two hours.
  4. Test to be witnessed by the Architect/Engineer or their representative, if requested by the Architect/Engineer.

#### 3.3 INSTALLATION

- A. General Installation Requirements:
  1. Route piping in orderly manner, straight, plumb, with consistent pitch, parallel to building structure, with minimum use of offsets and couplings. Provide only offsets required for needed headroom or clearance and needed flexibility in pipe system.
  2. Install piping to conserve building space, and not interfere with other work.
  3. Group piping whenever practical at common elevations.
  4. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
  5. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it. Where pipe sizes are not shown, the larger size in either direction shall continue through the fitting nearest to the indication of a smaller pipe size.
  6. Install bell and spigot pipe with bells upstream.
  7. Seal pipes passing through exterior walls with a wall seal per Section 23 05 29. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe.

8. Branch takeoffs shall be from the top side (if branch is two sizes smaller than main), or any angle from the horizontal plane to the top of piping.

B. Installation Requirements in Electrical Rooms:

1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment plus its required clearance space.

C. Valves/Fittings and Accessories:

1. Provide chain operators for all valves over 2" size that are over 10'-0" above finished floor. Extend to 7'-0" above finished floor.
2. Provide valve position indicator on all valves 10'-0" or greater above finish floor and not located above ceiling.
3. Provide clearance for installation of insulation, and access to valves and fittings.
4. Provide access doors where valves are not exposed.
5. Where a manual balance valve is shown to be installed in series with a service (isolation) valve, separate balance and service (isolation) valves shall be installed.
6. Install balancing valves with the manufacturer's recommended straight upstream and downstream diameters of pipe.
7. Prepare pipe, fittings, supports, and accessories for finish painting.
8. Install valves with stems upright or horizontal, not inverted, except install manual quarter turn valves in radiation cabinets and all butterfly valves with stems horizontal.
9. Provide shutoff valves and flanges or unions at all connections to equipment, traps, and items that require servicing.
10. Provide flanges or unions at all final connections to equipment, traps and valves.
11. Arrange piping and piping connections so equipment may be serviced or totally removed without disturbing piping beyond final connections and associated shutoff valves.

3.4 PIPE ERECTION AND LAYING

- A. Carefully inspect all pipe, fittings, valves, equipment and accessories prior to installation. Immediately reject and remove from the job any items which are unsuitable, cracked or otherwise defective.
- B. All pipe, fittings, valves, equipment and accessories shall have factory-applied markings, stampings, or nameplates sufficient to determine their conformance with specified requirements.
- C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not erect or install any unclean item.



- D. During construction, until system is fully operational, keep all openings in piping and equipment closed at all times except when actual work is being performed on that item. Closures shall be plugs, caps, blind flanges or other items designed for this purpose.
- E. Change direction of pipes only with fittings or pipe bends. Change size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. **2-1/2" and larger fittings shall be long radius type**, unless otherwise shown on the drawings or specified. Construct welded elbows of angles not available as standard fittings by cutting and welding standard elbows to form smooth, long radius fittings.
- F. Use full and double lengths of pipe wherever possible.
- G. Unless otherwise indicated, install all inlet and outlet piping, including shutoff valves and strainers, to coils, pumps and other equipment at line size with reduction in size being made only at control valve or pump.
- H. Cut all pipe to exact measurement and install without springing or forcing except in the case of expansion loops where cold springing is indicated on the drawings.
- I. Do not create, even temporarily, undue loads, forces or strains on valves, equipment or building elements.

### 3.5 DRAINING AND VENTING

- A. Unless otherwise indicated on the drawings, all horizontal pipes, including branches, shall pitch 1" in 40 feet to low points for complete drainage, removal of condensate, and venting.
- B. Provide drain valves at all low points of water piping systems or where indicated on drawings for complete or sectionalized draining. Drain valves are defined above.
- C. Use eccentric reducing fittings on horizontal runs when changing size for proper drainage and venting. Install all liquid lines with top of pipe and eccentric reducers in a continuous line.
- D. Provide air vents at all high points and wherever else required for elimination of air in all water piping systems. Do not use automatic air vents in glycol systems unless they are piped to the fill tank.
- E. Air vents shall be in accessible locations. If needed to trap and vent air in a remote location, a 1/8" pipe shall connect the tapping location to a venting device in an accessible location.
- F. All vent and drain piping shall be of same materials and construction as the service involved.

### 3.6 BRANCH CONNECTIONS

- A. Make branch connections with standard tee or cross fittings of the type required for the service unless otherwise specified herein or detailed on the drawings.
- B. At the option of the Contractor, branch connections from headers and mains may be cut into black steel pipe using forged weld-on fittings.
- C. Use of forged weld-on fittings is also limited as follows:
  - 1. Must have at least same pressure rating as the main.
  - 2. Header or main must be 2-1/2" or over.
  - 3. Branch line is at least two pipe sizes under header or main size.

### 3.7 JOINING OF PIPE

#### A. Threaded Joints:

1. Ream pipe ends and remove all burrs and chips.
2. Protect plated pipe and valve bodies from wrench marks when making up joints.
3. Apply Teflon tape to male threads.

#### B. Flanged Joints:

1. Bronze flanges shall conform to B16.24 and ductile iron flanges to B16.42. Steel flanges shall be raised face except when bolted to flat face cast iron flange.
2. Bolting shall be ASTM A307 Grade B with bolts and heavy hexagonal nuts conforming to ASME B18.2.1 and B18.2.2.
3. Torque bolts in at least three passes, tightening to 1/3, 2/3, and final torque in a cross pattern with an indicating torque wrench for equal tension in all bolts.
4. Gaskets for flat face flanges shall be full-face type. Gaskets for raised faced flanges shall conform to requirements for "Group I gaskets" in ASME B16.5. All gaskets shall conform to ASME B16.21. Unless otherwise specified, gaskets shall meet the following requirements:
  - a. Gasket material and thickness approved by manufacturer for intended service, chemical compatibility, pipe system test pressure, and operating temperature range.
  - b. Maximum pressure rating of at least 250 psig.
  - c. Minimum temperature rating: -10°F.
  - d. Maximum temperature rating of at least 250°F for water systems operating above 140°F and up to 180°F.

#### C. Solder Joints:

1. Make up joints with 95% tin and 5% antimony (95-5) solder conforming to ASTM B32 Grade 95TA. Cut copper tubing ends perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt and grease just prior to soldering. Apply flux evenly, but sparingly, to all surfaces to be joined. Heat joints uniformly to proper soldering temperature so solder flows to all mated surfaces. Wipe excess solder, leaving a uniform fillet around cup of fitting.
2. Flux shall be non-acid type conforming to ASTM B813.
3. Solder end valves may be installed directly in the piping system if the entire valve is suitable for use with 470°F melting point solder. Remove composition discs and all seals during soldering if not suitable for 470°F.

#### D. Welded Joints:

1. Welding of all pipe joints, both as to procedures and qualification of welders, shall be in accordance with Section IX, ASME "Boiler & Pressure Vessel Code" unless local codes take precedence.

2. Furnish certificates qualifying each welder to the Owner's Representative prior to start of work.
3. The Owner's Representative reserves the right to require qualifying demonstration, at the Contractor's expense, of any welders assigned to the job.
4. Ends of pipe and fittings to be joined by butt-welding shall be beveled, cleaned to bare metal and internal diameters aligned before tack welding.

E. Mechanical Joints:

1. Joints shall conform to ANSI/AWWA C104/A21.11. Gasket material shall be neoprene. The standard bolts and nuts of the pipe manufacturer shall be used and be coated at the factory with rust preventive lubricant after threading and tapping.
2. Final tightening of bolts shall be with a torque wrench for equal tension in all bolts.
3. All fittings shall be provided by one manufacturer. Mixing fittings will not be acceptable.

END OF SECTION

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**SECTION 23 31 00  
DUCTWORK**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Galvanized Ductwork
- B. Ductwork Reinforcement
- C. Ductwork Sealants
- D. Rectangular Ductwork
- E. Round Ductwork
- F. Exposed Ductwork (Rectangular, Round, or Oval)
- G. Flexible Duct
- H. Acoustical Lagging
- I. Ductwork Penetrations
- J. Duct Cleaning

**1.2 REFERENCES:** Conform to all applicable requirements of the following publications:

- A. ADC Flexible Duct Performance and Installation Standards, 3<sup>rd</sup> Edition 1996.
- B. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- C. ASHRAE - Handbook 2012 Systems and Equipment; Chapter 19 - Duct Construction.
- D. ASHRAE - Handbook 2013 Fundamentals; Chapter 21 - Duct Design.
- E. ASHRAE 170 (latest published edition) - Ventilation of Health Care Facilities.
- F. ASTM A90 - Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
- G. ASTM A167- Stainless & Heat-Resisting Chromium-Nickel Steel Plate, Sheet, & Strip.
- H. ASTM A653 - Steel Sheet, Zinc-Coated (Galvanized) or zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- I. ASTM A924 - Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- J. ASTM B209 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- K. ASTM E90-02 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
- L. ASTM E413-87 - Classification for Rating Sound Insulation.
- M. AWS D9.1M/D9.1 - Sheet Metal Welding Code.
- N. NFPA 90A - Installation of Air-Conditioning and Ventilating Systems.
- O. NFPA 90B - Installation of Warm Air Heating and Air- Conditioning Systems.
- P. NFPA 96 - Ventilation Control and Fire Protection of Commercial Cooking Equipment.
- Q. SMACNA - HVAC Duct Construction Standards - 2005 Edition.
- R. UL 181 - Factory-Made Air Ducts and Air Connectors.
- S. UL 181A - Closure Systems for Use with Rigid Air Ducts and Air Connectors
- T. UL 181B - Closure Systems for Use with Flexible Air Ducts and Air Connectors.

**1.3 DEFINITIONS**

- A. Duct Sizes shown on drawings are inside clear dimensions. Maintain clear dimensions inside any lining.
- B. Transitions are generally not shown in single-line ductwork. Where sizes change at a divided flow fitting, the larger size shall continue through the fitting.

#### 1.4 COORDINATION DRAWINGS

- A. Reference Coordination Drawings article in Section 23 05 00 for required duct systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.
- B. Duct drawings shall be at 1/4"1:50 minimum scale complete with the following information:
  - 1. Actual duct routing, ductwork fittings, actual sheet metal dimensions including insulation liner and wrap, duct hanger and support types, ductwork accessories, etc. with lengths and weights noted.
  - 2. Differentiate ducts that are lined or wrapped. Include insulation thickness, type of insulation, and acoustical lagging.
  - 3. Location and size of all duct access doors.
  - 4. Room names and numbers, ceiling types, and ceiling heights.
  - 5. Indicate location of all beams, bar joists, etc. along with bottom of steel elevations for each member.
- C. IMEG will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings. Architectural plans will need to be obtained from the Architect

#### PART 2 - PRODUCTS

##### 2.1 GALVANIZED DUCTWORK

- A. General Requirements:
  - 1. Duct and reinforcement materials shall conform to ASTM A653 and A924.
  - 2. Interior Ductwork and reinforcements: G60Z180 galvanized (0.60 ounces per square foot180 g/m<sup>2</sup> total zinc coating for two sides per ASTM A90) unless noted otherwise.
  - 3. Exterior Ductwork: G90Z275 galvanized (0.90 ounces per square foot275 g/m<sup>2</sup> total zinc coating for two sides per ASTM A90) unless noted otherwise. G60 is not acceptable for exterior use.
  - 4. Ductwork reinforcement shall be of galvanized steel.
  - 5. Ductwork supports shall be of galvanized or painted steel.
  - 6. Slip cable hangers are acceptable. Protective sleeve tubing shall be used on the cable when supporting duct with exterior insulation. Corner saddles are required when supporting

rectangular ductwork. Acceptable manufacturers are Gripple, Ductmate, Duro Dyne, or Architect/Engineer approved. All fasteners shall be galvanized or cadmium plated.

## 2.2 DUCTWORK REINFORCEMENT

### A. General Requirements:

1. All reinforcement shall be external to the duct except that tie rods may be used with the following limitations.
  - a. Ducts must be over 18" x 450 mm wide.
  - b. Duct dimensions must be increased 2" x 50 mm in one dimension (h or w) for each row of tie rods installed.
  - c. Tie rods must not exceed 1/2" x 15 mm diameter.
  - d. Manufacturer of tie rod system must certify pressure classifications of various arrangements, and this must be in the shop drawings.

## 2.3 DUCTWORK SEALANTS

- A. One-part joint sealers shall be water-based mastic systems that meet the following requirements: maximum 48-hour cure time, service temperature of -20°F-29°C to +175°F80°C, resistant to mold, mildew and water, flame spread rating below 25 and smoke-developed rating below 50 when tested in accordance with ASTM E84, suitable for all SMACNA seal classes and pressure classes. Mastic used to seal flexible ductwork shall be marked UL 181B-M. Joint sealers for use on exterior weather exposed ductwork shall be rated for -30°F-34°C to +175°F80°C and 2000-hour minimum UV resistance per ASTM G-53.
- B. Where pressure sensitive tape is called for on drawings and specifications for sealing flexible ductwork, tape shall be minimum 2.5-inch x 65 mm wide, UL 181 B-FX listed, and marked tape having minimum 60 oz/inch x 67 kg/m peel adhesion to steel and service temperature range from -20°F-29°C to +250°F121°C. Acceptable manufacturers include: Venture Tape 1581A, Compac #340, Scotch Foil Tape 3326, Polyken 339.

## 2.4 RECTANGULAR DUCT - SINGLE WALL

### A. General Requirements:

1. All ductwork gauges and reinforcements shall be as listed in SMACNA Duct Construction Standards Chapter 2. Where necessary to fit in confined spaces, furnish heaviest duct gauge and least space consuming reinforcement.
2. Transitions shall not exceed the angles in Figure 4-7.

### B. Exceptions and modifications to the 2005 HVAC Duct Construction Standards are:

1. All ducts shall be cross-broken or beaded.
2. Snap lock seams are not permitted.
3. Turning vanes shall be used in all 90° mitered elbows, unless clearly noted otherwise on the drawings. Vanes shall be as follows:

- a. Type 1:
    - 1) **Description:** Single wall type with 22-gauge (0.029") (0.76 mm) or heavier vanes, 3-1/4"80 mm blade spacing, and 4"100 mm to 4-1/2"115 mm radius. Vanes hemmed if recommended by runner manufacturer. Runners shall have extra-long locking tabs. C-value independently tested at below 0.26. EZ Rail II by Sheet Metal Connectors or equal.
    - 2) **Usage:** Limited to 3,000 fpm15 m/s and vane lengths 36"900 mm and under.
  - b. Type 2:
    - 1) **Description:** Double wall type with 3-1/4"80 mm blade spacing, 4-1/2"115 mm radius, 24-gauge (0.61 mm) minimum, and SMACNA Type 1 runners. C-value below 0.27.
    - 2) **Usage:** No limits other than imposed by the manufacturer. Provide intermediate support for vanes over 48"1200 mm long.
  - c. Type 3 (acoustical - where acoustical lagging is located or as noted on drawings):
    - 1) **Description:** Same as Type 2, except filled with fiberglass and with slotted or perforated inner curve. Minimum insertion loss of 9 dB at 250 Hz and 6 dB at 1 KHz.
    - 2) **Usage:** No limits other than imposed by the manufacturer. Provide intermediate support for vanes over 48"1200 mm long.
  - d. Turning vanes shall operate quietly. Repair or replace vanes that rattle or flutter.
  - e. Runners must be installed at a 45° angle. Elbows with different size inlet and outlet must be radius type.
  - f. Omitting every other vane is prohibited.
- 4. Where smooth radius rectangular elbows are shown, they shall be constructed per SMACNA Figure 4-2. Type RE1 shall be constructed with a centerline duct radius R/W of 1.0. Where shown on drawings, Type RE3 elbows with 3 vanes shall be used with centerline duct radius R/W of 0.6 (SMACNA r/W=0.1). RE1 or RE3 elbows may be used where mitered elbows are shown if space permits. **Mitered elbows (with or without turning vanes) may not be substituted for radius elbows.** Do not make branch takeoffs within 4 duct diameters on the side of the duct downstream from the inside radius of radius elbows.
  - 5. Rectangular branch and tee connections in ducts over 1"0.25 kPa pressure class shall be 45° entry type per Figs. 4-5 and 4-6. Rectangular straight taps are not acceptable above 1"0.25 kPa pressure class.
  - 6. Bellmouth fittings shown on return duct inlets shall expand at a 60-degree total angle horizontally and vertically (space permitting) and have length of at least 25% of the smallest duct dimension.
  - 7. Round taps off rectangular unlined ducts shall be flanged conical or bellmouth type (equal to Buckley Bellmouth or Sheet Metal Connectors E-Z Tap), or 45° rectangular with transition to round (equal to Sheet Metal Connectors Inc. High Efficiency Takeoff).



Straight taps are acceptable if pressure class is 1"0.25 kPa or less, round duct is 12"300 mm diameter or less, and the tap is not located between fans and TAB devices.

8. Duct offsets shall be constructed as shown on drawings. Additional offsets required in the field shall be formed of mitered elbows without turning vanes for offsets up to 30° maximum angle in accordance with SMACNA offset Type 2. Offsets of greater than 30° angle shall be formed of radius elbows with centerline radius R/W=1.0 or greater. SMACNA Type 1 offsets are not permitted.
9. All lined duct shall utilize dovetail joints where round or conical taps occur. The dovetail joints shall extend past the liner before being folded over.
10. Cushion heads are acceptable only downstream of TAB devices in ducts up to  $\pm 2" \pm 0.5$  kPa pressure class and must be less than 6"150 mm in length.
11. Slide-on flanged transverse joint systems are acceptable provided they are a manufactured product that has been tested for conformance with Chapter 2 of the SMACNA HVAC Duct Construction Standards for sheet and joint deflection at the specified pressure class.
  - a. Apply sealant to all inside corners. Holes at corners are not acceptable.
  - b. Acceptable Manufacturers: Ductmate Industries - 25/35/45, Nexus, Mez, or WDCI. Other manufacturers must submit test data and fabrication standards and receive Architect/Engineer's approval before any fabrication begins.
12. Formed-on flanged transverse joint systems are acceptable provided they are a manufactured product that has been tested for conformance with Chapter 2 of the SMACNA HVAC Duct Construction Standards for sheet and joint deflection at the specified pressure class.
  - a. Apply sealant to all inside corners. Holes at corners are not acceptable.
  - b. Flanges shall be 24-gauge (0.61 mm) minimum (not 26 gauge (0.45 mm)).
  - c. Acceptable Manufacturers: Lockformer TDC, TDF, United McGill, or Sheet Metal Connectors. Other manufacturers must submit test data and fabrication standards and receive Architect/Engineer's approval before any fabrication begins.

## 2.5 EXPOSED DUCTWORK (RECTANGULAR)

- A. The following applies to all ductwork exposed in finished areas in addition to requirements noted above:
  1. Provide extra shipping protection. Use Cardboard or other protective means to prevent dents and deformed ends.
  2. Provide cardboard or other means of protection during field fabrication. Protect from scratches. Provide stiffeners to retain shape during fabrication.
  3. Remove all identification stickers and thoroughly clean exterior of all ducts.
  4. Locate fitting seams on least visible side of duct.
  5. Provide exterior finish suitable for field painting without further oil removal.

6. Provide ramp-type internal joint couplings. Provide bead of sealant around the inside of the duct about 1/2"12 mm from the end of the duct. Slide-on flanges as manufactured by Ductmate Industries, Accuflange or Sheet Metal Connectors are acceptable. Self-sealing duct system is also acceptable (Lindab, Ward "Keating Koupling").
  7. The system shall be free of visible dents and scratches when viewed from normal occupancy.
- B. In addition to the paragraphs above, this section applies to all ductwork specified or shown as "Architecturally Exposed":
1. All spiral ductwork fittings shall be carbon arc welded.
  2. Grind all welds to remove irregularities.
  3. Conical taps shall be one piece. Taps for grilles and takeoffs shall be factory installed with a continuous weld and ground smooth.
  4. Welds shall be ground smooth and painted.
  5. All architecturally exposed ducts shall be round or flat oval except where not possible (grilles, reheat coils, etc.).
- C. Alternate manufacturers, including shop fabricated duct, must be reviewed before installation. The following information is required:
1. Metal gauge of duct and fittings.
  2. Fitting type and construction.
  3. Type and size of reinforcement.

## 2.6 FLEXIBLE DUCT

- A. Flexible duct shall be listed and labeled as UL 181 Class 1 Air Duct Material, and shall comply with NFPA 90A and 90B, and meet GSA, FHA and other U.S. Government agency standards. Flexible duct shall bear the ADC Seal of Certification.
- B. Flame Spread/Smoke Developed: Not over 25/50.
- C. Flexible duct shall have corrosion-resistant wire helix, bonded to an inner liner that prevents air from contacting the insulation, covered with minimum 1-1/2"40 mm thick, 3/4 lb/cf12 kg/m<sup>3</sup> density fiberglass insulation blanket, sheathed in a vapor barrier of metalized polyester film laminated to glass mesh.
- D. Inner liner shall be airtight and suitable for 6" WC1.5 kPa static pressure through 16"400 mm diameter through 10"250 mm diameter and shall be airtight and suitable for 4" WC1.0 kPa static pressure 12"300 mm through 16"400 mm diameter. Outer jacket shall act as a vapor barrier only with permeance not over 0.1 perm per ASTM E96, Procedure A." R" value shall not be less than 4.0 ft<sup>2</sup>\*°F\*hr/Btuh0.70 °K \*m<sup>2</sup>/ W. Temperature range of at least 0-180°F-18 to 82°C. Maximum velocity of 4,000 fpm20 m/s.
- E. Usage:
1. Take-offs from supply ducts to inlets of terminal air boxes. Do not exceed 36"900 mm in length.
  2. Connections to air inlets and outlets. Do not exceed 6'-0"1800 mm in length.

- F. Stretch all flexible duct to prevent sags and reduce air friction. Shorten and reinstall all sagging or loose flexible duct. Avoid sharp elbows. Elbows shall maintain 1.5 diameter centerline turning radius.
- G. Install per the SMACNA Flexible Duct Manual. Secure inner layer with draw band. Wrap with pressure sensitive tape for protection prior to installing draw band. Pressure sensitive tape alone is not acceptable.

## 2.7 ACOUSTICAL LAGGING

- A. Type A: Lagging shall be a loaded vinyl noise barrier, fiberglass scrim facing, and 1"25 mm thick quilted fiberglass decoupling layer. Lagging shall have a minimum STC of 28, and Class A flammability (maximum 25/50) rating per ASTM E-84. Install lagging per manufacturer's recommendations.
  - 1. Acceptable Products: Sound Seal B-10 Lag/QFA-3, McGill Air Pressure PDL-3, Kinetics KNM 100ALQ-1.
- B. Type B: Lagging shall be a loaded vinyl noise barrier, fiberglass scrim facing, and 2"50 mm thick quilted fiberglass decoupling layer. Lagging shall have a minimum STC of 30, and Class A flammability (maximum 25/50) rating per ASTM E-84. Install lagging per manufacturer's recommendations.
  - 1. Acceptable Products: Sound Seal B-10 Lag/QFA-9, McGill Air Pressure PDL-9.
- C. Refer to drawings for acoustical lagging locations.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Provide openings in ducts for thermometers and controllers.
- B. Locate ducts with space around equipment for normal operation and maintenance.
- C. Do not install ducts or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet7.6 m from the floor to the structural ceiling with width and depth equal to the electrical equipment. Unless intended to serve these rooms, do not install any ductwork or equipment in electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms.
- D. During construction provide temporary closures of metal or taped polyethylene on open ducts to prevent dust from entering ductwork.
- E. Repair all duct insulation and liner tears.
- F. Install manual volume dampers in branch supply ducts so all outlets can be adjusted. Do not install dampers at air terminal device or in outlets, unless specifically shown.
- G. Insulate terminal air box reheat coils. Seal insulation tight to form a tight vapor barrier.
- H. Install flexible duct in accordance with the ADC Flexible Duct Performance and Installation Standards.

- I. Flexible duct shall NOT be joined to flat-oval connections. Provide sheet metal oval-to-round transitions where required, to include, but not limited to, all connections to air inlets, air outlets, and terminal air boxes.
- J. Install all exterior ductwork per SMACNA Fig. 6-3. Where drawings do not indicate otherwise, ductwork seams and joints shall be sealed watertight and pitched to shed water.
- K. Support all duct systems in accordance with the SMACNA HVAC Duct Construction Standards: Metal and Flexible and the SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems, where applicable. Refer to Section 23 05 50 for seismic requirements.
- L. Adhesives, sealants, tapes, vapor retarders, films, and other supplementary materials added to ducts, plenums, housing panels, silencers, etc. shall have flame spread/smoke developed ratings of under 25/50 per ASTM E84, NFPA 255, or UL 723.
- M. All duct support shall extend directly to building structure. Do not support ductwork from pipe hangers. Do not allow lighting or ceiling supports to be hung from ductwork or ductwork supports.
- N. Kitchen Grease and Dishwasher Ductwork:
  - 1. All kitchen grease and dishwasher ductwork shall be installed with a continuous slope and grease tight welds on all seams and joints.

### 3.2 DUCTWORK APPLICATION SCHEDULE

USAGE	MATERIAL	PRESSURE CLASS	SEAL CLASS†	INSULATION (Refer to Section 23 07 13 for insulation types) ±
Supply Duct from Fan to Terminal Air Boxes – Single Wall	Galvanized Sheet Metal - Rectangular	+3"+0.75 kPa	A	1-1/2"40 mm thick Type A (R=4.5) or 1"25 mm thick Type C (R=3.6)
Supply Duct from Fan to Terminal Air Boxes – Single Wall	Galvanized Sheet Metal - Round	+3"+0.75 kPa	A	1-1/2"40 mm thick Type A (R=4.5) or 1"25 mm Type G (R=4.3)
Supply Duct from Terminal Air Boxes to Outlets	Galvanized Sheet Metal - Rectangular	+2"+0.5 kPa	A	1-1/2"40 mm thick Type A (R=4.5) or 1"25 mm thick Type C (R=3.6)
Supply Duct from Terminal Air Boxes to Outlets	Galvanized Sheet Metal - Round	+2"+0.5 kPa	A	1-1/2"40 mm thick Type A (R=4.5) or 1"25 mm thick Type G (R=3.6)
Constant Volume from Fan to Outlet	Galvanized Sheet Metal - Rectangular	+2"+0.5 kPa	A	1-1/2"40 mm thick Type A (R=4.5) or 1"25 mm thick Type C (R=3.6)
Constant Volume from Fan to Outlet	Galvanized Sheet Metal - Round	+2"+0.5 kPa	A	1-1/2"40 mm thick Type A (R=4.5) or 1"25 mm thick Type G(R=4.3)
Return Duct	Galvanized Sheet Metal	-2"-0.5 kPa	A	
General Exhaust Duct	Galvanized Sheet Metal	-1"-0.25 kPa	A	None or 1"25 mm thick Type C (R=3.6)
Combustion Air Duct	Galvanized Sheet Metal	-1"-0.25 kPa	A	1 1/2"40 mm thick Type B (R=6.0)

USAGE	MATERIAL	PRESSURE CLASS	SEAL CLASS†	INSULATION (Refer to Section 23 07 13 for insulation types) ±
AHU Exhaust Air Duct	Galvanized Sheet Metal	+2"+0.5 kPa	A	1"25 mm thick Type C (R=3.6)
Relief/Exhaust Air Duct from fan to Exhaust Outlet	Galvanized Sheet Metal	+2"+0.5 kPa	A	1-1/2"40 mm thick Type A (R=4.5) or 1"25 mm thick Type C (R=3.6)
Outside Air Intake from Louver to Coil	Galvanized Sheet Metal	-2"-0.5 kPa	A	1 1/2"40 mm thick Type B (R=6.0)
Ductwork Accessories (Fabric Flex Connectors, Equipment Flanges, etc.)	---	---	---	1-1/2"40 mm thick Type A (R=4.5)
All Terminal Air Box/ Reheat Coil Headers and Duct Mounted Coil Headers	--	--	(Note 2)	1-1/2"40 mm thick Type A (R=4.5)
† Seal Class is per SMACNA HVAC Air Duct Leakage Test Manual ± Type A insulation (Flexible Fiberglass Wrap) R-values noted are based on installed values (25% compression). Note 1: Apply aluminum based adhesive sealant tape at non-flanged joints on ducts serving dedicated outside air supply (DOAS) and exhaust system in addition to Class A sealant.				

### 3.3 DUCTWORK SEALING

#### A. General Requirements:

1. Openings, such as rotating shafts, shall be sealed with bushings or similar.
2. Pressure sensitive tape shall not be used as the primary sealant unless it has been certified to comply with UL-181A or UL-181B by an independent testing laboratory and the tape is used in accordance with that certification.
3. All connections shall be sealed including, but not limited to, taps, other branch connections, access doors, access panels, and duct connections to equipment. Sealing that would void product listings is not required. Spiral lock seams need not be sealed.
4. Mastic-based duct sealants shall be applied to joints and seams in minimum 3 inch80 mm wide by 20 mil500 µm thick bands using brush, putty knife, trowel, or spray, unless manufacturer's data sheet specifies other application methods or requirements.

- B. For Seal Class A ducts, all transverse joints, longitudinal seams, and duct wall penetrations shall be sealed. Joints are inclusive of, but not limited to, girth joints, branch and sub-branch intersections, duct collar tap-ins, fitting subsections, louver and air terminal connections to ducts, access door and access panel frames and jambs, duct, plenum, and casing abutments to building structures.

### 3.4 DUCTWORK PENETRATIONS

- A. All duct penetrations of firewalls shall have fire or fire/smoke dampers where required by code.
- B. Dampers shall be compatible with fire rating of wall assembly. Verify actual rating of any wall being penetrated with Architect/Engineer.

- C. Seal all duct penetrations of walls that are not fire rated by caulking or packing with fiberglass. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms.

### 3.5 ACOUSTICAL LAGGING

- A. Where indicated on drawings, completely wrap ductwork with lagging and seal all joints airtight with tape recommended by the lagging manufacturer to prevent acoustical leakage at joints. Overlap lagging 2"50 mm at any wall, floor, or structural deck penetration to prevent acoustical leakage.

END OF SECTION

**SECTION 23 33 00**  
**DUCTWORK ACCESSORIES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Manual Volume Dampers.
- B. Duct Access Doors.

**1.2 REFERENCES**

- A. ASTM E477-06a - Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.
- B. ASTM E2336-04 – Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems.
- C. NFPA 90A - Installation of Air-Conditioning and Ventilating Systems.
- D. SMACNA - HVAC Duct Construction Standards – Third Edition - 2005.

**1.3 SUBMITTALS**

- A. Submit shop drawings under provisions of Section 23 05 00.
- B. Submit manufacturer's installation instructions.

**PART 2 - PRODUCTS**

**2.1 MANUAL VOLUME DAMPERS**

- A. Fabricate in accordance with SMACNA Duct Construction Standards, and as indicated.
- B. Fabricate single blade dampers for duct sizes to 9-1/2" x 30 inches 750 mm.
- C. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12" x 300 mm x 72" x 1800 mm. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
- D. Except in round ductwork 12 inches 300 mm and smaller, provide end bearings. On multiple blade dampers, provide molded synthetic or oil-impregnated nylon or sintered bronze bearings.
- E. Provide locking quadrant regulators on single and multi-blade dampers.
- F. On insulated ducts, mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
- G. If blades are in open position and extend into the main duct, mount damper so blades are parallel to airflow.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. General Installation Requirements:
  - 1. Install accessories in accordance with manufacturer's instructions.

2. Where duct access doors are located above inaccessible ceilings, provide ceiling access doors. Coordinate location with the Architect/Engineer.
3. Coordinate and install access doors provided by others.
4. Provide access doors for all equipment requiring maintenance or adjustment above an inaccessible ceiling. Minimum size shall be 24"600 mm x 24"600 mm.
5. Provide duct test holes where indicated and as required for testing and balancing purposes.

B. Manual Volume Damper:

1. Provide manual volume dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts where indicated on drawings and as required for air balancing. Use splitter dampers only where indicated.
2. Provide ceiling access doors for manual volume dampers. When manual volume dampers are located above an inaccessible ceiling and an access door cannot be installed, provide a remote-controlled volume control device for operation of the damper. Coordinate location with the Architect/Engineer.

END OF SECTION



**SECTION 23 36 00**  
**AIR TERMINAL UNITS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Single Duct Variable Air Volume Terminal Box.
- B. Fan Powered Variable Air Volume Terminal Box.

**1.2 REFERENCES**

- A. NFPA 70 - National Electric Code.
- B. NFPA 90A - Installation of Air-Conditioning and Ventilation Systems.
- C. UL 181 - Factory-Made Air Ducts and Connectors.

**1.3 SUBMITTALS**

- A. Submit shop drawings under provisions of Section 23 05 00.
- B. Submit shop drawings indicating configuration, general assembly, and materials used in fabrication.
- C. Submit product data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings which indicate airflow, static pressure, and NC designation.
- D. Include schedules listing discharge and radiated sound power level for each of second through sixth octave bands at inlet static pressures of one to 4 inch WG0.25-1 kPa.
- E. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.
- F. Submit manufacturer's installation instructions.

**1.4 OPERATION AND MAINTENANCE DATA**

- A. Submit operation and maintenance data.
- B. Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists.
- C. Include directions for resetting constant volume regulators.

**PART 2 - PRODUCTS**

**2.1 ACOUSTICAL CONSIDERATIONS (THIS APPLIES TO ALL UNITS)**

- A. All units shall have noise data certified in accordance with AHRI Standard 885-98 with 5/8"16 mm 20-lb.320 kg/m<sup>3</sup> density mineral fiber ceiling tile and shall not produce space noise values over NC-35 due to radiated and airborne noise combined. Acoustical considerations shall take priority over sizes noted in schedule. Noise in classrooms shall not exceed 35 dBA or 55 dBC per ANSI Standard S12.60-2002.

## 2.2 SINGLE DUCT VARIABLE AIR VOLUME TERMINAL BOX

- A. Casing: Minimum 22 gauge (0.85 mm) galvanized steel. Fully lined with minimum 1"25 mm, minimum 1-1/2 pound24 kg/m<sup>3</sup> density fiberglass insulation. Insulation shall be UL listed and meet NFPA 90A requirements.
- B. All insulation in contact with the air stream shall be foil faced, UL listed and NFPA 90A approved.
- C. Damper Blade: Extruded aluminum or minimum 18 gauge (1.31 mm) galvanized steel. Nylon or bronze bushings on damper shafts. Dampers shall seal against gasketed stops. Leakage shall not exceed 4% of unit nominal cfmairflow at 3.0 inches WG0.75 kPa inlet static pressure.
- D. Volume Regulator: Boxes shall have pressure independent control to maintain constant air volume regardless of duct pressure changes up to 6 inches WG1.5 kPa. Regulator shall have field adjustable maximum and minimum settings. Furnish calibration charts mounted on each box. Boxes shall be factory set for the maximum and minimum settings shown on the drawings.
- E. Hot Water Coils: Copper tubes, aluminum fins, minimum 0.016"0.4 mm wall thickness, leak tested at 300 psig2070 kPa gauge. Air pressure drop shall not exceed scheduled value. Provide access door or removable panel for access to the upstream side of the heating coil. Capacity shall be as scheduled on the drawings. Hot water control valve shall be by the TCC.
- F. Boxes shall not exceed the static pressure drop and N.C. level scheduled on the drawings.
- G. Refer to control diagrams and notes on control drawings for complete sequence of control.
- H. Acceptable Manufacturers: Titus, Trane, Krueger, Carnes, E.H. Price, Tuttle & Bailey, Nailor, Enviro-Tec,

## 2.3 FAN POWERED VARIABLE AIR VOLUME TERMINAL BOX

- A. Casing: Minimum 22 gauge (0.85 mm) galvanized steel. Filter rack provided on plenum inlet. Factory mounted access panel to provide access to air valve and fan.
- B. Insulation: Fully lined with 1"25 mm, 1-1/2 pound48 kg/m<sup>3</sup> density fiberglass insulation. Insulation shall be UL listed and meet NFPA 90A and UL 181 requirements.
- C. Fan: FC style, galvanized steel fan wheel. Fan housing shall be 22 gauge (0.85 mm) steel and fan board shall be 18 gauge (1.31 mm) steel. Motors shall be permanently lubricated, single speed, direct drive, ECM motor with factory mounted SCR speed controller. Maximum motor temperature rise on all speeds of 50°F10°C. Fan motor voltage shall be as scheduled on the drawings.
- D. Fan Controls: Factory mounted and wired manual adjustment of SCR fan speed controller.
- E. Damper Blade: Extruded aluminum or minimum 18 gauge (1.31 mm) galvanized steel. Nylon or bronze bushings on damper shafts. Dampers shall seal against gasketed stops. Leakage shall not exceed 4% of unit nominal cfmairflow at 3.0 inches WG0.75 kPa inlet static pressure.
- F. Volume Regulator: Boxes shall have pressure independent control to maintain constant air volume regardless of duct pressure changes up to 6 inches WG1.5 kPa. Regulator shall have field adjustable maximum and minimum settings. Furnish calibration charts mounted on each box. Boxes shall be factory set for the maximum and minimum settings shown on the drawings.
- G. Boxes shall be normally closed, direct acting with an 8-13 psi55-90 kPa operating range.

- H. Electric Heating Coil: Open nichrome type electric resistance coils, automatic reset thermal cut-out primary safety device, manual reset thermal cut-out secondary safety device, airflow switch interlock, disconnect switch on face of integral control panel, magnetic mercury contactors, 24-volt control, control voltage transformer and fusing, pressure-electric switch for two-stage step control. Capacity and voltage shall be as scheduled on the drawings.
- I. Boxes shall not exceed the static pressure drop and N.C. level scheduled on the drawings.
- J. Refer to control diagrams and notes on control drawings for complete sequence of control.
- K. Acceptable Manufacturers: Titus, Trane, Krueger, Carnes, E.H. Price, Nailor, Enviro-Tec.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Maintain minimum working clear space for all electrical connections in accordance with NFPA 70, National Electrical Code.
- C. Provide ceiling access doors or locate units above easily removable ceiling components.
- D. Support units individually from structure. Do not support from adjacent ductwork.
- E. Where boxes are located adjacent to a wall or joist, the damper motors and control valves shall be located on the side of the box away from the wall or joist to permit easy access.
- F. Comb fins on coils to repair bent fins.
- G. Insulate terminal air box reheat coils to prevent condensation. Tape insulation tight to box. Do not insulate the box itself to prevent interference with actuator, access panel and control panel.

#### 3.2 ADJUSTING

- A. All boxes shall be set to the cfm/airflow shown on the drawings. TCC shall be responsible to field recalibrate all boxes that are not set correctly.

END OF SECTION

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**SECTION 23 37 00**  
**AIR INLETS AND OUTLETS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Grilles and Registers.
- B. Architectural Square Panel Diffusers.
- C. Louvers.

**1.2 QUALITY ASSURANCE**

- A. Test and rate performance of air inlets and outlets per ASHRAE 70.
- B. Test and rate performance of louvers per AMCA 500L-99.
- C. All air handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow, using the rain test apparatus described in Section 58 of UL 1995.

**1.3 REFERENCES**

- A. AMCA 500L-07 - Test Method for Louvers, Dampers and Shutters.
- B. ANSI/ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Inlets and Outlets.
- C. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- D. SMACNA - Duct Construction Standards.

**1.4 SUBMITTALS**

- A. Submit product data under provisions of Section 23 05 00.
- B. Review requirements of inlets and outlets as to size, finish, and type of mounting prior to submitting product data and schedules of inlets and outlets.

**1.5 REGULATORY REQUIREMENTS**

- A. Conform to ANSI/NFPA 90A.
- B. Conform to ASHRAE 90.1.

**PART 2 - PRODUCTS**

**2.1 GRILLES AND REGISTERS**

- A. Reference to a grille means an air supply, exhaust or transfer device without a damper.
- B. Reference to a register means an air supply, exhaust or transfer device with a damper.
- C. The type of unit, margin, material, finish, etc., shall be as shown on the drawing schedule and suitable for the intended use.
- D. All margins shall be compatible with ceiling types specified (including 'Thin-Line' T-bar lay-in grid system). Any discrepancies in contract documents shall be brought to the attention of the

Architect/Engineer, in writing, prior to Bid Date. Submission of Bid indicates ceiling and air inlet and outlet types have been coordinated.

- E. The capacity and size of the unit shall be as shown on the drawings.
- F. All units shall handle the indicated cfm/airflow L/s as shown on the drawings while not exceeding an NC level of 25, referenced to  $10^{-12}$  watts with a 10 dB room effect. Noise in classrooms may not exceed 35 dBA or 55 dBC per ANSI Standard S12.60-2002 and ASHRAE 70.
- G. Refer to the drawings for construction material, color and finish, margin style, deflection, and sizes of grilles and registers.
- H. Provide with 3/4" 20 mm blade spacing. Blades shall have steel friction pivots to allow for blade adjustment, plastic pivots are not acceptable.
- I. Corners of steel grilles and registers shall be welded and ground smooth before painting. Aluminum grilles and registers shall have staked corners.
- J. Where specified to serve registers, provide opposed blade volume dampers operable from the face of the register.
- K. Screw holes for surface fasteners shall be countersunk for a neat appearance. Provide concealed fasteners for installation in lay-in ceilings and as specified on the drawings.
- L. Acceptable Manufacturers: Tuttle & Bailey, Titus, Price, Nailor, Carnes, Metalaire, Krueger, Anemostat, Raymon Donco.

## 2.2 ARCHITECTURAL SQUARE PANEL DIFFUSERS

- A. Reference to a diffuser means an air supply device, ceiling mounted, that shall diffuse air uniformly throughout the conditioned space.
- B. The type of unit, margin, material, finish, etc., shall be as shown on the drawing schedule. Flat-oval inlets are not acceptable for connection to flexible ducts.
- C. All margins shall be compatible with ceiling types specified (including 'Thin-Line' T-bar lay-in grid system). Any discrepancies in contract documents should be brought to the attention of the Architect/Engineer, in writing, prior to Bid Date. Submission of Bid indicates ceiling and air inlet and outlet types have been coordinated.
- D. The capacity and size of the unit shall be as shown on the drawings.
- E. All units shall handle the indicated cfm/airflow L/s as shown on the drawings while not exceeding an NC level of 25, referenced to  $10^{-12}$  watts with a 10 dB room effect. Noise in classrooms may not exceed 35 dBA or 55 dBC per ANSI Standard S12.60-2002 and ASHRAE 70.
- F. Diffusers shall be architectural solid square panel and flush with ceiling.
- G. The exposed surface shall be smooth, flat and free of visible fasteners. The face panel shall be 22 gauge (0.76 mm) steel with a rolled edge or shall be 18 gauge (1.21 mm) with a smooth ground, uniform edge.
- H. The back pan shall be one piece 22 gauge (0.76 mm) stamped and shall include an integral inlet. (Welded inlets and corner joints are not acceptable).

- I. Diffusers with a 24x24600 mm x 600 mm back pan shall have a minimum 18x18450 mm x 450 mm face panel size. Diffusers with a 12x12300 mm x 300 mm back pan shall have a minimum 9x9225 mm x 225 mm face panel size.
- J. The face panel shall be mechanically fastened to the back panel with steel components. (Plastic fasteners are not acceptable.)
- K. Acceptable Manufacturers: Tuttle & Bailey, Titus, Price, Nailor, Carnes, Metalaire, Krueger, Anemostat, Raymon Donco.

## 2.3 LINEAR DIFFUSERS

### A. Linear Bar Grille Diffusers:

- 1. The type of unit, margin size, material, finish, etc., shall be as shown on the Drawing Schedule. Flat-oval inlets are NOT acceptable for connection to flexible ducts. Provide sheet metal oval-to-round transition if required.
- 2. The capacity and size of the unit shall be as shown on the drawings.
- 3. All units shall handle the indicated cfm/airflow L/s as shown on the drawings while not exceeding an NC level of 25, referenced to 10<sup>-12</sup> watts with a 10 dB room effect per ANSI/ASHRAE 70.
- 4. Install T-bars on both sides of diffusers for lay-in ceiling system, install manufacturer frame for sheetrock or plaster ceiling system. Diffuser margins system shall be compatible with ceiling types specified, color to match ceiling system. Contractor shall coordinate margin types with ceilings prior to submitting shop drawings.
- 5. Provide with concealed fasteners for installation in the field.
- 6. Linear bar diffusers and mounting frames shall be furnished as one piece up to 6'1.8 m in length. Provide auxiliary support per manufacturer's recommendations for slot diffusers greater than 4'1.2 m in length.
- 7. A manual volume damper shall be furnished and installed by the Contractor in branch ductwork to each bar grille. Balancing dampers shall not be installed in supply plenum or at air outlet unless otherwise indicated on the drawings.
- 8. Diffuser length and width, bar width, and spacing between bars shall be as shown on the drawings.
- 9. Provide insulated plenum for each linear diffuser. Refer to linear diffuser supply plenum section for details.
- 10. Acceptable Manufacturers: Tuttle & Bailey 4000, Carnes CC;CT;CW, Krueger 1500/1600, Price LB, Nailor 4900, Titus CT, Metalaire 2000, Anemostat AL/TL, Raymon Donco DGB.

## 2.4 LINEAR DIFFUSER SUPPLY PLENUM

- A. Linear diffusers shall be provided with field fabricated or prefabricated supply plenums. Plenum shall be a minimum of 2-1/2"65 mm wider than total slot width, minimum length of slot, and minimum height of 10"250 mm. Plenums with end fed duct connections shall not exceed 8'2.4 m in length. The cross sectional area of the plenum shall be designed for a maximum velocity of 500 fpm2.5 m/s and the aspect ratio shall be limited to a width-to-height ratio of less than 1.5. Plenums

with side outlets shall be designed for a maximum velocity of 600 fpm3 m/s and inlet ducts to plenum shall be spaced 5'1.5 m on center maximum. Inlet ducts to plenums shall have a maximum velocity of 900 fpm4.6 m/s. Flat-oval inlets are NOT acceptable for connection to flexible ducts. Provide sheet metal oval-to-round transition if required.

- B. Plenum shall be constructed with 24 gauge (0.7 mm) galvanized steel and shall have side inlets unless shown otherwise on the drawings. Refer to Ductwork Application Schedule in Section 23 31 00 for insulation requirements.
- C. End caps and required accessories shall be integral with the plenum or furnished and installed by the Mechanical Contractor.
- D. A manual volume damper shall be furnished and installed by the Mechanical Contractor in branch ductwork to each slot diffuser. Balancing dampers shall not be installed in supply plenum or at air outlet unless otherwise indicated on the drawings
- E. Prefabricated plenums shall be by the same manufacturer as the linear diffuser or Kees Inc.

## 2.5 LOUVERS - FIXED - ALUMINUM

- A. Louvers shall be minimum 4"100 mm deep and constructed of extruded aluminum. Blade, jamb and sill thickness shall be minimum 0.081"2 mm. Blades shall be spaced at a maximum of 5.1"130 mm apart.
- B. Louvers shall be of the drainable blade design with water collected on the leading edge of the blade and diverted to the jamb.
- C. Louvers shall be furnished with aluminum bird screen mounted on the inside surface.
- D. Size, cfmairflow L/s, finish and pressure drop for louvers shall be as scheduled on the drawings.
- E. AMCA Certified performance for 48"1200 mm x 48"1200 mm samples with intake airflow of 8,000 cfm3775 L/s shall not exhibit more than 0.19"0.05 kPa pressure drop. Maximum water penetration shall be 0.01 ounces per square foot3 g/m<sup>2</sup> at the scheduled intake velocity based on 15 minute test duration when subjected to a water flow rate of 0.25 gal/min0.05 m<sup>3</sup>/hr as described under the Water Penetration Test in AMCA 500-L-07.
- F. Contractor shall provide the General Contractor with the correct sizes and locations of all louvers required in masonry walls.
- G. Louvers shall be sealed around perimeter to avoid moisture penetration between the louver frame and wall.
- H. Louvers shall be suitable for duct connection.
- I. Acceptable Manufacturers: Air Flow - "EA-403", Arrow - "EA-415-D", American Warming & Ventilating - "LE-21", Construction Specialties - "A4097", Dowco - "DBE-4", Louvers & Dampers, Inc. - "IL-23", Ruskin - "ELF375DX", Vent Products - "2760", Greenheck - "ESD-403", Pottorff - "EFD".

## 2.6 LOUVERS - BY GENERAL CONTRACTOR

- A. Louvers shall be provided and installed by the General Contractor.
- B. Coordinate exact sizes and locations required for ductwork connections.



PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Install items in accordance with manufacturers' instructions.
2. Check location of inlets and outlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.
3. Install diffusers to ductwork with air tight connections.
4. Flexible ducts shall NOT be joined to flat-oval connections. Provide sheet metal oval-to-round transitions where required.
5. Supply grille and register blades shall be aimed in the field to provide adequate air distribution in the space. All return grilles and registers blades shall be oriented to minimize sight distance beyond installed device.

B. Volume Damper:

1. Provide manual volume dampers on duct take-off to diffusers when there are multiple connections to a common duct. Locate volume dampers as far as possible from the air inlet or outlet.

END OF SECTION

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**SECTION 26 05 00**  
**BASIC ELECTRICAL REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Requirements applicable to all Division 26 Sections. Also refer to Division 1 - General Requirements. This section is also applicable to Interior Communications Pathways Section 27 05 28. This section is also applicable to Fire Alarm and Detection Systems Section 28 31 00.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

**1.2 REFERENCES**

- A. NFPA 70 - National Electrical Code (NEC)

**1.3 SCOPE OF WORK**

- A. This Specification and the associated drawings govern furnishing, installing, testing and placing into satisfactory operation the Electrical Systems.
- B. The Contractor shall furnish and install all new materials as indicated on the drawings, and/or in these specifications, and all items required to make his portion of the Electrical Work a finished and working system.
- C. Description of Systems shall be as follows:
  - 1. Electrical power system to and including luminaires, equipment, motors, devices, etc.
  - 2. Fire alarm system.
  - 3. Wiring system for temperature control system as shown on the drawings.
  - 4. Wiring of equipment furnished by others.
  - 5. Removal work and/or relocation and reuse of existing systems and equipment.
  - 6. Technology Systems as described in Division 27/28 and on the T-series documents as described in the Suggested Matrix of Scope Responsibility.
- D. Work Not Included:
  - 1. Telecommunications cabling will be by Division 27, in raceways and conduits furnished and installed as part of the Electrical work.
  - 2. Temperature control wiring for plumbing and HVAC equipment (unless otherwise indicated) will be by other Contractors.

**1.4 OWNER FURNISHED PRODUCTS**

- A. The following items shall be relocated, installed and/or connected by this Contractor:
  - 1. Sound booths.

- B. The Owner will supply manufacturer's installation data for new equipment purchased by him for this project.
- C. This Contractor shall make all electrical system connections shown on the drawings **or** required for fully functional units.
- D. This Contractor is responsible for all damage to Owner furnished equipment caused during installation.

1.5 WORK SEQUENCE

- A. All work that will produce excessive noise or interference with normal building operations, as determined by the Owner, shall be scheduled with the Owner. It may be necessary to schedule such work during unoccupied hours. The Owner reserves the right to determine when restricted construction hours are required.

1.6 ALTERNATES

- A. Refer to Drawings.

1.7 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL, AND CONTROL CONTRACTORS

- A. Division of work is the responsibility of the Prime Contractor. Any scope of work described at any location on the contract document shall be sufficient for including said requirement in the project. The Prime Contractor shall be solely responsible for determining the appropriate subcontractor for the described scope. In no case shall the project be assessed an additional cost for scope that is described on the contract documents on bid day. The following division of responsibility is a guideline based on typical industry practice.
- B. Definitions:
  - 1. "Mechanical Contractors" refers to the Contractors listed in Division 21/22/23 of this Specification.
  - 2. "Technology Contractors" refers to the Contractors furnishing and installing systems listed in Division 27/28 of this Specification.
  - 3. Motor Power Wiring: The single phase or 3 phase wiring extending from the power source (transformer, panelboard, feeder circuits, etc.) through disconnect switches and motor controllers to, and including the connections to the terminals of the motor.
  - 4. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case, the devices are usually single phase, have "Manual-Off-Auto" provisions, and are usually connected into the motor power wiring through a manual motor starter.
  - 5. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.
  - 6. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. When the motor power wiring exceeds 120 volts, a control transformer is usually used to give a control voltage of 120 volts.

7. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring that directly powers or controls a motor used to drive equipment such as fans, pumps, etc. This wiring will be from a 120-volt source and may continue as 120 volt, or be reduced in voltage (24 volt), in which case a control transformer shall be furnished as part of the temperature control wiring.
8. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.
9. Low Voltage Technology Wiring: The wiring associated with the technology systems, used for analog or digital signals between equipment.

C. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractors' responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors, etc. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals approved. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.
2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall furnish complete wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.
3. Control low (24V) and control line (120V) voltage wiring, conduit, and related switches and relays required for the automatic control and/or interlock of motors and equipment, including final connection, are to be furnished and installed under Divisions 21, 22 and 23. Materials and installation to conform to Class 1 or 2 requirements.
4. The Electrical Contractor shall establish electrical utility elevations prior to fabrication and installation. The Electrical Contractor shall coordinate utility elevations with other trades. When a conflict arises, priority shall be as follows:
  - a. Luminaires.
  - b. Gravity flow piping, including steam and condensate.
  - c. Sheet metal.
  - d. Cable trays, including access space.
  - e. Other piping.
  - f. Conduits and wireway.

D. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment furnished by the Mechanical Contractor.
2. Assumes all responsibility for miscellaneous items furnished by the Mechanical Contractor that require wiring but are not shown on the electrical drawings or specified in the Electrical Specification. If items such as relays, flow switches, or interlocks are required to make the

mechanical system function correctly or are required by the manufacturer, they are the responsibility of the Mechanical Contractor.

3. Assumes all responsibility for Temperature Control wiring, if the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.
4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

E. Temperature Control Contractor's or Subcontractor's Responsibility:

1. Wiring of all devices needed to make the Temperature Control System functional.
2. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Contractor or Subcontractor.
3. Coordinating equipment locations (such as PE's, EP's, relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.

F. Electrical Contractor's Responsibility:

1. Furnishes and installs all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor in the Mechanical Drawings or Specifications.
2. Installs and wires all remote-control devices furnished by the Mechanical Contractor or Temperature Control Contractor when so noted on the Electrical Drawings.
3. Furnishes and installs motor control and temperature control wiring, when noted on the drawings.
4. Furnishes, installs, and connects all relays, etc., for automatic shutdown of certain mechanical equipment (supply fans, exhaust fans, etc.) upon actuation of the Fire Alarm System.
5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

G. General (Electrical/Technology):

1. "Electrical Contractor" as referred to herein shall be responsible for scope listed in Division 27/28 of this specification when the "Suggested Matrix of Scope Responsibility" indicated work shall be furnished and installed by the EC. Refer to the Contract Documents for this "Suggested Matrix of Scope Responsibility".
2. The purpose of these Specifications is to outline the Electrical and Technology Contractor's work responsibilities as related to Telecommunications Rough-in, conduit, cable tray, power wiring and Low Voltage Technology Wiring.
3. The exact wiring requirements for much of the equipment cannot be determined until the systems have been purchased and submittals approved. Therefore, only known wiring, conduits, raceways and electrical power related to such items is shown on the Technology drawings. Other wiring, conduits, raceways, junction boxes and electrical power not shown

on the Technology Drawings but required for operation of the systems is the responsibility of the Technology Contractor and included in said Contractor's bid.

H. Technology Contractor's Responsibility:

1. Assumes all responsibility for the low voltage technology wiring of all systems, including cable support where open cable is specified.
2. Assumes all responsibility for all required backboxes, conduit and power connections not specifically shown as being furnished and installed by the Electrical Contractor on the "Suggested Matrix of Scope Responsibility".
3. Assumes all responsibility for providing and installing all ladder rack and other cable management hardware (as defined herein).
4. Responsible for providing the Electrical Contractor with the required grounding lugs or other hardware for each piece of technology equipment which is required to be bonded to the telecommunications ground bar.
5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.8 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.
  - a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.
  - b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, raceway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
  - c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
  - d. Maintenance clearances and code-required dedicated space shall be included.
  - e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.
2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

**B. Participation:**

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.
2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.
  - a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.
3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

**C. Drawing Requirements:**

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.
  - a. Scale of drawings:
    - 1) General plans: 1/4 Inch = 1'-0" (minimum).
    - 2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
    - 3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
    - 4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1'-0" (minimum).
    - 5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).
2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.
3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.
4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the A/E for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

**D. General:**

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion but will not perform as a coordinator.



2. A plotted set of coordination drawings shall be available at the project site.
3. Coordination drawings are not shop drawings and shall not be submitted as such.
4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.
6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.
9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.
  - a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
  - b. Potential layout changes shall be made to avoid additional access panels.
  - c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.
  - d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.
  - e. When additional access panels are required, they shall be provided without additional cost to the Owner.
10. Complete the coordination drawing process and obtain sign-off of the drawings by all contractors prior to installing any of the components.
11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements or installed their work without proper coordination.
12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

#### 1.9 QUALITY ASSURANCE

##### A. Contractor's Responsibility Prior to Submitting Pricing/Bid Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-

dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guides, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Architect/Engineer any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.

2. The Contractor shall resolve all reported deficiencies with the Architect/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/Engineer will be done at the Contractor's risk.

B. Qualifications:

1. Only products of reputable manufacturers as determined by the Architect/Engineer are acceptable.
2. All Contractors and subcontractors shall employ only workmen who are skilled in their trades. At all times, the number of apprentices at the job site shall be less than or equal to the number of journeymen at the job site.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the State of Michigan Codes, Laws, Ordinances and Wayne State University Office of Risk Management, and other regulations having jurisdiction.
2. Conform to all published standards of Wayne State University.
3. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.
4. If the Contractor notes, at the time of bidding, any parts of the drawings or specifications that do not comply with the codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, he shall submit with his proposal a separate price to make the system comply with the codes and regulations.
5. All changes to the system made after the letting of the contract to comply with codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Owner.
6. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
7. If there are no local codes having jurisdiction, the current issue of the NEC shall be followed.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.
3. Pay all charges for permits or licenses.

4. Pay all fees and taxes imposed by State, Municipal, and other regulatory bodies.
5. Pay all charges arising out of required inspections by an authorized body.
6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.
7. Where applicable, all fixtures, equipment and materials shall be listed by Underwriter's Laboratories, Inc. or a nationally recognized testing organization.
8. Pay all telephone company charges related to the service or change in service.

E. Examination of Drawings:

1. The drawings for the electrical work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of raceways to best fit the layout of the job. Conduit entry points for electrical equipment including, but not limited to, panelboards, switchboards, switchgear and unit substations, shall be determined by the Contractor unless noted in the contract documents.
3. Scaling of the drawings will not be sufficient or accurate for determining these locations.
4. Where job conditions require reasonable changes in arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
5. Because of the scale of the drawings, certain basic items, such as junction boxes, pull boxes, conduit fittings, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.
6. If an item is either shown on the drawings or called for in the specifications, it 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 greater and better-quality number shall govern.
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 also be furnished unless otherwise noted.

F. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.
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 Contractor shall complete and return a signed "Electronic File Transmittal" form provided by IMEG.
4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
7. The use of these CAD 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 IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor's use of these documents.

G. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any conduit, conductors, wireways, fittings, etc.

1.10 SUBMITTALS

A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

<b>Referenced Specification</b>	<b><u>Section</u></b>	<b><u>Submittal Item</u></b>
	26 05 35	Surface Raceways
	26 09 33	Lighting Control System
	26 28 16	Disconnect Switches
	26 51 00	Lighting
	28 31 00	Fire Alarm and Detection Systems

B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:
  - a. Date
  - b. Project title and number
  - c. Contractor's name and address
  - d. Division of work (e.g., electrical, plumbing, heating, ventilating, etc.)
  - e. Description of items submitted and relevant specification number
  - f. Notations of deviations from the contract documents
  - g. Other pertinent data

2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:
  - a. Date
  - b. Project title and number
  - c. Architect/Engineer
  - d. Contractor and subcontractors' names and addresses
  - e. Supplier and manufacturer's names and addresses
  - f. Division of work (e.g., electrical, plumbing, heating, ventilating, etc.)
  - g. Description of item submitted (using project nomenclature) and relevant specification number
  - h. Notations of deviations from the contract documents
  - i. Other pertinent data
  - j. Provide space for Contractor's review stamps
3. Composition:
  - a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
  - b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
  - c. All sets shall contain an index of the items enclosed with a general topic description on the cover.
4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
5. Contractor's Approval Stamp:
  - a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
  - b. Unstamped submittals will be rejected.
  - c. The Contractor's review shall include, but not be limited to, verification of the following:
    - 1) Only approved manufacturers are used.
    - 2) Addenda items have been incorporated.
    - 3) Catalog numbers and options match those specified.
    - 4) Performance data matches that specified.
    - 5) Electrical characteristics and loads match those specified.
    - 6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
    - 7) Dimensions and service clearances are suitable for the intended location.

- 8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
  - 9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).
  - d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.
  - e. **The 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 deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.**
6. Submittal Identification and Markings:
- a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
  - b. The Contractor shall clearly indicate the size, finish, material, etc.
  - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
  - d. All marks and identifications on the submittals shall be unambiguous.
7. Schedule submittals to expedite the project. Coordinate submission of related items.
8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
9. Reproduction of contract documents alone is not acceptable for submittals.
10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
11. Submittals not required by the contract documents may be returned without review.
12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any equipment for manufacture or shipment.
14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.

C. Electronic Submittal Procedures:

- 1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.

2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
  - a. Submittal file name: 26 XX XX.description.YYYYMMDD
  - b. Transmittal file name: 26 XX XX.description.YYYYMMDD
5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be transmitted via a pre-approved method.

#### 1.11 CHANGE ORDERS

- A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders with inadequate breakdown will be rejected.
- B. Change order work shall not proceed until authorized.

#### 1.12 PRODUCT DELIVERY, STORAGE, HANDLING AND MAINTENANCE

- A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage.
- B. Keep all materials clean, dry and free from damaging environments.
- C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Electrical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.
- D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate his/her work with other trades.

#### 1.13 WARRANTY

- A. Provide one-year warranty for all fixtures, equipment, materials, and workmanship.
- B. The warranty period for all work in this specification Division shall commence on the date of Substantial Completion or successful system performance whichever occurs later. The warranty may also commence if a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization of the Owner. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.
- C. Warranty requirements extend to correction, without cost to the Owner, of all work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage due to defects or nonconformance with contract documents excluding repairs

required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

1.14 INSURANCE

- A. This Contractor shall maintain insurance coverage as set forth in Division 1 of these specifications.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All items of material having a similar function (e.g., safety switches, panelboards, switchboards, contactors, motor starters, dry type transformers) shall be of the same manufacturer unless specifically stated otherwise on drawings or elsewhere in specifications.

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employees and subconsultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 ARCHITECT/ENGINEER OBSERVATION OF WORK

- A. The contractor shall provide seven (7) calendar days' notice to the Architect/Engineer prior to:
1. Covering interior partitions and chases.
  2. Installing hard or suspended ceilings and soffits.
- B. The Architect/Engineer will review the installation and provide a written report noting deficiencies requiring correction. The contractor's schedule shall account for these reviews and show them as line items in the approved schedule.
- C. Above-Ceiling Final Observation:
1. All work above the ceilings must be complete prior to the Architect/Engineer's review. This includes, but is not limited to:
    - a. All junction boxes are closed and identified in accordance with Section 26 05 53 Electrical Identification.
    - b. Luminaires, including ceiling-mounted exit and emergency lights, are installed and operational.



- c. Luminaire whips are supported above the ceiling.
  - d. Conduit identification is installed in accordance with Section 26 05 53 Electrical Identification.
  - e. Luminaires are suspended independently of the ceiling system when required by these contract documents.
  - f. All wall penetrations have been sealed.
- 2. 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 Architect/Engineer finds the ceilings have been installed prior to this review and prior to seven days elapsing, the Architect/Engineer may not recommend further payments to the contractor until full access has been provided.

### 3.3 PROJECT CLOSEOUT

- A. The following paragraphs supplement the requirements of Division 1.
- B. Final Jobsite Observation:
  - 1. To prevent the Final Jobsite Observation from occurring too early, the Contractor shall review the completion status of the project and certify that the job is ready for the final jobsite observation.
  - 2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review. The Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.
  - 3. It is understood that if the Architect/Engineer finds the job not ready for the final observation and additional trips and observations are required to bring the project to completion, the cost of the additional time and expenses incurred by the Architect/Engineer will be deducted from the Contractor's final payment.
  - 4. Contractor shall notify Architect/Engineer 48 hours prior to installation of ceilings or lay-in ceiling tiles.
- C. The following must be submitted before Architect/Engineer recommends final payment:
  - 1. Operation and maintenance manuals with copies of approved shop drawings.
  - 2. Record documents including marked-up or reproducible drawings and specifications.
  - 3. A report documenting the instructions given to the Owner's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of this Contractor and shall be signed by the Owner's representatives.
  - 4. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site and place in location as directed and submit receipt to Architect/Engineer.
  - 5. Inspection and testing report by the fire alarm system manufacturer.

6. Start-up reports on all equipment requiring a factory installation or start-up.

D. Circuit Directories:

1. Provide custom typed circuit directory for each branch circuit panelboard. Provide updated custom typed circuit directory for each existing branch circuit panelboard with new or revised circuits per the scope of work. Label shall include equipment name or final approved room name, room number, and load type for each circuit (examples: SUMP SP-1 or ROOM 101 RECEIPT). Revise directory to reflect circuit changes required to balance phase loads. Printed copies of the bid document panel schedules are not acceptable as circuit directories.

3.4 OPERATION AND MAINTENANCE MANUALS

A. General:

1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.
2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
  - a. O&M file name: O&M.div26.contractor.YYYYMMDD
  - b. Transmittal file name: O&Mtransmittal.div26.contractor.YYYYMMDD
5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be divided into files that are clearly labeled as "1 of 2", "2 of 2", etc.
6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
7. All text shall be searchable.
8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the

nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

C. Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
4. Copies of all factory inspections and/or equipment startup reports.
5. Copies of warranties.
6. Schematic wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
7. Dimensional drawings of equipment.
8. Detailed parts lists with lists of suppliers.
9. Operating procedures for each system.
10. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
11. Repair procedures for major components.
12. Replacement parts and service material requirements for each system and the frequency of service required.
13. Instruction books, cards, and manuals furnished with the equipment.
14. Include record drawings of the one-line diagrams for each major system. The graphic for each piece of equipment shown on the one-line diagram shall be an active link to its associated Operation & Maintenance data.
15. Copies of all panel schedules in electronic Microsoft Excel spreadsheet (.xlsx) file. Each panelboard shall be a separate tab in the workbook.

3.5 INSTRUCTING THE OWNER'S REPRESENTATIVE

- A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of the complete systems installed under this contract.
- B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.

- C. The instructions shall include:
  - 1. Maintenance of equipment.
  - 2. Start-up procedures for all major equipment.
  - 3. Description of emergency system operation.
- D. Notify the Architect/Engineer of the time and place for the verbal instructions to the Owner's representative so his representative can be present if desired.
- E. Minimum hours of instruction time for each item and/or system shall be as indicated in each individual specification section.
- F. Operating Instructions:
  - 1. 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 Architect/Engineer to perform these services.

### 3.6 RECORD DOCUMENTS

- A. The following paragraphs supplement the requirements of Division 1.
- 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 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 Architect/Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect/Engineer's hourly rates in effect at the time of work.
- D. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.
- E. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.
- F. Record actual routing of conduits exceeding 2 inches.

### 3.7 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 decor 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 decor. Painting shall be performed as described in 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 baked enamel finish coat free from scratches, abrasions, chipping, etc. If color option is specified or is standard to the unit, verify with the Architect his color preference before ordering.

### 3.8 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.

### 3.9 SYSTEM STARTING AND ADJUSTING

- A. The electrical systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain 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. Complete all manufacturer-recommended startup procedures and checklists to verify proper equipment operation and does not pose a danger to personnel or property.
- C. All operating conditions and control sequences shall be tested during the start-up period. Testing all interlocks, safety shut-downs, controls, and alarms.
- D. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, 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/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

### 3.10 FIELD QUALITY CONTROL

- A. General:
  - 1. Conduct all tests required during and after construction. Submit test results in NETA format, or equivalent form, that shows the test equipment used, calibration date, tester's name, ambient test conditions, humidity, conductor length, and results corrected to 40°C.
  - 2. Supply necessary instruments, meters, etc., for the tests. Supply competent technicians with training in the proper testing techniques.
  - 3. All cables and wires shall be tested for shorts and grounds following installation and connection to devices. Replace shorted or grounded wires and cables.
  - 4. Any wiring device, electrical apparatus or luminaire, if grounded or shorted on any integral "live" part, shall have all defective parts or materials replaced.

5. Test cable insulation of panel feeder conductors for proper insulation values. Tests shall include the cable, all splices, and all terminations. Each conductor shall be tested and shall test free of short circuits and grounds and have an insulation value not less than NEC Standards. Take readings between conductors, and between conductors and ground.
  6. If the results obtained in the tests are not satisfactory, make adjustments, replacements, and changes as needed. Then repeat the tests, and make additional tests, as the Architect/Engineer or authority having jurisdiction deems necessary.
- B. Other Equipment:
1. Give other equipment furnished and installed by the Contractor all standard tests normally made to assure that the equipment is electrically sound, all connections properly made, phase rotation correct, fuses and thermal elements suitable for protection against overloads, voltage complies with equipment nameplate rating, and full load amperes are within equipment rating.
- C. If any test results are not satisfactory, make adjustments, replacements and changes as needed and repeat the tests and make additional tests as the Architect/Engineer or authority having jurisdiction deem necessary.

END OF SECTION

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

To prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. Penetrations of fire-rated construction fire sealed in accordance with specifications.
2. Electrical panels have typed circuit identification.
3. Smoke and fire/smoke dampers are wired and have been tested.
4. Per Section 26 05 00, cable insulation test results have been submitted.
5. Per Section 26 05 00, medium voltage testing report has been submitted.
6. Per Section 26 05 00, ground resistance test results have been submitted.
7. Operation and Maintenance manuals have been submitted as per Section 26 05 00.
8. Bound copies of approved shop drawings have been submitted as per Section 26 05 00.
9. Report of instruction of Owner's representative has been submitted as per Section 26 05 00.
10. Fire alarm inspection and testing report has been submitted as per Sections 26 05 00 and 28 31 00.
11. Start-up reports from factory representative have been submitted as per Section 26 05 00.

Accepted by:

Prime Contractor \_\_\_\_\_

By \_\_\_\_\_ Date \_\_\_\_\_

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

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**SECTION 26 05 03**  
**THROUGH PENETRATION FIRESTOPPING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Through-Penetration Firestopping.

**1.2 QUALITY ASSURANCE**

- A. Manufacturer: Company specializing in manufacturing products specified in this Section.
- B. Installer: Individuals performing work shall be certified by the manufacturer of the system selected for installation.

**1.3 REFERENCES**

- A. UL 263 - Fire Tests of Building Construction and Materials.
- B. UL 723 - Surface Burning Characteristics of Building Materials
- C. ANSI/UL 1479 - Fire Tests of Through Penetration Firestops
- D. UL 2079 - Tests for Fire Resistance of Building Joint Systems
- E. UL Fire Resistance Directory Through Penetration Firestop Systems (XHEZ)
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
- G. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Firestops
- H. 2015 Michigan Building Code

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Store, protect and handle products on site. Accept material on site in factory containers and packing. Inspect for damage. Protect from deterioration or damage due to moisture, temperature changes, contaminants, or other causes. Follow manufacturer's instructions for storage.
- B. Install material prior to expiration of product shelf life.

**1.5 PERFORMANCE REQUIREMENTS**

- A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
  - 1. Fire-resistance-rated walls including fire partitions, fire barriers, and smoke barriers.
  - 2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.
- B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per UL 1479:
  - 1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling, or exceeding fire-resistance rating of constructions penetrated.

2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings:
  - a. Floor penetrations located outside wall cavities.
  - b. Floor penetrations located outside fire-resistance-rated shaft enclosures.
- C. For through-penetration firestop systems exposed to light, traffic, moisture, or physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
- D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- E. For through-penetration firestop systems in air plenums, provide products with flame-spread and smoke-developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.

#### 1.6 MEETINGS

- A. Pre-installation meeting: A pre-installation meeting shall be scheduled and shall include the Construction Manager, General Contractor, all Subcontractors associated with the installation of systems penetrating fire barriers, Firestopping Manufacturer's Representative, and the Owner.
  1. Review foreseeable methods related to firestopping work.
  2. Tour representative areas where firestopping is to be installed; inspect and discuss each type of condition and each type of substrate that will be encountered, and preparation to be performed by other trades.

#### 1.7 WARRANTY

- A. Provide one-year warranty on parts and labor.
- B. Warranty shall cover repair or replacement of firestop systems which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability, or appear to deteriorate in any manner not clearly specified by the manufacturer as an inherent quality of the material.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers. All firestopping systems installed shall be provided by a single manufacturer.
  1. 3M; Fire Protection Products Division
  2. Hilti, Inc.
  3. Johns-Manville
  4. Dow Corning Corp

#### 2.2 THROUGH PENETRATION FIRESTOP SYSTEMS

- A. Provide materials and systems classified by or listed by UL to provide firestopping equal to time rating of construction being penetrated.

- B. All firestopping materials shall be free of asbestos, lead, PCB's, and other materials that would require hazardous waste removal.
- C. Firestopping shall be flexible to allow for normal penetrating item movement due to expansion and contraction.
- D. Provide firestopping systems capable of supporting floor loads where systems are exposed to possible floor loading or traffic.
- E. Provide firestopping systems classified by UL for penetrations through all fire rated construction. Firestopping systems shall be selected from the UL Fire Resistance Directory Category XHEZ based on substrate construction and penetrating item size and material and shall fall within the range of numbers listed:

1. Combustible Framed Floors and Chase Walls - 1 or 2 Hour Rated  
F Rating = Floor/Wall Rating  
T Rating = Floor/Wall Rating

<u>Penetrating Item</u>	<u>UL System No.</u>
No Penetrating Item	FC 0000-0999*
Metallic Pipe or Conduit	FC 1000-1999
Electrical Cables	FC 3000-3999
Cable Trays	FC 4000-4999
Multiple Penetrations	FC 8000-8999

2. Non-Combustible Framed Walls - 1 or 2 Hour Rated  
F Rating = Wall Rating  
T Rating = 0

<u>Penetrating Item</u>	<u>UL System No.</u>
No Penetrating Item	WL 0000-0999*
Metallic Pipe or Conduit	WL 1000-1999
Electrical Cables	WL 3000-3999
Cable Trays	WL 4000-4999
Multiple Penetrations	WL 8000-8999

3. Concrete or Masonry Floors and Walls - 1 or 2 Hour Rated  
F Rating = Wall/Floor Rating  
T Rating (Floors) = Floor Rating

<u>Penetrating Item</u>	<u>UL System No.</u>
No Penetrating Item	CAJ 0000-0999*
Metallic Pipe or Conduit	CAJ 1000-1999
Electrical Cables	CAJ 3000-3999
Cable Trays	CAJ 4000-4999
Multiple Penetrations	CAJ 8000-8999

\*Alternate method of firestopping is patching opening to match original rated construction.

- F. Any opening in walls or floors not covered by the listed series of numbers shall be coordinated with the firestopping manufacturer.

- G. Any openings in floors or walls not described in the UL Fire Resistance Directory, or outlined in manufacturer's information shall be sealed in a manner agreed upon by the Firestopping Manufacturer, Owner, and the Authority Having Jurisdiction.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Ensure all surfaces that contact seal materials are free of dirt, dust, grease, oil, rust, or loose materials. Clean and repair surfaces as required. Remove laitance and form-release agents from concrete.
- B. Ensure substrate and penetrating items have been permanently installed prior to installing firestopping systems. Ensure penetrating items have been properly spaced and have proper clearance prior to installing firestopping systems.
- C. Surfaces to which sealing materials are to be installed must meet the selected UL system substrate criteria.
- D. Prime substrates where recommended in writing by through-penetration firestop system manufacturer. Confine primer to area of bond.

### 3.2 INSTALLATION

- A. In existing construction, provide firestopping of openings prior to and after installation of penetrating items. Remove any existing coatings on surfaces prior to firestopping installation. Temporary firestopping shall consist of packing openings with fire resistant mineral wool for the full thickness of substrate, or an alternate method approved by the Authority Having Jurisdiction. All openings shall be temporarily firestopped immediately upon their installation and shall remain so until the permanent UL listed firestopping system is installed.
- B. Install penetration seal materials in accordance with printed instructions of the UL Fire Resistance Directory and with the manufacturer's printed application instructions.
- C. Install dams as required to properly contain firestopping materials within openings and as required to achieve required fire resistance rating. Remove combustible damming after appropriate curing.

### 3.3 CLEANING AND PROTECTING

- A. Clean excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not cause damage.
- B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

### 3.4 INSPECTION

- A. All penetrations shall be inspected by the manufacturer's representative to ensure proper installation.
- B. Access to firestop systems shall be maintained for examination by the Authority Having Jurisdiction at their request.

- C. Proceed with enclosing through-penetration firestop system with other construction only after inspection reports are issued and firestop installations comply with requirements.

END OF SECTION

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**SECTION 26 05 05**  
**ELECTRICAL DEMOLITION FOR REMODELING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Electrical demolition

**PART 2 - PRODUCTS**

**2.1 MATERIALS AND EQUIPMENT**

- A. Materials and equipment for patching and extending work shall be as specified in individual Sections.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. THE DRAWINGS ARE INTENDED TO INDICATE THE SCOPE OF WORK REQUIRED AND DO NOT INDICATE EVERY BOX, CONDUIT, OR WIRE THAT MUST BE REMOVED. THE CONTRACTOR SHALL VISIT THE SITE PRIOR TO SUBMITTING A BID AND VERIFY EXISTING CONDITIONS.
- B. Where walls, ceilings, structures, etc., are indicated as being removed on general or electrical drawings, the Contractor shall be responsible for the removal of all electrical equipment, devices, fixtures, raceways, wiring, systems, etc., from the removed area.
- C. Where ceilings, walls, structures, etc., are temporarily removed and replaced by others, this Contractor shall be responsible for the removal, storage, and replacement of equipment, devices, fixtures, raceways, wiring, systems, etc.
- D. Where mechanical or technology equipment is indicated as being removed on electrical, mechanical, or technology drawings, the Contractor shall be responsible for disconnecting the equipment and removing all starters, VFD, controllers, electrical equipment, raceways, wiring, etc. associated with the device.
- E. Verify that abandoned wiring and equipment serve only abandoned equipment or facilities. Extend conduit and wire to facilities and equipment that will remain in operation following demolition. Extension of conduit and wire to equipment shall be compatible with the surrounding area. Extended conduit and conductors to match existing size and material.
- F. Coordinate scope of work with all other Contractors and the Owner at the project site. Schedule removal of equipment and electrical service to avoid conflicts.
- G. Bid submittal shall mean the Contractor has visited the project site and has verified existing conditions and scope of work.

**3.2 PREPARATION**

- A. The Contractor shall obtain approval from the Owner before turning off power to circuits, feeders, panels, etc. Coordinate all outages with Owner.

- B. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations. Assume all equipment and systems must remain operational unless specifically noted otherwise on drawings.
- C. Disconnect electrical systems in walls, floors, structures, and ceilings scheduled for removal.
- D. All Contractors must obtain approval from the University Project Manager prior to interrupting existing services. All service interruptions shall be at a time suitable to the University. Include specification language covering off hours tie-ins. In general, all shutdown of electrical services shall be performed during off hours and may include Sunday and holiday periods. This premium time cost shall be included in the Contractor's Base Bid.
- E. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from Owner at least 48 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area. Service changeover shall be completed on an overtime basis.
- F. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Obtain permission from Owner at least 48 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area. Provide a watchman to make required premise observations during all outages, requirements as dictated by codes and Owner's insurance carrier.

### 3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Demolish and extend existing electrical work under provisions of Division 1 of Specifications and this Section.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned wiring and raceway to source of supply. Existing conduit in good condition may be reused in place by including an equipment ground conductor in reused conduit. Reused conduit and boxes shall have supports revised to meet current codes. Relocating conduit shall not be allowed.
- D. Abandoned and inactive conduits, wire, devices, equipment, etc., shall be removed in their entirety. Above new ceilings, existing lighting fixtures shall be removed. Conduit and boxes shall be removed. Conduit and wiring feeding devices, and equipment to be removed shall be also removed up to the next active pull box, junction box or panel. Hangers, messenger cable, brackets etc., supporting items to be removed shall also be unfastened and removed. Open holes in ducts, boxes, panels and knock-outs shall be closed with suitable snap plugs or blank-off steel plates.
- E. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces. Remove all associated clamps, hangers, supports, etc. associated with raceway removal.
- F. Disconnect and remove outlets and devices that are to be demolished. Remove outlet or devices associated back box, supports, and conduit and conductors back to source. Patch opening created from removal of device to match surrounding finishes.
- G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.



- H. Disconnect and remove abandoned luminaires. When light fixtures are being removed and not reused, the specifications or construction drawings shall instruct the contractor to remove fluorescent lamps and ballasts (unless ballasts are confirmed to contain no PCB's); consolidate items for transportation, and coordinate with the Project Manager to have the materials transported to the designated University location for disposal or to be manifested for hazardous waste disposal. Remove brackets, stems, hangers, and other accessories.
- I. Repair adjacent construction and finishes damaged during demolition and extension work. Patch openings to match existing surrounding finishes.
- J. Maintain access to existing electrical installations that remain active. Modify installation or provide junction boxes and access panel as appropriate.
- K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified. Extended conduit and conductors to match existing size and material.
- L. HID and fluorescent lamps, determined by the Toxicity Characteristic Leachate procedure (TCLP), to be hazardous waste shall be disposed of in an EPA-permitted hazardous waste disposal facility or by a permitted lamp recycler.
- M. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- N. Floor slabs may contain conduit systems. This Contractor is responsible for taking any measures required to ensure no conduits or other services are damaged. This includes x-ray or similar non-destructive means. Where conduit is in concrete slab, cut conduit flush with floor, pull out conductors, and plug conduit ends.
- O. This Contractor is responsible for all costs incurred in repair, relocations, or replacement of any cables, conduits, or other services if damaged without proper investigation.

#### 3.4 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment that remain or are to be reused.
- B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
- C. Luminaires: Remove existing luminaires for cleaning as indicated on the drawings. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts, and broken electrical parts. Replacement parts shall match specified components for new luminaires of same type when applicable. Reinstall luminaire and connect to circuiting as indicated on drawings.
- D. ELECTRICAL ITEMS (E.G., LIGHTING FIXTURES, RECEPTACLES, SWITCHES, CONDUIT, WIRE, ETC.) REMOVED AND NOT RELOCATED REMAIN THE PROPERTY OF THE OWNER. CONTRACTOR SHALL PLACE ITEMS RETAINED BY THE OWNER IN A LOCATION COORDINATED WITH THE OWNER. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE DISPOSAL OF MATERIAL THE OWNER DOES NOT WANT. Remove and deliver to a place designated by the University, all existing electrical equipment selected for salvage by the University. This equipment remains the property of the University. Any equipment, devices, materials, etc., that the University elects not to retain shall be legally disposed of by this Contractor

3.5 INSTALLATION

- A. Install relocated materials and equipment under the provisions of Division 1 of Specifications.

END OF SECTION

**SECTION 26 05 13**  
**WIRE AND CABLE**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Building wire
- B. Remote control and signal cable

**1.2 RELATED WORK**

- A. Section 26 05 53 – Electrical Identification: Refer to electrical identification for color and identification labeling requirements.

**1.3 REFERENCES**

- A. NEMA WC 70 - Power Cables Rated 2,000V or Less for the Distribution of Electrical Energy
- B. NFPA 70 - National Electrical Code (NEC)
- C. UL 83 – Thermoplastic-Insulated Wires and Cables
- D. UL 1581 – Standard for Electrical Wires, Cables, and Flexible Cords

**PART 2 - PRODUCTS**

**2.1 BUILDING WIRE**

- A. Feeders and Branch Circuits Larger Than 6 AWG: Copper, stranded conductor, 600-volt insulation, THHN/THWN.
- B. Feeders and Branch Circuits 6 AWG and Smaller: Copper conductor, 600-volt insulation, THHN/THWN. 6 and 8 AWG, stranded conductor; smaller than 8 AWG, solid or stranded conductor, unless otherwise noted on the drawings.
- C. Control Circuits: Copper, stranded conductor 600-volt insulation, THHN/THWN.
- D. Each 120-volt branch circuit shall have a dedicated neutral conductor. Neutral conductors shall be considered current-carrying conductors for wire derating.
- E. Approved Manufacturers: Southwire, Triangle, Rome, Cablec.

**2.2 REMOTE CONTROL AND SIGNAL CABLE**

- A. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600-volt insulation, rated 60°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°C, individual conductors twisted together, shielded, and covered with a PVC jacket; UL listed.
- C. Approved Manufacturers: Southwire, Triangle, Rome, Cablec.

## 2.3 CONNECTORS

- A. Solderless Type:
  - 1. Approved Manufacturers: IlSCO, Burndy, Thomas & Betts.
- B. Spring-Wire Type:
  - 1. Approved Manufacturers: Ideal, 3M, Buchanan..
- C. Compression Type:
  - 1. Approved Manufacturers: IlSCO, Burndy, Square D.
- D. Terminal Blocks:
  - 1. Approved Manufacturers: Ideal, Square D, Thomas & Betts.

## PART 3 - EXECUTION

### 3.1 WIRE AND CABLE INSTALLATION SCHEDULE

- A. All Locations: Building wire in raceway. All conductors installed above grade shall be type "THHN".
- B. Low Voltage Cable (less than 100 volts): Low voltage cable shall be installed in raceway.

### 3.2 GENERAL WIRING METHODS

- A. Use no wire smaller than 12 AWG for power and lighting circuits, and no smaller than 14 AWG for control wiring.
- B. Use no wire smaller than 14 AWG for low voltage control wiring (<100 volts).
- C. Use 10 AWG conductor for 20 amperes, 120-volt branch circuit home runs longer than 75 feet.
- D. The ampacity of multiple conductors in one conduit shall be derated per NEC 310. In no case shall more than 4 conductors be installed in one conduit to such loads as motors larger than 1/4 HP, panelboards, etc.
- E. Splice only in junction or outlet boxes.
- F. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- G. All conductors shall be continuous in conduit from last outlet to their termination.
- H. Terminate all spare conductors on terminal blocks and label the spare conductors.
- I. Cables or wires shall not be laid out on the ground before pulling.
- J. Cables or wires shall not be dragged over earth or paving.
- K. Care shall be taken so as not to subject the cable or wire to high mechanical stresses that would cause damage to the wire and cable.

- L. At least six (6)-inch loops or ends shall be left at each outlet for installation connection of luminaires or other devices.
- M. All wires in outlet boxes not connected to fixtures or other devices shall be rolled up, spliced if continuity of circuit is required, and insulated.

### 3.3 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time. Use UL listed wire pulling lubricant for pulling 4 AWG and larger wires.
- B. Pulling shall be continuous without unnecessary stops and starts with wire or cable only partially through raceway.
- C. Where reels of cable or wire are used, they shall be set up on jacks close to the point where the wire or cable enters the conduit or duct so that the cable or wire may be unreeled and run into the conduit or duct with a minimum of change in the direction of the bend.
- D. Conductors shall not be pulled through conduits until plastering or masonry work is completed and conduits are free from moisture. Care shall be taken so that long pulls of wire or pulls around several bends are not made where the wire may be permanently stretched and the insulation damaged.
- E. Only nylon rope shall be permitted to pull cables into conduit and ducts.
- F. Completely and thoroughly swab raceway system before installing conductors.
- G. Conductor Supports in Vertical Raceways:
  - 1. Support conductors in vertical raceways in accordance with NEC 300.19 and Table 300.19(A) Spacing of Conductors Supports.
  - 2. Supports shall be of insulated wedge type (OZ Gedney Type S, or equal) and installed in a tapered insulated bushing fitting or a metal woven mesh with a support ring that fits inside conduit fitting installed in an accessible junction box (Hubbell Kellems support grip or equal).

### 3.4 WIRING CONNECTIONS AND TERMINATIONS

- A. Splice and tap only in accessible junction boxes.
- B. Use solderless, tin-plated copper, compression terminals (lugs) applied with circumferential crimp for conductor terminations, 8 AWG and larger.
- C. Use solderless, tin-plated, compression terminals (lugs) applied with indenter crimp for copper conductor terminations, 10 AWG and smaller.
- D. Use solderless pressure connectors with insulating covers for copper wire splices and taps, 8 AWG and smaller. For 10 AWG and smaller, use insulated spring wire connectors with plastic caps.
- E. Use compression connectors applied with circumferential crimp for conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of conductor
- F. Thoroughly clean wires before installing lugs and connectors.

- G. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
- H. Phase Sequence: All apparatus shall be connected to operate in the phase sequence A-B-C representing the time sequence in which the phase conductors so identified reach positive maximum voltage.
- I. As a general rule, applicable to switches, circuit breakers, starters, panelboards, switchgear and the like, the connections to phase conductors are intended thus:
  - 1. Facing the front and operating side of the equipment, the phase identification shall be:
    - a. Left to Right - A-B-C
    - b. Top to Bottom - A-B-C
- J. Connection revisions as required to achieve correct rotation of motors shall be made at the load terminals of the starters or disconnect switches.

### 3.5 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Division 1.
- B. Feeder Testing: Perform an insulation-resistance test on each conductor with respect to ground and adjacent conductors. Test shall be made by means of a low-resistance ohmmeter, such as a "Megger". The applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. The test duration shall be one minute. Insulation resistance must be greater than 100 mega-ohm for 600 volt and 25 mega-ohm for 300 volt rated cables per NETA Acceptance Testing Standard.
- C. Inspect wire and cable for physical damage and proper connection.
- D. Torque test conductor connections and terminations to manufacturer's recommended values.
- E. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.
- F. Protection of wire and cable from foreign materials:
  - 1. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any wire or cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited to, overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid, or compound that could come in contact with the cable, cable jacket, or cable termination components.
- G. Overspray of paint on any wire or cable will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed.

END OF SECTION

**SECTION 26 05 26**  
**GROUNDING AND BONDING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Equipment grounding system
- B. Bonding system

**1.2 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 UL 467 Grounding and Bonding Equipment.

**1.3 REFERENCES**

- A. NFPA 70 – National Electrical Code (NEC)

**1.4 SUMMARY**

- A. This section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

**PART 2 - PRODUCTS**

**2.1 GROUNDING CONDUCTORS**

- A. For insulated conductors, comply with Division 26 Section 26 05 13 "Wire and Cable".
- B. Equipment Grounding Conductors: Insulated. Refer to Section 26 05 53 for insulation color.
- C. Copper Bonding Conductors: As follows:
  - 1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
  - 2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
  - 3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
  - 4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
  - 5. Bonding Jumper: Aluminum tape, braided bare aluminum conductors, terminated with aluminum ferrules; 1-5/8 inches wide and 1/16 inch thick.

## 2.2 CONNECTOR PRODUCTS

- A. Comply with UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

## PART 3 - EXECUTION

### 3.1 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
  - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
  - 2. Make connections with clean, bare metal at points of contact.
  - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
  - 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
  - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- C. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- D. Connections at back boxes, junction boxes, pull boxes, and equipment terminations: The equipment grounding conductor(s) associated with all circuits in the box shall be connected together and to the box using a suitable grounding screw. The removal of the respective receptacle, luminaire, or other device served by the box shall not interrupt the grounding continuity.
- E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

### 3.2 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then use a bolted



clamp. Bond straps directly to the basic structure, taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

- C. In raceways, use insulated equipment grounding conductors.

### 3.3 EQUIPMENT GROUNDING SYSTEM

- A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- B. Install equipment grounding conductors in all feeders and circuits. Terminate each end on a grounding lug or bus.

### 3.4 BONDING SYSTEM

- A. Remote control, signaling, and fire alarm circuits shall be bonded in accordance with the most recent version of the National Electric Code.

### 3.5 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
  - 1. Measure ground resistance from system neutral connection at service entrance to convenient ground reference points using suitable ground testing equipment. Resistance shall not exceed 5 ohms.
  - 2. Testing: Owner will engage a qualified testing agency to perform the following field quality-control testing:
  - 3. Testing: Engage a qualified testing agency to perform the following field quality-control testing:
  - 4. Testing: Perform the following field quality-control testing:
    - a. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
    - b. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the 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. Perform tests, by the fall-of-potential method according to IEEE 81.
    - c. Provide 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.
      - 1) Equipment Rated 500 kVA and Less: 10 ohms.
      - 2) Equipment Rated 500 to 1000 kVA: 5 ohms.
      - 3) Equipment Rated More Than 1000 kVA: 3 ohms.

- 4) Substations and Pad-Mounted Switching Equipment: 5 ohms.
  - 5) Manhole Grounds: 10 ohms.
- d. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect/Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION

**SECTION 26 05 27**  
**SUPPORTING DEVICES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Conduit and equipment supports
- B. Fastening hardware

**1.2 QUALITY ASSURANCE**

- A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

**1.3 COORDINATION**

- A. Coordinate size, shape and location of concrete pads with Section on Cast-in-Place Concrete or Concrete Topping.

**PART 2 - PRODUCTS**

**2.1 ACCEPTABLE MANUFACTURERS**

- A. Allied Support Systems
- B. Cooper B-Line
- C. Erico, Inc.
- D. Hilti
- E. Power Fasteners

**2.2 MATERIAL**

- A. Support Channel: Hot-dip galvanized for wet/damp locations; painted steel for interior/dry locations. All field cut ends shall be touched up with matching finish to inhibit rusting.
- B. Hardware: Corrosion resistant.
- C. Anchorage and Structural Attachment Components:
  - 1. Strength: Defined in reports by ICBO Evaluation Service or another agency acceptable to Authorities Having Jurisdiction.
    - a. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.
  - 2. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.
  - 3. Beam clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.
  - 4. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings and matched to the type and size of attachment devices used.

5. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-14. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.
6. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors in concrete and beam clamps on structural steel.
- B. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.
- C. Do not fasten supports to ceiling systems, piping, ductwork, mechanical equipment, or conduit, unless otherwise noted.
- D. Do not use powder-actuated anchors without specific permission.
- E. Do not drill structural steel members.
- F. In wet locations and on all building floors below exterior earth grade install free-standing electrical equipment on concrete pads.
- G. Install cabinets and panelboards with minimum of four anchors. Provide horizontal backing/support framing in stud walls for rigid mounting.
- H. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (excludes concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.
- I. Refer to Section 26 05 33 for special conduit supporting requirements.

### 3.2 FINISH

- A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and above suspended ceiling spaces are not considered exposed.
- B. Trim all ends of exposed field fabricated steel hangers, slotted channel and threaded rod to within 1" of support or fastener to eliminate potential injury to personnel unless shown otherwise on the drawings. Smooth ends and install elastomeric insulation with two coats of latex paint if exposed steel is within 6'-6" of finish floor and presents potential injury to personnel.

END OF SECTION

**SECTION 26 05 33  
CONDUIT AND BOXES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Rigid metallic conduit and fittings (RMC)
- B. Electrical metallic tubing and fittings (EMT)
- C. Flexible metallic conduit and fittings (FMC)
- D. Liquidtight flexible metallic conduit and fittings (LFMC)
- E. Wall and ceiling outlet boxes
- F. Electrical connection
- G. Pull and junction boxes

**1.2 RELATED WORK**

- A. Section 26 05 53 – Electrical Identification: Refer to electrical identification for color and identification labeling requirements.

**1.3 REFERENCES**

- A. American National Standards Institute (ANSI):
  - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated
  - 2. ANSI C80.3 - Electrical Metallic Tubing, Zinc-Coated and Fittings
  - 3. ANSI C80.4 - Fittings for Rigid Metal Conduit and Electrical Metallic Tubing
  - 4. ANSI/NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports
- B. NECA “Standards of Installation”
- C. National Electrical Manufacturers Association (NEMA):
  - 1. ANSI/NEMA FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
- D. NFPA 70 – National Electrical Code (NEC)
- E. Underwriters Laboratories (UL): Applicable Listings
  - 1. UL 1 – Flexible Metal Conduit
  - 2. UL 6 – Rigid Metal Conduit
  - 3. UL 360 – Liquid Tight Flexible Steel Conduit
  - 4. UL514-B – Conduit Tubing and Cable Fittings
  - 5. UL797 – Electrical Metal Tubing
- F. Definitions:
  - 1. Fittings: Conduit connection or coupling.
  - 2. Body: Enlarged fittings with opening allowing access to the conductors for pulling purposes only.

3. Mechanical Spaces: Enclosed areas, usually kept separated from the general public, where the primary use is to house service equipment and to route services. These spaces generally have exposed structures, bare concrete and non-architecturally emphasized finishes.
4. Finished Spaces: Enclosed areas where the primary use is to house personnel and the general public. These spaces generally have architecturally emphasized finishes, ceilings and/or floors.
5. Concealed: Not visible by the general public. Often indicates a location either above the ceiling, in the walls, in or beneath the floor slab, in column coverings, or in the ceiling construction.

#### 1.4 SUBMITTALS

- A. Include fittings and conduits 1.5" and larger in coordination files. Refer to Section 26 05 00 for coordination drawing requirements.

### PART 2 - PRODUCTS

#### 2.1 RIGID METALLIC CONDUIT (RMC) AND FITTINGS

- A. Acceptable Manufacturers:
  1. Acceptable Manufacturers: Allied, Triangle PWC, Wheatland Tube Co.
  2. Acceptable Manufacturers of RMC Conduit Fittings: Appleton Electric, O-Z/Gedney Co., Electroline, Raco, Thomas & Betts, Crouse-Hinds, Killark, or approved equal.
- B. Minimum Size Galvanized Steel: 3/4 inch, unless otherwise noted.
- C. Fittings and Conduit Bodies:
  1. Expansion Joints: Malleable iron and hot dip galvanized providing a minimum of 4 inches of movement. Fitting shall be watertight with an insulating bushing and a bonding jumper.
  2. Conduit End Bushings: Malleable iron type with molded-on high impact phenolic thermosetting insulation. Where required elsewhere in the contract documents, bushing shall be complete with ground conductor saddle and clamp. **High impact phenolic threaded type bushings are not acceptable.**
  3. All other fittings and conduit bodies shall be of malleable iron construction and hot dip galvanized.

#### 2.2 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

- A. Minimum Size Electrical Metallic Tubing: 3/4 inch, unless otherwise noted.
- B. Acceptable Manufacturers of EMT Conduit: Allied, Triangle PWC, Wheatland Tube Co.
- C. Fittings and Conduit Bodies:
  1. 2" Diameter or Smaller: Steel set screw type of steel designed for their specific application.
  2. 1/2" and 3/4" Conduit: Push-on connectors and couplers with locking ring and washer of zinc plated steel, listed for use in dry locations.

3. Larger than 2": Steel set screw type of steel designed for their specific application.
4. Acceptable Manufacturers of EMT Conduit Fittings: Appleton Electric, O-Z/Gedney Co., Electroline, Raco, Thomas & Betts, or approved equal.

## 2.3 FLEXIBLE METALLIC CONDUIT (FMC) AND FITTINGS

- A. Minimum Size Galvanized Steel: 3/4 inch, unless otherwise noted. Lighting branch circuit wiring to an individual luminaire may be a manufactured, UL listed 3/8" flexible metal conduit and fittings with #14 AWG THHN conductors and an insulated ground wire. Maximum length of 3/8" FMC shall be six (6) feet.
- B. Acceptable Manufacturers: AFC, Electri-Flex, O.Z. Gedney.
- C. Construction: Flexible steel, approved for conduit ground, zinc coated, threadless type formed from a continuous length of spirally wound, interlocked zinc coated strip steel. Provide a separate equipment grounding conductor when used for equipment where flexibility is required.
- D. Fittings and Conduit Bodies:
  1. Screw-in type, die-cast zinc.
  2. Fittings and conduit bodies shall include plastic or cast metal inserts supplied by the manufacturer to protect conductors from sharp edges.
  3. Acceptable Manufacturers: O-Z/Gedney Co., Thomas & Betts, Appleton Electric, or approved equal.

## 2.4 LIQUIDTIGHT FLEXIBLE METALLIC CONDUIT (LFMC) AND FITTINGS

- A. Acceptable Manufacturers: AFC, Electri-Flex, O.Z. Gedney.
- B. Construction: Flexible steel, approved for conduit ground, zinc coated, threadless type formed from a continuous length of spirally wound, interlocked zinc coated strip steel and an extruded PVC cover.
- C. Fittings and Conduit Bodies:
  1. Watertight, compression type, galvanized zinc coated cadmium plated malleable cast iron, UL listed.
  2. Fittings and conduit bodies shall include plastic or cast metal inserts supplied by the manufacturer to protect conductors from sharp edges.
  3. Acceptable Manufacturers: Appleton Electric, O-Z/Gedney Co., Electroline, Bridgeport, Thomas & Betts, Midwest, Regal, Carlon (Lamson & Sessions), or approved equal.

## 2.5 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1; galvanized steel, minimum of 14 gauge, with 1/2-inch male fixture studs where required.
- B. Nonmetallic Outlet Boxes: ANSI/NEMA OS 2.
- C. Cast Boxes: NEMA FB1, Type FD, Aluminum, cast fer alloy, or stainless steel deep type, gasketed cover, threaded hubs.

- D. Outlet boxes for luminaires to be not less than 1-1/2" deep, deeper if required by the number of wires or construction. The box shall be coordinated with surface luminaires to conceal the box from view or provide a finished trim plate.
- E. Switch outlet boxes for local light control switches, dimmers and occupancy sensors shall be 4 inches square by 2-1/8 inches deep, with raised cover to fit flush with finish wall line. Multiple gang switch outlets shall consist of the required number of gang boxes appropriate to the quantity of switches comprising the gang. Where walls are plastered, provide a plaster raised cover. Where switch outlet boxes occur in exposed concrete block walls, boxes shall be installed in the block cavity with a raised square edge tile cover of sufficient depth to extend out to face of block or masonry boxes.
- F. Outlet boxes for technology devices in walls shall be 4 inches square and 2-1/8 inches deep with single gang raised cover to fit flush with finished wall line equipped with flush telephone plate.
- G. Wall receptacle outlet boxes shall be 4 inches square with raised cover to fit flush with finished wall line. Boxes in concrete block walls shall be installed the same as for switch boxes in block walls.

## 2.6 [ECONN]: ELECTRICAL CONNECTION

- A. Electrical connection to equipment and motors, sized per NEC. Coordinate requirements with contractor furnishing equipment or motor. Refer to specifications and general installation notes for terminations to motors.

## 2.7 [JB]: PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: ANSI/NEMA OS 1; galvanized steel.
- B. Sheet metal boxes larger than 12 inches in any dimension that contain terminations or components: Continuous hinged enclosure with 1/4 turn latch and white back panel for mounting terminal blocks and electrical components.
- C. Cast Metal Boxes for Outdoor and Wet Location Installations: NEMA 250; Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Galvanized cast iron box and cover with ground flange, neoprene gasket, and stainless-steel cover screws.
- D. Flanged type boxes shall be used where installed flush in wall.

## PART 3 - EXECUTION

### 3.1 CONDUIT INSTALLATION SCHEDULE AND SIZING

- A. In the event the location of conduit installation represents conflicting installation requirements as specified in the following schedule, a clarification shall be obtained from the Architect/Engineer. If this Contractor is unable to obtain a clarification as outlined above, concealed rigid galvanized steel conduit installed per these specifications and the NEC shall be required.
- B. The following schedule shall be adhered to unless they constitute a violation of applicable codes or are noted otherwise on the drawings. The installation of RMC conduit will be permitted in place of all conduit specified in this schedule. Refer to 260535 for Architectural Surface Raceway (ASR).

Installation Type	RMC	EMT	ASR
Branch Circuits: Lighting, receptacles, controls, etc.		X	
Mechanical Equipment Feeders: Air handling units, etc.		X	



Installation Type	RMC	EMT	ASR
Controls		X	
Finished Spaces / Concealed		X	
Wet and Damp Locations: (conduit, boxes, fittings, installed and equipped to prevent water entry)	X		
Interior Locations: Concealed		X	
Interior Locations: Exposed		X	
Interior Locations: Existing walls and exposed installation (finished spaces)			X

- C. Size conduit as shown on the drawings and specifications. Where not indicated in the contract documents, conduit size shall be according to NEC. Conduit and conductor sizing shall be coordinated to limit conductor fill to less than 40%, maintain conductor ampere capacity as required by the NEC (to include enlarged conductors due to temperature and quantity derating values) and to prevent excessive voltage drop and pulling tension due to long conduit/conductor lengths.
- D. Minimum Conduit Size (Unless Noted Otherwise):
1. Power Conduit: 3/4 inch.
  2. Telecommunication Conduit: 1 inch.
  3. Controls Conduit: 3/4 inch.
- E. Conduit sizes shall change only at the entrance or exit to a junction box, unless specifically noted on the drawings.

### 3.2 CONDUIT ARRANGEMENT

- A. In general, conduit shall be installed concealed in walls, in finished spaces and where possible or practical, or as noted otherwise. Conduit shall be installed parallel or perpendicular to walls, ceilings, and exposed structural members. In unfinished spaces, mechanical and utility areas, conduit may run exposed. Installation shall maintain headroom in exposed vicinities of pedestrian or vehicular traffic.
- B. Exposed conduit on exterior walls or above roof will not be allowed without prior written approval of Architect/Engineer. A drawing of the proposed routing and a photo of the location shall be submitted 14 days prior to start of conduit rough-in. Routing shall be shown on coordination drawings.
- C. Contractor shall adapt his work to the job conditions and make such changes as required and permitted by the Architect/Engineer, such as moving to clear beams and joists, adjusting at columns, avoiding interference with windows, etc., to permit the proper installation of other mechanical and/or electrical equipment.
- D. Contractor shall cooperate with all Contractors on the project. He shall obtain details of other Contractor's work to ensure fit and avoid conflict. Any expense due to the failure of This Contractor to do so shall be paid for in full by him. The other trades involved as directed by the Architect/Engineer shall perform the repair of work damaged as a result of neglect or error by This Contractor. The resultant costs shall be borne by This Contractor.

### 3.3 CONDUIT SUPPORT

- A. Conduit runs installed above a suspended ceiling shall be properly supported. In no case shall conduit rest on the suspended ceiling construction, nor utilize ceiling support system for conduit support.
- B. Conduit shall not be supported from ductwork, water, sprinkler piping, or other non-structural members, unless approved by the Architect/Engineer. All supports shall be from structural slabs, walls, structural members, and bar joists, and coordinated with all other applicable contractors, unless noted otherwise.
- C. Conduit shall be held in place by the correct size of galvanized one-hole conduit clamps, two-hole conduit straps, patented support devices, clamp back conduit hangers, or by other means if called for on the drawings.
- D. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- E. Group conduits in parallel runs where practical and use conduit racks or trapeze hangers constructed of steel channel, suspended with threaded solid rods or wall mounted from metal channels with conduit straps or clamps. Provide space in each rack or trapeze for 25% additional conduits.
- F. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (excludes concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.
- G. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
- H. Supports for metallic conduit shall be no greater than 10 feet. A smaller interval may be used if necessitated by building construction, but in no event shall support spans exceed the NEC requirements. Conduit shall be securely fastened within 3 feet of each outlet box, junction box, device box, cabinet, or fitting.
- I. Supports of flexible conduit shall be within 12 inches of each outlet box, junction box, device box, cabinet, or fitting and at intervals not to exceed 3 feet.

### 3.4 CONDUIT INSTALLATION

- A. Install in accordance with NFPA 70 "Standards of Installation".
- B. Conduit Connections:
  - 1. Shorter than standard conduit lengths shall be cut square using industry standards. The ends of all conduits cut shall be reamed or otherwise finished to remove all rough edges.
  - 2. Where conduits with tapered threads cannot be coupled with standard couplings, then approved split or Erickson couplings shall be used. Running threads will not be permitted.
  - 3. Install expansion/deflection joints where conduit crosses structure expansion/seismic joints.
- C. Conduit terminations for all low voltage wiring shall have nylon bushings installed on each end of every conduit run.

D. Conduit Bends:

1. Use factory elbows for bends in conduit 2" in size or larger.
2. A run of conduit shall not contain more than the equivalent of three (3) quarter bends (360°), including those bends located immediately at the outlet or body.
3. Use conduit bodies to make sharp changes in direction (i.e. around beams).

E. Conduit Placement:

1. Conduit shall be mechanically continuous from source of current to all outlets. Conduit shall be 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 the NEC.
2. Route exposed conduit and conduit above suspended ceilings (accessible or not) parallel/perpendicular to the building structural lines, and as close to building structure as possible. Wherever possible, route horizontal conduit runs above water and steam piping.
3. Conduits, raceway, and boxes shall not be installed in concealed locations in metal deck roofing or less than 1.5" below bottom of roof decking.
4. Avoid moisture traps where possible. Where unavoidable, provide a junction box with drain fitting at conduit low point.
5. All conduits through walls shall be grouted or sealed into openings. Where conduit penetrates firewalls and floors, seal with a UL listed sealant.
6. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL OPENINGS REQUIRED IN MASONRY OR EXTERIOR WALLS UNDER THIS DIVISION. A QUALIFIED MASON AT THE EXPENSE OF THIS CONTRACTOR SHALL REPAIR ALL OPENINGS TO MATCH EXISTING CONDITIONS.
7. Seal interior of conduit at air handling units,, and where the temperature differential can potentially be greater than 20°F, to prevent moisture penetration. Seal shall be placed where conduit enters warm space. Conduit seal fitting shall be a drain/seal, with sealing compound, equal to O-Z/Gedney type EYD.
8. Contractor shall provide suitable mechanical protection around all conduits stubbed out from floors, walls or ceilings during construction to prevent bending or damaging of stubs due to carelessness with construction equipment.
9. Contractor shall provide a polypropylene pull cord with 2000 lbs. tensile strength in each empty conduit (indoor and outdoor), except in sleeves and nipples.
10. Maintain 12-inch clearance between conduit and surfaces with temperatures exceeding 104 deg F.

3.5 CONDUIT TERMINATIONS

- A. Where conduit bonding is indicated or required in the contract documents, the bushings shall be a grounding type sized for the conduit and ground bonding conductor as manufactured by O-Z/Gedney, Appleton, Thomas & Betts, Burndy, or approved equal.

- B. Conduits with termination fittings shall be threaded for one (1) lock nut on the outside and one (1) lock nut and bushing on the inside of each box.
- C. Where conduits terminate in boxes with knockouts, they shall be secured to the boxes with lock nuts and provided with approved screw type tinned iron bushings or fittings with plastic inserts.
- D. Where conduits terminate in boxes, fittings, or bodies with threaded openings, they shall be tightly screwed against the shoulder portion of the threaded openings.
- E. Conduit terminations to all motors shall be made with flexible metallic conduit (FMC), unless noted otherwise. Final connections to roof exhaust fans, or other exterior motors and motors in damp or wet locations shall be made with liquidtight flexible metallic conduit (LFMC).. Flexible conduit shall not exceed 6' in length. Route equipment ground conductors from circuit ground to motor ground terminal through flexible conduit.
- F. All conduit ends shall be sealed with plastic immediately after installation to prevent the entrance of any foreign matter during construction. The seals shall be removed, and the conduits blown clear of all foreign matter prior to any wires or pull cords being installed.

### 3.6 BOX INSTALLATION SCHEDULE

- A. Galvanized steel boxes may be used in:
  - 1. Concealed interior locations above ceilings and in hollow stud partitions.
  - 2. Exposed interior locations.
- B. Cast boxes shall be used in:
  - 1. Exterior locations.
  - 2. Wet locations.

### 3.7 COORDINATION OF BOX LOCATIONS

- A. Provide electrical boxes as shown on the drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.
- B. Electrical box locations shown on the Contract Drawings are approximate, unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.
- C. Locate and install boxes to allow access. Avoid interferences with ductwork, piping, structure, equipment, etc. Where installation is inaccessible, provide access doors. Coordinate locations and sizes of required access doors with the Architect/Engineer and General Contractor.
- D. Locate and install to maintain headroom and to present a neat appearance.
- E. Coordinate locations with Heating Contractor to avoid baseboard radiation cabinets.

### 3.8 OUTLET BOX INSTALLATION

- A. Do not install boxes back-to-back in walls.
  - 1. Provide a minimum horizontal separation of 12 inches between boxes installed on opposite sides of non-rated stud walls.
  - 2. Provide a minimum horizontal separation of 24 inches between boxes installed on opposite sides of fire-rated walls.

- B. The Contractor shall anchor switch and outlet box to wall construction so that it is flush with the finished masonry, paneling, drywall, plaster, etc. The Contractor shall check the boxes as the finish wall surface is being installed to assure that the box is flush. (Provide plaster rings as necessary.)
- C. Mount at heights shown or noted on the drawings or as generally accepted if not specifically noted.
- D. Locate boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat openings for boxes.
- E. Provide knockout closures for unused openings.
- F. Support boxes independently of conduit.
- G. Use multiple-gang boxes where more than one device is mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
- H. Install boxes in walls without damaging wall insulation.
- I. Coordinate mounting heights and locations of outlets mounted above counters, benches, backsplashes, and below baseboard radiation.
- J. Position outlets to locate luminaires as shown on reflected ceiling drawings.
- K. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.
- L. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioned to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.
- M. Provide cast outlet boxes in exterior locations and wet locations, and where exposed rigid conduit is used.

### 3.9 PULL AND JUNCTION BOX INSTALLATION

- A. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.
- B. Support pull and junction boxes independent of conduit.

### 3.10 EXPOSED BOX INSTALLATION

- A. Boxes shall be secured to the building structure with proper size screws, bolts, hanger rods, or structural steel elements.
- B. On brick, block and concrete walls or ceilings, exposed boxes shall be supported with no less than two (2) Ackerman-Johnson, Paine, Phillips, or approved equal screw anchors or expansion shields and round head machine screws. Cast boxes shall not be drilled.
- C. On steel structures, exposed boxes shall be supported to the steel member by drilling and tapping the member and fastening the boxes by means of round head machine screws.
- D. Boxes may be supported on steel members by APPROVED beam clamps if conduit is supported by beam clamps.
- E. Boxes shall be fastened to wood structures by means of a minimum of two (2) wood screws adequately large and long to properly support. (Quantity depends on size of box.)

- F. Wood, plastic, or fiber plugs shall not be used for fastenings.
- G. Explosive devices shall not be used unless specifically allowed.

END OF SECTION

**SECTION 26 05 35**  
**SURFACE RACEWAYS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Architectural surface raceways.

**1.2 SUBMITTALS**

- A. Submit shop drawings under provisions of Section 26 05 00.
- B. Include product data for surface metal raceways, multi-outlet assemblies, surface non-metallic raceways, auxiliary gutters, and accessories.

**PART 2 - PRODUCTS**

**2.1 ARCHITECTURAL SURFACE RACEWAY**

- A. Surface Metal Raceway: Steel channel with fitted cover, 3/4"x1/2" 3/4"x5/8" size per circuit requirements.
- B. Finish: Color selection by Architect.
- C. Fittings: Couplings, elbows, and connectors designed for use with the raceway system.
- D. Boxes and Extension Rings: Designed for use with the raceway system.
- E. Approved Manufacturers: Wiremold V500/V700 series, Mono-Systems SMS500/SMS700 series, Thomas & Betts.

**PART 3 - EXECUTION**

**3.1 INSTALLATION – ARCHITECTURAL SURFACE RACEWAY**

- A. Use flat-head screws to fasten channel to surfaces. Mount plumb and level.
- B. Maintain grounding continuity between raceway components to provide a continuous grounding path.
- C. Fastener: Use clips and straps suitable for the purpose.
- D. Field cuts to be clean and straight and use the proper tools as recommended by the system manufacturer to prohibit damage to factory finish or raceway. Joints to be matched so there are no gaps or spaces in the cover. Furnish and install manufacturer's raceway accessories as needed.
- E. Routing and Planning: Coordinate routings with existing vertical/horizontal building lines and features (doorways, wall trim, at wall/ceiling interface, etc.). Match the square / parallel lines of other existing features. Do not route raceway across large open spaces of the wall unless required by the application.

END OF SECTION



**SECTION 26 05 53**  
**ELECTRICAL IDENTIFICATION**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Adhesive labels, markings, nameplates, and signs
- B. Wire and cable markers
- C. Raceway, box, and wire identification
- D. Electrical equipment labeling

**1.2 REFERENCES**

- A. NFPA 70 – National Electrical Code (NEC)
- B. ANSI A13.1 – Standard for Pipe Identification

**PART 2 - PRODUCTS**

**2.1 ADHESIVE MARKINGS AND FIELD LABELS**

- A. Colored Adhesive Marking Tape for banding Wires and Cables: Self-adhesive vinyl tape not less than 3 mils thick by 1 inch to 2 inches in width.
- B. Pretensioned Flexible Wraparound Colored Plastic Sleeves for Cable Identification: flexible acrylic bands sized to suit the cable diameter and arranged to stay in place by pre-tensioned gripping action when coiled around the cable.
- C. Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with preprinted numbers and letter.
- D. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18-inch minimum width, 50-lb minimum tensile strength, and suitable for a temperature range from minus 50°F to 350°F. Provide ties in specified colors when used for color coding.
- E. Text Sizes:
  - 1. The following information shall be used for text heights, fonts, and size, unless otherwise noted.
    - a. Font: Normal 721 Swiss Bold
    - b. Adhesive Labels: 3/16 inch (5mm) minimum text height
    - c. Vinyl / Plastic Laminate Labels: 3/4" inch (19mm) minimum text height

## 2.2 NAMEPLATES AND SIGNS

- A. 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. Labels shall be punched for mechanical fasteners.
- B. Text Sizes:
  - 1. The following information shall be used for text heights, fonts, and size, unless otherwise noted.
    - a. Text Height: 3/8 inch minimum
- C. Fasteners for Plastic-Laminated Signs; Self-tapping stainless-steel screws or number 10/32 stainless steel machine screws with nuts and flat and lock washers.

## 2.3 PRODUCT COLORS

- A. Adhesive Markings and Field Labels:
  - 1. All Labels: Black letters on white face
  - 2. Normal Power and General Labels: Black letters on white face.
  - 3. Fire Alarm: Red letters on white face
- B. Nameplates and Signs:
  - 1. NORMAL POWER: Black letters on white face
- C. Raceways and Conduit:
  - 1. Provide color coded conduit as indicated below. Conduit shall be colored by the manufacturer:
    - a. Normal Power and General Distribution: Silver
    - b. Fire Alarm System: Red
- D. Box Covers: Box cover colors shall match conduit colors listed above.
- E. Conductor Color Identification: Refer to Part 3 for additional information.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as required by code.
- B. Install identification devices in accordance with manufacturer's written instruction and requirements of NEC.
- C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work. All mounting surfaces shall be cleaned and degreased prior to identification installation.

- D. Circuit Identification: Tag or label conductors as follows:
1. Multiple Power or Lighting Circuits in 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. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.
- E. Apply circuit/control/item designation labels of engraved plastic laminate for pushbuttons, pilot lights, alarm/signal components, and similar items, except where labeling is specified elsewhere.
- F. Install labels parallel to equipment lines at locations as required and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

### 3.2 LIGHTING CONTROL AND RECEPTACLE COVER PLATES

- A. Product: Adhesive labels and field markings
- B. Identification material to be a clear, 3/8-inch (10mm) Kroy tape or Brother self-laminating vinyl label with black letters. Embossed Dymo-Tape labels are not acceptable. Permanently affix identification label to cover plates, centered above the receptacle openings.
- C. Provide identification on all switch and receptacle cover plates. Identification shall indicate source and circuit number serving the device (e.g. "C1A #24"). Identification for switch cover plates shall be installed on the inside cover.

### 3.3 CONDUCTOR COLOR CODING

- A. Products:
1. All wire and cables shall be color coded by the manufacturer.
  2. All wires and cables, 6 AWG or larger, used in motor circuits, main feeders, sub-main feeders, and branch circuits shall be coded by the application of plastic tape. The tape shall be 3-M, Plymouth or Permacel in colors specified below. The tape shall be applied at each conductor termination with two 1-inch (25mm) tape bands at 6-inch (150mm) centers. Contractor option to use colored cabling in lieu of the tape at each end for conductor 6 AWG to 500 KCM. Wire and cables smaller than 6 AWG shall be color coded by the manufacturer.
- B. Color coding shall be applied at all panels, switches, junction boxes, pull boxes, etc., where the wires and cables are visible, and terminations are made. The same color coding shall be used throughout the entire electrical system, therefore maintaining proper phasing throughout the entire project.

- C. Colored cable ties shall be applied in groups of three ties of specified color to each conductor at each terminal or splice point starting 3 inches (76mm) from the termination and spaced at 3- inches (76mm) centers. Tighten to a snug fit, and cut off excess length.
- D. Conductors shall be color coded as follows:
  - 1. 208Y/120 Volt, 4-Wire:
    - a. A-Phase – Black
    - b. B-Phase – Red
    - c. C-Phase – Blue
    - d. Neutral – White
    - e. Ground Bond – Green
  - 2. Grounding Conductors:
    - a. Equipment grounding conductors, main/system/supply-side bonding jumpers: Green.

### 3.4 CONTROL EQUIPMENT IDENTIFICATION

- A. Products: Nameplates and signs
- B. Provide identification on the front of all control equipment such as combination starters, starters, VFDs, contactors, etc.
- C. Identification shall be provided for all connections to equipment furnished by this Contractor, other contractors, or the Owner.
- D. Labeling shall include:
  - 1. Equipment type and contract documents designation of equipment being served.
  - 2. Location of equipment being served if it is not located within sight.
  - 3. Voltage and phase of circuit(s).
  - 4. Panel and circuit number(s) serving the equipment.

EXHAUST FAN EF-1 ("LOCATED ON ROOF") 480V, 3-PHASE FED FROM "1HA1-1"
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### 3.5 EQUIPMENT CONNECTION IDENTIFICATION

- A. Products: Nameplates and signs
- B. Provide identification for hard wired electrical connections to equipment such as disconnects switches, starters, etc. Plug and cord type connections do not require this specific label.
- C. Identification shall be provided for all connections to equipment furnished by this Contractor, other contractors, or the Owner.
- D. Labeling shall include:
  - 1. Equipment type and contract documents designation of equipment being served
  - 2. Location of equipment being served if it is not located within sight.
  - 3. Voltage and rating of the equipment.

4. Panel and circuit numbers(s) serving the equipment

UNIT HEATER UH-1  
("LOCATED IN STORAGE ROOM 200")  
480V: 3-PHASE  
FED FROM "1HA1-1"

END OF SECTION

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**SECTION 26 09 33**  
**LIGHTING CONTROL SYSTEMS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Line and low voltage standalone lighting controls

**1.2 RELATED WORK**

- A. Section 26 51 00 - Lighting

**1.3 QUALITY ASSURANCE**

- A. Manufacturers shall be regularly engaged in the manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than five (5) years.
- B. Comply with NEC as applicable to electrical wiring work.
- C. All assemblies are to be in compliance with FCC emissions standards specified in Part 15 Subpart J for Class A applications.

**1.4 REFERENCES**

- A. NEMA WD 1 - General Color Requirements for Wiring Devices
- B. NEMA WD 7 - Occupancy Motion Sensors
- C. NFPA 70 - National Electrical Code (NEC)
- D. UL Standard 916 Energy Management Equipment
- E. UL 924 - Emergency Lighting and Power Equipment
- F. UL 1472 – Solid-State Dimming Controls

**1.5 SUBMITTALS**

- A. Submit product data under provisions of Section 26 05 00.
- B. Submit a comprehensive package including devices, hardware, software, product specification, finishes, dimensions, installation instructions, warranty, system software requirements.
- C. Provide floor plan showing location, orientation, and coverage area of each control device, sensor, and controller/interface. For areas requiring multiple sensor devices for appropriate coverage, submit specific manufacturer-approved sensor layout as an overlay directly on the project drawings, either in print or approved electronic form.
- D. Submit a list of devices and equipment that will be installed for each sequence of operation.
- E. Submit project specific control wiring diagrams showing all equipment, line voltage, and control wiring requirements for all components including, but not limited to, relays, low voltage switches, occupancy sensors, and communication interfaces and programming instructions for each sequence of operation. Include network cable specification and end-of-line termination details, if required.

**1.6 PROJECT RECORD DOCUMENTS**

- A. Submit project record documents under provisions of Section 26 05 00.

- B. Accurately record location of all controls and devices. Include description of switching sequences and circuiting arrangements.

#### 1.7 OPERATION AND MAINTENANCE DATA

- A. Submit emergency, operation, and maintenance data under provisions of Section 26 05 00. Data shall also include the following:
  - 1. Schedule for routine maintenance, inspection, and calibration of all lighting control devices and system components. Recommended schedule for inspection and recalibration of sensors.
  - 2. Complete narrative describing intended operation and sequence for each control scenario and system component, updated to reflect all changes resulting from commissioning of systems. Narrative shall indicate recommended settings for devices where applicable.
  - 3. Replacement part numbers for all system components.
- B. Identify installed location and labeling for each luminaire controlled by automated lighting controls.

#### 1.8 SYSTEM DESCRIPTION

- A. Performance Statement: This specification section and the accompanying lighting design documents describe the minimum material quality, required features, and operational requirements of the lighting control system (LCS). These documents do not convey every wire that must be installed and every equipment connection that must be made. Based on the performance required of the system, as presented in these documents, the Contractor and system manufacturer/vendor are solely responsible for determining all equipment, wiring, and programming required for a complete and operational system.
- B. Provide an integrated lighting controls system consisting of power supplies, controllers, sensors, relays, switches, devices, wiring, etc. necessary to perform the Lighting Control Sequence of Operation as defined on the plans and specifications. Contractor is responsible for confirming that all components and luminaires interoperate as a single system.
  - 1. Sequence of Operation: Describes the required operation and performance for lighting control in each space. Sequences of operation are indicated on the drawings.
  - 2. Drawings: The drawings include sequences of operation, locations of control interface devices, sensors, and control zones. Wiring and additional equipment to make a complete and functioning system has not been shown, but shall be submitted with the shop drawings.
- C. The following control types and features are acceptable. Acceptable control locations are shown on the drawings.
  - 1. Line Voltage Control: Control equipment consists of traditional line voltage wiring devices and equipment such as switches, dimmers and combination occupancy/vacancy sensor switches, etc.

#### 1.9 WARRANTY

- A. Manufacturer shall warrant products under normal use and service to be free from defects in materials and workmanship for a period of two (2) years from date of commissioning.
- B. Occupancy, vacancy, daylight sensors and controls shall have a five (5) year warranty from date of Substantial Completion.



## PART 2 - PRODUCTS

### 2.1 LIGHTING CONTROLS

- A. All items of material having a similar function (e.g., switches, dimmers, sensors, contactors, relays, etc.) shall be of the same manufacturer, unless specifically stated otherwise on drawings or elsewhere in the specifications.
- B. Color of lighting controls and sensors shall match the receptacle wiring devices specified in the space.
- C. The functions described in the lighting sequence of operation shall dictate the actual lighting control device required to accomplish the functions described for the space.

### 2.2 DEVICE COLOR

- A. All switch, lighting controls, and coverplate colors shall be the same as wiring devices, unless indicated otherwise.

### 2.3 COVERPLATES

- A. All switches and lighting controls shall be complete with coverplates that match material and color of the wiring device coverplates in the space.
- B. Where several devices are ganged together, the coverplate shall be of the ganged style for the number of devices used.
- C. Install nameplate identification as indicated in Section 26 05 53.
- D. Plate-securing screws shall be metal with head color matching the wall plate finish.

### 2.4 WALL SWITCHES

- A. Refer to Electrical Symbols List for device type.
- B. **[SW-1P]:** Single Pole Switch:
  - 1. Single throw, 120/277-volt, 20-amp maintained contact. Toggle handle, side and back wired.
  - 2. Approved Manufacturers: Bryant 4801, Hubbell HBL1221Pass & Seymour PS20AC1.
- C. **[SW-1P-M]:** Momentary Contact Single Pole Switch:
  - 1. 120/277-volt, 20 amps. Three positions, two circuit. Center off toggle spring return handle.
  - 2. Approved Manufacturers: Bryant 4921, Hubbell HBL1557, Pass & Seymour 1251,

### 2.5 INDOOR OCCUPANCY SENSORS

- A. General Description: Wall- or ceiling-mounting, solid-state units with a separate power supply/relay unit.
  - 1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied, with a time delay for turning lights off, adjustable over a minimum

range of 1 to 30 minutes. Vacancy sensors require a manual switch operation to turn lights on and off, with a time delay for turning lights off when unoccupied.

2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
  3. Relay Unit: Dry contacts rated for 20 A ballast load at 120 and 277 VAC, for 13-amp tungsten at 120 VAC, and for 1 hp at 120 VAC. Power supply to sensor shall be 24 V dc, 150-mA, Class 2 power source as defined by NFPA 70.
  4. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outlet box.
    - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure. Mount relay above accessible ceiling near entry door to room or area.
    - c. Time Delay and Sensitivity Adjustments: Recessed and concealed.
  5. Indicator: LED to show when motion is being detected during testing and normal operation of the sensor.
  6. Bypass Switch: Override the on function in case of sensor failure.
  7. Power Supply and Slave Packs: Provide as required for sensor quantity and switching scheme. Mount to standard 1/2" knockout on electrical box above accessible ceiling near entry door to room or area. Sensor power shall be from emergency circuit if emergency lighting is in the area.
  8. Detection Coverage (Room): Detect occupancy anywhere in an area based on hand motion.
  9. Warranty: Five (5) year warranty.
- B. Dual-Technology Type: Detect occupancy by using a combination of PIR and ultrasonic or acoustic detection methods in area of coverage. Particular technology or combination of technologies that controls on and off functions shall be selectable in the field by operating controls on unit.
1. **[SW-OC-D]:** 360 Degree Coverage Pattern:
    - a. Frequency greater than 40 KHz. Dual sensing verifications (requires both technologies to activate), either technology maintains on status. Adjustable sensitivity and time delay. Sensor shall control all circuits in area, unless noted otherwise.
    - b. Approved Manufacturers: Watt Stopper DT 300 Series, Hubbell OMNI-DT2000 or ATD2000C, Sensor Switch CM PDT 10.
  2. **[SW-O]:** Wall Switch:
    - a. Wall switch with manual on/auto off. 120/277 VAC load rating of 0-800 W for ballast, LED or tungsten. 5-, 15-, 30-minute adjustable OFF delay. Coverage of minor motion in 12' x 15' pattern.
    - b. Approved Manufacturers: Watt Stopper DW-100 Series, Hubbell LHMTS, Sensor Switch WSD-PDT SA Series.

- 3. Sensitivity Adjustment: Separate for each sensing technology.
  - 4. Detection Coverage:
    - a. Task Areas: Detect occupancy anywhere in an area based on hand motion.
    - b. Circulation Areas: Detect occupancy anywhere in an area based upon half-step walking motion.
  - C. Mask sensors where necessary to prevent nuisance switching from adjacent areas.
- 2.6 CONDUCTORS AND CABLES
- A. Control Wiring:
    - 1. Where installed with the line-voltage wiring, control wiring shall be copper conductors not smaller than No. 14 AWG with insulation voltage rating and temperature rating equal to that of the line-voltage wiring, complying with Division 26 Section 26 05 13 "Wire and Cable."
  - B. Splices and Taps:
    - 1. Tapping or wire trap connectors shall be used to splice all Class 1 and Class 2 control wiring. Twist-on, wire-nut type connectors are not allowed.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work.
- B. Verify field dimensions and coordinate physical size of all equipment with the architectural requirements of the spaces into which they are to be installed. Allow space for adequate ventilation and circulation of air.
- C. Verify that required utilities are available, in proper location, and ready for use.
- D. Beginning of installation means installer accepts existing conditions.

### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings.
- B. All wiring shall be installed in conduit.
- C. All branch load circuits shall be live tested before connecting the loads to the lighting control panel.

### 3.3 SUPPORT SERVICES

- A. System Startup:
  - 1. Manufacturer shall provide factory authorized technician to confirm proper installation and operation of all system components.

B. Testing:

1. System shall be completely functional tested by a factory-authorized technician. All loads shall be tested live for continuity and freedom from defects, and all control wiring shall be tested for continuity and connections prior to energizing the system components.
2. Programming of initial zones, schedules, lighting levels, control station groups, and sensor settings shall be performed by a factory-authorized technician. Lighting Control Sequence of Operation shall serve as a basis for programming, However, all final decisions regarding groups and schedules shall be at the direction of the Owner. The following procedures shall be performed at a minimum:
  - a. Confirm occupancy sensor placement, sensitivity, and time delay settings to meet specified performance criteria.
3. Verify occupancy sensor operation is correct after furniture and equipment is installed in each area. Make adjustments to sensor settings and time delays to allow proper operation.
4. Verify occupancy sensors are located to provide complete coverage for the area served with no nuisance switching.
  - a. Relocate sensors or provide additional sensors as necessary to provide adequate coverage.
  - b. Mask occupancy sensors where necessary to prevent nuisance switching from adjacent areas.

END OF SECTION

**SECTION 26 27 26**  
**WIRING DEVICES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Device plates and box covers
- B. Receptacles
- C. Poke-through fittings

**1.2 QUALITY ASSURANCE**

- A. Provide similar devices from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the NEC Article 100, by a testing agency to Authorities Having Jurisdiction and marked for intended use.
- C. Comply with the NEC.

**1.3 REFERENCES**

- A. NEMA WD 1 – General Color Requirements for Wiring Devices
- B. NEMA WD 6 – Wiring Devices – Dimensional Requirements
- C. NFPA 70 - National Electrical Code (NEC)
- D. UL 498 – Standard for Attachment Plugs and Receptacles
- E. UL 943 – Standard for Ground Fault Circuit Interrupters

**1.4 COORDINATION**

- A. Receptacles for Owner Furnished Equipment: Match plug configurations.
- B. Coordinate installation of receptacle assemblies in countertops and furniture with the contractor providing the countertop or furniture. Contractor shall coordinate penetrations and conduit routing in countertops and furniture with drawings and other obstacles below the installation surface.

**PART 2 - PRODUCTS**

**2.1 DEVICE COLOR**

- A. All switch, receptacle, outlet, and coverplate colors shall be verified with Architect, unless indicated otherwise.

**2.2 COVERPLATES**

- A. All switches, receptacles, and outlets shall be complete with #302 stainless steel.
  - 1. Approved Manufacturers: Appleton, Bryant, Hubbell, Pass & Seymour.
- B. Where several devices are ganged together, the coverplate shall be of the ganged style for the number of devices used.
- C. Install nameplate identification as indicated in Section 26 05 53.

- D. Plate securing screws shall be metal with head color matching the wall plate finish.

## 2.3 RECEPTACLES

- A. Refer to Electrical Symbols List for device type.
- B. **[REC-DUP]:** NEMA 5-20R Duplex Receptacle:
1. 125-volt, 20 amps, 3-wire grounding type with impact resistant thermoplastic face and brass back strap.
  2. Approved Manufacturers: Bryant 5362, Hubbell 5352, Pass & Seymour 5362.
- C. **[REC-DUP-GFI]:** NEMA 5-20R Ground Fault Duplex Receptacle:
1. 125-volt, 20 amps, 3-wire grounding type with test and reset buttons in impact resistant thermoplastic face.
  2. Device shall perform self-test of GFCI circuitry in accordance with UL 943.
  3. Approved Manufacturers: Bryant GFRST20, Hubbell GF20L, Pass & Seymour 2097.
- D. **[REC-DUP-WP]:** NEMA 5-20R Weatherproof Ground Fault Duplex Receptacle:
1. 125-volt, 20 amp, 3-wire grounding type with test and reset buttons in impact resistant thermoplastic face. Provide NEMA 3R rated while-in-use cast aluminum cover.
  2. Device shall perform self-test of GFCI circuitry in accordance with UL 943.
  3. Approved Manufacturers: Bryant GFWRST20/WPB26E, Hubbell GFTR20/WP826, Pass & Seymour 2097TRWR/WIUCAST1.
- E. **[REC-SIM-520R]:** NEMA 5-20R Simplex Receptacle:
1. 125-volt, 20 amp, 3-wire grounding type with impact resistant thermoplastic face.
  2. Approved Manufacturers: Bryant 5361, Hubbell HBL5361, Pass & Seymour 5361.
- F. **[REC-QUAD]:** NEMA 5-20R Double Duplex Receptacle:
1. Consists of two duplex receptacles, double gang box, plaster ring and faceplate.
  2. Approved manufacturers: Refer to Duplex Receptacle above.
- G. **[REC-QUAD-GFI]:** NEMA 5-20R Double Duplex GFI Receptacle:
1. Consists of two duplex GFI receptacles, double gang box, plaster ring and faceplate.
  2. Approved Manufacturers: Refer to Duplex GFI Receptacle above.
- H. Back wired devices shall be complete with eight holes that are screw activated with metal clamps for connection to #12 or #10 copper conductors.
- I. Side wired devices shall have four binding screws that are undercut for positive wire retention.

- J. Ground fault circuit interrupter (GFCI) receptacles shall comply with UL 943 requiring increased surge immunity, improved corrosion resistance, improved resistance to false tripping and diagnostic indication for miswiring if the line and load conductors are reversed during installation.

## 2.4 POKE-THROUGH FITTINGS

- A. UL listed as fire-rated poke-through device for 1, 1-1/2 and 2 hour rated floors; include fire stops and smoke barriers in through-floor component. UL514A listed for scrub locations.
- B. Terminate in 4-inch square by 2-1/2-inch deep junction box.
- C. Suitable for installation with a floor thickness of 2-1/4 to 7 inches.
- D. Semi-flush die-cast aluminum carpet flange.
- E. Spring loaded receptacle covers.
- F. Verify color with Architect.
- G. **[REC-FB-#]:** Fire Rated Poke-Through:
  - 1. Flush mounted. For use with 4-inch core holes. Provide with two 125-volt, 20 amp, NEMA 5-20R duplex receptacles with 3/4" conduit and junction box. Provide with capacity for six data jacks and oversized conduit, with painted aluminum flange.
  - 2. Cast aluminum cover with separate hinged doors to open 180°. Finish as selected by Architect.
  - 3. Approved Manufacturers: Hubbell S1PT4X4, Wiremold, Thomas & Betts.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install convenience receptacles at elevations indicated in the General Installation Notes on the contract drawings.
- B. Install specific-use receptacles at heights shown on the contract drawings. Install devices level, plumb, and square with building lines. Coordinate installation of adjacent devices of separate systems with common mounting heights, including lighting, power, systems, technology, and temperature control device rough-ins.
- C. Drill opening for poke-through fitting installation in accordance with manufacturer's instructions. This Contractor is responsible for taking any measures required to ensure no conduits or other services are damaged. This may include X-ray or similar non-destructive means.
- D. Install decorative plates on switch, receptacle, and blank outlets in finished areas, using jumbo size plates for outlets installed in masonry walls.
- E. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.
- F. Install devices and wall plates flush and level.

- G. Install nameplate identification to receptacle cover plates indicated. Identification shall identify panel name and circuit number. Refer to Specification Section 26 05 53 - Electrical Identification.
- H. Test receptacles for proper polarity, ground continuity and compliance with requirements.

END OF SECTION



**SECTION 26 28 13  
FUSES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Fuses

**1.2 REFERENCES**

- A. UL 198C - High-Interrupting Capacity Fuses; Current Limiting Types
- B. UL 198E - Class R Fuses
- C. NEMA FU 1 - Low Voltage Cartridge Fuses
- D. NFPA 70 – National Electrical Code

**1.3 PROJECT CONDITIONS**

- A. Where ambient temperature to which fuses are directly exposed is less than 40°F (5°C) or more than 100°F (38°C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

**PART 2 - PRODUCTS**

**2.1 ACCEPTABLE MANUFACTURERS – FUSES**

- A. Bussman, Division of Eaton
- B. Gould Shawmut
- C. Littelfuse Inc

**2.2 FUSES**

- A. Dimensions and Performance: NEMA FU 1, Class as specified or indicated.
- B. Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage.
- C. Fuses with ratings larger than 200 amperes but equal to or less than 600 amperes: Class RK-1 (time delay), unless otherwise noted on the drawings.
- D. Fuses with ratings less than or equal to 200 amperes (not including control transformer fuses): Class RK-5, unless otherwise noted on the drawings.
- E. Control transformer fuses: Class CC (time delay).
- F. Fuses for packaged equipment: Size and type as recommended by equipment manufacturer.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Install fuses where indicated on the drawings and specifications.
- B. Install fuses in accordance with manufacturer's instruction.

- C. Install fuses in packaged equipment as required by equipment manufacturer.
- D. Install fuse with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION

**SECTION 26 51 00  
LIGHTING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Interior luminaires and accessories
- B. Lamps
- C. Ballasts

**1.2 REFERENCES**

- A. ANSI C82.11 - High Frequency Fluorescent Lamp Ballasts
- B. ANSI C82.77-2002 – Standard for Harmonic Emission Limits and Related Power Quality Requirements for Lighting Equipment
- C. UL 935 – Standard for Fluorescent Lamp Ballasts

**1.3 SUBMITTALS**

- A. Submit product data under provisions of Section 26 05 00.
- B. Submit product data sheets for luminaires, lamps, ballasts. Include complete product model number with all options as specified.

**1.4 WARRANTY**

- A. Fluorescent ballasts shall carry a three-year warranty from date of Substantial Completion. HID ballasts shall carry a two-year warranty from date of Substantial Completion. Dimming electronic ballasts shall have a five-year warranty.
- B. Emergency fluorescent ballast shall have a three-year warranty from date of substantial completion.
- C. Fluorescent lamps shall carry a two-year warranty from date of Substantial Completion.

**PART 2 - PRODUCTS**

**2.1 INTERIOR LUMINAIRES AND ACCESSORIES - GENERAL**

- A. Recessed Luminaires: Confirm ceiling and wall type and furnish trim and accessories necessary to permit proper installation in each system.
- B. Luminaires: Louvers shall be anodized low iridescent specular aluminum with mitered corners and interlocking construction. Provide ballast covers to separate inboard/outboard lamps when multi-level switching is indicated, so light does not spill into unlit cells.
- C. Self-Powered Exit Signs: Stencil face, 6-inch high letters, directional arrows as indicated, universal mounting type as indicated on the drawings. One-piece, self-contained unit with sealed, maintenance-free nickel cadmium battery, automatic charger and electronic circuitry. Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

- D. Self-Powered Emergency Lighting Units: One-piece, self-contained unit with sealed, maintenance-free nickel cadmium battery, automatic charger and electronic circuitry. Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

## 2.2 ACCEPTABLE MANUFACTURERS – LAMPS

MANUFACTURER	INCAND. HALOGEN	FLUORESCENT	COMPACT FLUOR.
Philips Lighting Company	<b>X</b>	<b>X</b>	<b>X</b>
Osram Sylvania	<b>X</b>	<b>X</b>	<b>X</b>
GE Lighting	<b>X</b>	<b>X</b>	<b>X</b>

## 2.3 INCANDESCENT LAMPS

- A. General Use Incandescent Lamps: Inside frosted type, rated 120 volts.
- B. Incandescent Reflector Lamps: Shape, beam spread, and voltage as scheduled.

## 2.4 FLUORESCENT LAMPS

- A. T-8 Type: Correlated color temperature (CCT) of 4100 deg Kelvin and minimum Color Rendering Index (CRI) of 80. Lamps shall be reduced mercury type having credentials that pass the EPA 1990 Toxic Characteristics. Four-foot, 32-watt lamps shall be 3100 lumen extended performance type, with minimum 30,000-hour lamp life at three-hour starts.
- B. Compact Fluorescent: Correlated color temperature (CCT) of 4100 deg Kelvin and minimum Color Rendering Index (CRI) of 80.

## 2.5 FLUORESCENT BALLASTS - GENERAL

- A. All ballasts shall have a Class A sound rating, or better.
- B. Ballast shall comply with EMI and RFI limits set by FCC (CFR 47 Part 18).
- C. Linear fluorescent ballasts shall operate parallel circuit lamps that allow remaining lamps to maintain full output if companion lamps fail.
- D. All fluorescent ballasts designed for operation of double-ended lamps or integral to a luminaire supplied by multi-wire branch circuits shall comply with disconnecting means as specified in NEC Article 410 and amendments thereto.
- E. Acceptable Manufacturers: Advance Electronic Mark V, Valmont, Universal.

## 2.6 FLUORESCENT ELECTRONIC BALLAST

- A. Fluorescent Ballast: Shall meet UL Standard 935. Ballasts shall be PROGRAM RAPID START (PRS) type.
- B. Ballasts operated by occupancy sensors shall be program rapid start type.

- C. Ballasts shall meet applicable ANSI and IEEE standards regarding harmonic distortion and surge protection. The input current 3rd harmonic content shall not exceed 13% of the input current. The total harmonic distortion shall not exceed 10%.
- D. Fluorescent ballasts shall conform to the performance criteria listed below:
  - 1. Minimum ballast factor: 88.
  - 2. Mean System Efficacy:
    - a. Program Start:  $\geq 88$  MLPW(T8);  $\geq 87$  MLPW(T5);  $\geq 85$  MLPW(T5HO)
- E. The ballast must maintain constant high output through input voltage ranges of 90 to 145 volts for a 120V ballast (+/- 25%).
- F. Ballast Requirements:
  - 1. Current crest factor shall be no greater than 1.7.
  - 2. The operating ambient temperature range shall be 50°F to 105°F.
  - 3. Fluorescent ballasts shall operate at 20KHZ or higher, with no detectable lamp flicker.
  - 4. Ballasts shall not be affected by lamp failure and shall yield normal lamp life.
  - 5. Ballast power factor shall be greater than 90%.
  - 6. Ballast shall be rated Class P and shall be thermally protected.
  - 7. Program rapid start ballasts shall heat the filament prior to applying the starting voltage to the lamp, then remove lamp cathode heat in a sequence consistent with ANSI standard C82.11.

## 2.7 COMPACT FLUORESCENT BALLASTS

- A. Fluorescent Ballast: ANSI C82.1; high power factor type, Class P with voltage rating matching branch circuit voltage. Ballast factor shall be .85 or greater.
- B. Current crest factor shall be no greater than 1.7. Ballast shall have a Class A sound rating.
- C. Ballast shall meet applicable ANSI and IEEE standards regarding harmonic distortion and surge protection. The total harmonic distortion for lamp wattage <26 watts shall not exceed 33%; all others shall not exceed 10%.
- D. Ballast shall have lamp fault shut off circuitry to prevent starting of a faulty lamp.
- E. Ballasts shall operate at a frequency of 20 KHz or higher with no detectable lamp flicker.

## 2.8 FLUORESCENT EMERGENCY BATTERY BALLASTS

- A. One-piece, self-contained unit with high-temperature, maintenance-free nickel cadmium battery, charger, and electronic circuitry.
- B. Charging indicator light to monitor charger and battery. Test switch and installation hardware.
- C. UL listed for installation inside or on top of luminaire.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Securely fasten luminaires to the listed and labeled ceiling framing member by mechanical means such as bolts, screws, rivets or listed clips identified for use with the type of ceiling framing members. If ceiling framing is not listed for luminaire size or weight, support luminaires independent of ceiling grid with a minimum of two (2) #12 gauge wires located on diagonal corners.
- B. Install recessed flanged luminaires to permit removal from below. Use manufacturer-supplied plaster frames and swing gate supports. Support luminaires independent of ceiling with a minimum of two (2) #12 gauge wires located on diagonal corners.
- C. Support surface-mounted luminaires directly from building structure. Install luminaires larger than eight square feet (8 ft<sup>2</sup>) or weighing more than 30 pounds independent of ceiling framing. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit, unless otherwise noted.
- D. Install lamps in lamp holders of luminaires.

### 3.2 LAMP SEASONING

- A. Operate all fluorescent and HID lamps for 100 hours prior to requesting final observation. Operate dimming fluorescent lamps at 100% output during seasoning. Operate lamps for minimum 8 hour intervals during seasoning.

### 3.3 RELAMPING

- A. Replace failed lamps at completion of work. Replacement of incandescent and other lamp burnouts after the warranty period starts shall be the responsibility of the final user.

### 3.4 ADJUSTING AND CLEANING

- A. Align luminaires and clean lenses and diffusers at completion of work. Clean paint splatters, dirt, and debris from installed luminaires.

### 3.5 LUMINAIRE SCHEDULE

- A. As shown on the drawings.

END OF SECTION

**SECTION 27 05 00**  
**BASIC COMMUNICATIONS SYSTEMS REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Basic Communications Systems Requirements specifically applicable to Division 27 sections, in addition to Division 1 - General Requirements.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

**1.2 SCOPE OF WORK**

- A. This Specification and the accompanying drawings govern the work involved in furnishing, installing, testing and placing into satisfactory operation the Communications Systems as shown on the drawings and specified herein.
- B. Each Contractor shall provide all new materials as indicated in the schedules on the drawings, and/or in these specifications, and all items required to make their portion of the Communications Systems a finished and working system.
- C. Description of Systems include but are not limited to the following:
  - 1. Complete Structured Cabling System including, but not limited to:
    - a. Voice and data horizontal cabling and terminations.
    - b. Information outlets (IOs) including faceplates, jacks and labeling.
    - c. Cable management and equipment.
    - d. Telecommunication Room equipment including patch panels, optical distribution cabinets, and termination blocks.
    - e. Cabling pathways.
    - f. Grounding and Bonding
    - g. Testing
  - 2. Removal/demolition work and/or relocation and reuse of existing systems and equipment.
  - 3. Low Voltage Communications Wiring (less than +120VAC) as specified and required for proper system control and communications.
  - 4. All associated electrical backboxes, conduit, miscellaneous cabling, and power supplies required for proper system installation and operation as defined in the "Suggested Matrix of Scope Responsibility".
  - 5. Firestopping of penetrations as described in Section 26 05 03.

**1.3 OWNER FURNISHED PRODUCTS**

- A. All active network and telephone electronics.
- B. Observation recording system head end equipment.
- C. Audiovisual and multimedia equipment.

1.4 DIVISION OF WORK BETWEEN ELECTRICAL AND COMMUNICATIONS CONTRACTORS

- A. Division of work is the responsibility of the Prime Contractor. Any scope of work described in the contract document shall be sufficient for including said requirement in the project. The Prime Contractor shall be solely responsible for determining the appropriate subcontractor for the described scope. In no case shall the project be assessed an additional cost for scope that is described in the contract documents. The following division of responsibility is a guideline based on typical industry practice.
- B. Definitions:
1. "Electrical Contractor" as referred to herein refers to the Contractors listed in Division 26 of this Specification.
  2. "Electrical Contractor" shall also refer to the Contractor listed in Division 27 of this specification when the "Suggested Matrix of Scope Responsibility" indicates the work shall be provided by the EC. Refer to the Contract Documents for the "Suggested Matrix of Scope Responsibility".
  3. "Technology Contractor" as referred to herein refers to the Contractors listed in Division 27 of this Specification.
  4. Low Voltage Technology Wiring: The wiring (less than 120VAC) associated with the Technology Systems, used for analog and/or digital signals between equipment.
  5. Telecommunications/Technology Rough-in: Relates specifically to the backboxes, necessary plaster rings and other miscellaneous hardware required for the installation and mounting of the telecommunications/technology outlet. Rough-in shall include conduit from the information outlet backbox to above finished ceiling. Where surface mounted backboxes are required, conduit shall be routed to above the finished ceiling .
- C. General:
1. The purpose of these specifications is to outline typical Electrical and Technology Contractor's work responsibilities as related to technology systems including telecommunications rough-in, audio/visual systems rough-in, conduit, power wiring, and low voltage communications and technology wiring. The prime contractor is responsible for all divisions of work.
  2. The exact wiring requirements for much of the equipment cannot be determined until the systems have been purchased and submittals are approved. Therefore, only known wiring, conduits, raceways, and electrical power as related to such items, is shown on the technology drawings. Other wiring, conduits, raceways, junction boxes, and electrical power not shown on the technology drawings but required for the successful operation of the systems shall be the responsibility of the Technology Contractor and included in the Contractor's bid.
  3. Where the Electrical Contractor is required to install conduit, conduit sleeves and/or power connections in support of technology systems, the final installation shall not begin until a coordination meeting between the Electrical Contractor and the Technology Contractor has convened to determine the exact location and requirements of the installation.
  4. Where the Electrical Contractor is required to install cable tray that will contain low voltage technology wiring, the installation shall not begin until the Technology Contractor has completed a coordination review of the cable tray shop drawing.



5. This Contractor shall establish electrical and technology utility elevations prior to fabrication and installation. The Technology Contractor shall cooperate with the Electrical Contractor and the determined elevations in accordance with the guidelines below. This Contractor shall coordinate utility elevations with other trades. When a conflict arises, priority shall be as follows:

- a. Lighting Fixtures
- b. Gravity Flow Piping, including Steam and Condensate
- c. Sheet Metal
- d. Electrical Busduct
- e. Sprinkler Piping and other Piping
- f. Conduit and Wireway
- g. Open Cabling

D. Electrical Contractor's Responsibility:

1. Assumes all responsibility for all required conduit and power connections when shown on the "Suggested Matrix of Scope Responsibility" to be provided by the Electrical Contractor.
2. Responsible for Communications Systems grounding and bonding.
3. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

E. Technology Contractor's Responsibility:

1. Assumes all responsibility for the low voltage technology wiring of all systems, including cable support where open cable is specified.
2. Assumes all responsibility for all required backboxes, conduit and power connections not specifically shown as being provided by the Electrical Contractor on the "Suggested Matrix of Scope Responsibility."
3. Assumes all responsibility for providing and installing all ladder rack and other cable management hardware (as defined herein).
4. Responsible for providing the Electrical Contractor with the required grounding lugs or other hardware for each piece of technology equipment which is required to be bonded to the technology bonding system.
5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.5 QUALITY ASSURANCE

A. Telecommunications Structured Cabling System Standards:

1. All work and equipment shall conform to the most current ratified version of the following published standards unless otherwise indicated that draft standards are to be followed:
  - a. ANSI/NECA/BICSI 568 - Standard for Installing Commercial Building Telecommunications Cabling

- b. ANSI/TIA-568-C.0 - Generic Telecommunications Cabling for Customer Premises
    - 1) C.1 - Commercial Building Telecommunications Standard
    - 2) C.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standard
    - 3) C.3 - Optical Fiber Cabling Components Standard
    - 4) C.4 - Broadband Coaxial Cabling and Components Standard
  - c. ANSI/TIA-569-C - Telecommunications Pathways and Spaces
  - d. ANSI/TIA-606-B - Administration Standard for Commercial Telecommunications Infrastructure
  - e. ANSI/TIA-607-B - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
  - f. ANSI/TIA-862-A - Building Automation Systems Cabling Standard
  - g. ANSI/TIA-942-A - Telecommunications Infrastructure Standard for Data Centers
  - h. ANSI/TIA-1152 - Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
  - i. ANSI/TIA/EIA-598-C - Optical Fiber Cable Color Coding
  - j. NFPA 70 (NEC) - National Electrical Code (Current Edition)
  - k. UL 444 - Standard for Safety for Communications Cable
- B. Refer to individual sections for additional Quality Assurance requirements.
- C. Qualifications:
- 1. Only products of reputable manufacturers as determined by the Architect/Engineer will be acceptable.
  - 2. The installing Contractor shall be certified by the manufacturer of the structured cabling system. Certification of Contractor shall have been in place for a minimum of one (1) year prior to bidding this project. Documentation of certification is required at the time of bid. Shop drawings will not be approved until proof of certification is submitted. Refer to the end of this specification section for certification documentation requirements.
  - 3. Each Contractor and their subcontractors shall employ only workers who are skilled in their respective trades and fully trained. All workers involved in the termination of cabling shall be individually certified by the manufacturer.
  - 4. The Contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size.
  - 5. The Contractor shall own and maintain tools and equipment necessary for successful installation and testing of optical and copper structured cabling systems and have personnel adequately trained in the use of such tools and equipment.

6. The Contractor must have a BICSI RCDD (Registered Communications Distribution Designer) or CNet CNIDP (Certified Network Infrastructure Design Professional) on-staff serving as a project manager. Project shop drawings and test reports shall be stamped by the RCDD or CNIDP.
7. The Contractor shall have certified BICSI installation technicians or CNet CNIT (Certified Network Infrastructure Technician) on staff to perform the following tasks on the project:
  - a. Act as the field superintendent or job foreman with the responsibility of monitoring the daily work of each technician.
  - b. Oversee all testing and termination of cabling.
8. The Contractor shall have certified BICSI Installer 2 or CNet CNCI (Certified Network Cabling Installer) on staff to perform the following tasks:
  - a. Installation and termination of copper cable.
  - b. Installation and termination of optical fiber.
9. A resume of qualification shall be submitted with the Contractor's bid indicating the following:
  - a. Documentation of certification of This Contractor by the proposed structured cabling system manufacturer as required at the end of this specification section.
  - b. A list of recently completed projects of similar type and size with contact names and telephone numbers for each.
  - c. A technical resume of experience for the Contractor's project manager and on-site installation supervisor assigned to this project.
  - d. Resume and certification of the RCDD or CNIDP for the project as required by the form at the end of this specification section.
  - e. Resume and certification of the BICSI installation technician or CNet CNIT for the project.

D. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the City of Detroit, Michigan Codes, Laws, Ordinances and other regulations having jurisdiction.
2. Conform to all published standards of Wayne State University.
3. In the event there are no local codes having jurisdiction over this job, the current issue of the National Electrical Code shall be followed.
4. If there is a discrepancy between the codes and regulations having jurisdiction over this installation, and these specifications, Architect/Engineer shall determine the method or equipment used.
5. If the Contractor notes, at the time of bidding, any parts of the drawings and specifications which are not in accordance with the applicable codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time to follow this procedure, he shall submit with the proposal, a separate price required to make the system shown on the drawings comply with the codes and regulations.

6. Verify the installation environment prior to purchasing or installing any cable. Cable installed in a plenum environment shall be appropriately rated. Bring all discrepancies between the contract documents and installation conditions to the attention of the Architect/Engineer prior to purchase or installation.
7. All changes to the system made after the letting of the contract, in order to comply with the applicable codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Owner.

E. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all applicable laws, regulations, ordinances, and other rules of the State or Political Subdivision wherein the work is done, or as required by any duly constituted public authority.
3. Pay all applicable charges for such permits or licenses that may be required.
4. Pay all applicable fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
5. Pay all charges arising out of required inspections due to codes, permits, licenses or as otherwise may be required by an authorized body.
6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized independent agency/consultant.
7. Pay any charges by the service provider related to the service or change in service to the project.
8. All equipment and materials shall be as approved or listed by the following (unless approval or listing is not applicable to an item by all acceptable manufacturers):
  - a. Factory Mutual
  - b. Underwriters' Laboratories, Inc.

F. Examination of Drawings:

1. The drawings for the technology systems work are diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and the exact routing of cabling to best fit the layout of the job. Scaling of the drawings will not be sufficient or accurate for determining this layout. Where a specific route is required, such route will be indicated on the drawings.
3. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
4. If an item is either shown on the drawings, called for in the specifications or required for proper operation of the system, it shall be considered sufficient for including same in this contract.

5. The determination of quantities of material and equipment required shall be made by the Contractor from the drawings. Schedules on the drawings and in the specifications are completed as an aid to the Contractor but where discrepancies arise, the greater number shall govern.
6. Where words "provide", "install", or "furnish" are used on the drawings or in the specifications, it shall be taken to mean, to furnish, install and terminate completely ready for operation, the items mentioned.

G. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.
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 Contractor shall complete and return a signed "Electronic File Transmittal" form provided by IMEG.
4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
7. The use of these CAD 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 IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor's use of these documents.

H. Field Measurements:

1. Before ordering any materials, this Contractor shall verify all pertinent dimensions at the job site and be responsible for their accuracy.
2. Field conditions that will result in telecommunications drops that exceed the length limitations identified in the contract documents shall be brought to the attention of the Architect/Engineer prior to installation. The cost of reworking cabling that is too long, that was not brought to the written attention of the Architect/Engineer will be borne entirely by the Contractor.
3. This Contractor shall provide the Architect/Engineer with written documentation of any cabling drops that will not be able to use the cable tray (where cable tray is available) due to the resulting cabling lengths. This documentation shall be submitted prior to installation and installation shall not commence until approved by the Architect/Engineer.

1.6 SUBMITTALS

- A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

**Referenced  
Specification**

<u>Section</u>	<u>Submittal Item</u>
27 05 28	Interior Communications Pathways
27 05 53	Identification and Administration
27 11 00	Communication Equipment Rooms
27 15 00	Horizontal Cabling Requirements
27 17 10	Testing

- B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:

- a. Date
- b. Project title and number
- c. Contractor's name and address
- d. Description of items submitted and relevant specification number
- e. Notations of deviations from the contract documents
- f. Other pertinent data

2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:

- a. Date
- b. Project title and number
- c. Architect/Engineer
- d. Contractor and subcontractors' names and addresses
- e. Supplier and manufacturer's names and addresses
- f. Description of item submitted (using project nomenclature) and relevant specification number
- g. Notations of deviations from the contract documents
- h. Other pertinent data
- i. Provide space for Contractor's review stamps

3. Composition:

- a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
- b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
- c. All sets shall contain an index of the items enclosed with a general topic description on the cover.

4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
5. Contractor's Approval Stamp:
  - a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
  - b. Unstamped submittals will be rejected.
  - c. The Contractor shall provide proof of RCDD or CNIDP review on the submittal.
  - d. The Contractor's review shall include, but not be limited to, verification of the following:
    - 1) Only approved manufacturers are used.
    - 2) Addenda items have been incorporated.
    - 3) Catalog numbers and options match those specified.
    - 4) Performance data matches that specified.
    - 5) Electrical characteristics and loads match those specified.
    - 6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
    - 7) Dimensions and service clearances are suitable for the intended location.
    - 8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
    - 9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).
  - e. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.
  - f. **The 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 deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.**
6. Submittal Identification and Markings:
  - a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
  - b. The Contractor shall clearly indicate the size, finish, material, etc.
  - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
  - d. All marks and identifications on the submittals shall be unambiguous.

7. Schedule submittals to expedite the project. Coordinate submission of related items.
8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
9. Reproduction of contract documents alone is not acceptable for submittals.
10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
11. Submittals not required by the contract documents may be returned without review.
12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any equipment for manufacture or shipment.
14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
  - a. Submittal file name: 27 XX XX.description.YYYYMMDD
  - b. Transmittal file name: 27 XX XX.description.YYYYMMDD
5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be transmitted via a pre-approved method.

1.7 CHANGE ORDERS

- A. A detailed material and labor take-off shall be prepared for each change order along with labor rates and mark-up percentages. Change orders with inadequate breakdown will be rejected.
- B. Change order work shall not proceed until authorized.



1.8 EQUIPMENT SUPPLIERS' INSPECTION

- A. The following equipment shall not be placed in operation until a representative of the manufacturer has inspected the installation and certified that the equipment is properly installed, and that the equipment is ready for operation:

- 1. Firestopping, including mechanical firestop systems.

1.9 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

- A. Exercise care in transporting and handling to prevent damage to fixtures, equipment and materials.
- B. Store materials on the site to prevent damage.
- C. Keep fixtures, equipment and materials clean, dry and free from deleterious conditions.

1.10 NETWORK / INTERNET CONNECTED EQUIPMENT

- A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Owner.

1.11 WARRANTY

- A. At a minimum, provide a one (1) year warranty for all equipment, materials, and workmanship. Individual specifications sections within Division 27 may require additional warranty requirements for specific equipment or systems.
- B. The warranty period for the entire installation described in this Division of the specifications shall commence on the date of substantial completion unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner or their representative.
- C. Warranty requirements shall extend to correction, without cost to the final user, of all work and/or equipment found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from such defects or nonconformance with contract documents exclusive of repairs required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

1.12 INSURANCE

- A. This Contractor shall maintain insurance coverage as set forth in Division 1 of these specifications.

1.13 MATERIAL SUBSTITUTION

- A. Where several manufacturers' names are given, the first named manufacturer constitutes the basis for job design and establishes the equipment quality required.
- B. Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meets all requirements of the drawings and specifications and fits in the allocated space. The Architect/Engineer shall make the final determination of whether a product is equivalent.

- C. Any material, article or equipment of other unnamed manufacturers 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/Engineer via addendum. The Contractor bears full responsibility for the unnamed manufacturers equipment adequately meeting the intent of design. The Architect/Engineer may reject manufacturer at time of shop drawing submittal. The Contractor assumes all costs incurred by other trades on the project as a result of changes necessary to accommodate the offered material, equipment or installation method.
- D. Should this Contractor be unable to secure approval from the Architect/Engineer for other unnamed manufacturers as outlined above, this Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder. Should a voluntary alternate material be accepted, This Contractor shall assume all costs that may be incurred as a result of using the offered material, article or equipment necessitating extra expense on This Contractor or on the part of other Contractors whose work is affected.

## PART 2 - PRODUCTS

- 2.1 Cable Jacket Rating: This project requires all cable jackets to carry a plenum rating.
- 2.2 Refer to individual sections.

## PART 3 - EXECUTION

### 3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employees and subconsultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

### 3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Installation of all conduit and cabling shall comply with Sections 26 05 33 and 26 05 13. Additional conduit requirements described within this Division shall be supplemental to the requirement described in Section 26 05 33. Should conflicts exist between the two Divisions the more stringent (more expensive material and labor) condition shall prevail until bidding addendum or construction clarification or RFI can be submitted and responded to. In no case shall the Contractor carry the least stringent condition in the pricing.
- B. It is the Contractor's responsibility to survey the site and include all necessary costs to perform the installation as specified.
- C. The Contractor shall be responsible for identifying and reporting to the Architect/Engineer any existing conditions including but not limited to damage to walls, flooring, ceiling and furnishings prior to start of work. All damage to interior spaces caused by this Contractor shall be repaired at this Contractor's expense to pre-existing conditions, including final colors and finishes.

- D. All cables and devices installed in damp or wet locations, including any underground or underslab location, shall be listed as suitable for use in such environments. Follow manufacturer's recommended installation practices for installing cables and devices in damp or wet locations. Any cable or device that fails as a result of being installed in a damp or wet location shall be replaced at the Contractor's expense.

### 3.3 FIELD QUALITY CONTROL

A. General:

1. Refer to specific Division 27 sections for further requirements.
2. The Contractor shall conduct all tests required and applicable to the work both during and after construction of the work.
3. The necessary instruments and materials required to conduct or make the tests shall be supplied by the Contractor who shall also supply competent personnel for making the tests who has been schooled in the proper testing techniques.
4. In the event the results obtained in the tests are not satisfactory, This Contractor shall make such adjustments, replacements and changes as are necessary and shall then repeat the test or tests which disclose faulty or defective work or equipment and shall make such additional tests as the Architect/Engineer or code enforcing agency deems necessary.
5. All communications cable tests that fail, including those due to excessive cabling lengths, shall be remedied by the Contractor without cost to the project.

B. Protection of cable from foreign materials:

1. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited, to overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid or compound that could come in contact with the cable, cable jacket or cable termination components.
2. Application of foreign materials of any kind on any cable, cable jacket or cable termination component will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed. This requirement is regardless of the PASS/FAIL test results of the cable containing overspray. Should the manufacturer and warrantor of the structured cabling system desire to physically inspect the installed condition and certify the validity of the structured cabling system (via a signed and dated statement by an authorized representative of the structured cabling manufacturer), the Owner may, at their sole discretion, agree to accept said warranty in lieu of having the affected cables replaced. In the case of plenum cabling, in addition to the statement from the manufacturer, the Contractor shall also present to the Owner a letter from the local Authority Having Jurisdiction stating that they consider the plenum rating of the cable to be intact and acceptable.

### 3.4 PROJECT CLOSEOUT

- A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.

B. Final Jobsite Observation:

1. The Architect/Engineer will not perform a final jobsite observation until the project is ready. This is not dictated by schedule, but rather by completeness of the project.
2. Refer to the end of this specification section for a "STATEMENT INDICATING READINESS FOR FINAL JOBSITE OBSERVATION."
3. The Contractor shall sign this form and return it to the Architect/Engineer so that the final observation can commence.

C. Before final payment will be authorized, this Contractor must have completed the following:

1. Submitted operation and maintenance manuals to the Architect/Engineer for review.
2. Submitted bound copies of approved shop drawings.
3. Record documents including edited drawings and specifications accurately reflecting field conditions, **inclusive** of all project revisions, change orders, and modifications.
4. Submitted a report stating the instructions given to the Owner's representative complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representative as having received the instructions.
5. Submitted testing reports for all systems requiring final testing as described herein.
6. Submitted start-up reports on all equipment requiring a factory installation inspection and/or start.
7. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site; submit receipt to Architect/Engineer prior to final payment being approved.
8. Provide System Assurance Warranty certificate for the telecommunications system.

3.5 OPERATION AND MAINTENANCE MANUALS

A. General:

1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.
2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.

3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
  - a. O&M file name: O&M.div27.contractor.YYYYMMDD
  - b. Transmittal file name: O&Mtransmittal.div27. contractor.YYYYMMDD
5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be divided into files that are clearly labeled as “1 of 2”, “2 of 2”, etc.
6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title “Operation and Maintenance Instructions”, title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
7. All text shall be searchable.
8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

C. Paper Copy Submittal Procedures:

1. Once the electronic version of the manuals has been approved by the Architect/Engineer, two (2) paper copies of the O&M manual shall be provided to the Owner. The content of the paper copies shall be identical to the corrected electronic copy.
2. Binder Requirements: The Contractor shall submit O&M manuals in heavy duty, locking three ring binders. 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. The three-ring binders shall be 1/2" thicker than initial material to allow for future inserts. If more than one notebook is required, label in consecutive order. For example; 1 of 2, 2 of 2. No other form of binding is acceptable.
3. Binder Labels: Label the front and spine of each binder with “Operation and Maintenance Instructions”, title of project, and subject matter.
4. Index Tabs: Divide information by specification section, major equipment, or systems using index tabs. All tab titling shall be clearly printed under reinforced plastic tabs. All equipment shall be labeled to match the identification in the construction documents.

D. Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.

3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
4. Copy of final approved test and balance reports.
5. Copies of all factory inspections and/or equipment startup reports.
6. Copies of warranties.
7. Schematic wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
8. Dimensional drawings of equipment.
9. Capacities and utility consumption of equipment.
10. Detailed parts lists with lists of suppliers.
11. Operating procedures for each system.
12. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
13. Repair procedures for major components.
14. List of lubricants in all equipment and recommended frequency of lubrication.
15. Instruction books, cards, and manuals furnished with the equipment.

### 3.6 INSTRUCTING THE OWNER'S REPRESENTATIVE

- A. Adequately instruct the Owner's designated representative or representatives in the maintenance, care, and operation of the complete systems installed under this contract.
- B. Provide verbal and written instructions to the Owner's representative or representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.
- C. The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions to facilitate this recording.
- D. The Architect/Engineer shall be notified of the time and place for the verbal instructions to be given to the Owner's representative so that their representative can be present if desirable.
- E. Refer to the individual specification sections for minimum hours of instruction time for each system.
- F. Operating Instructions:
  1. The Contractor is responsible for all instructions to the Owner and/or Owner's operating staff on the Communications Systems.
  2. If the Contractor does not have Engineers and/or Technicians on staff who can adequately provide the required instructions on system operation, performance, troubleshooting, care and maintenance, they shall include in the bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

### 3.7 SYSTEM COMMISSIONING

- A. The Communications Systems included in the construction documents are to be complete and operating systems. The Architect/Engineer will make periodic job site observations during the construction period. The system start-up, testing, configuration, and satisfactory system performance is the responsibility of the Contractor. This shall include all calibration and adjustments of electrical equipment controls, equipment settings, software configuration, troubleshooting and verification of software, and final adjustments that may be required.
- B. All operating conditions and control sequences shall be simulated and tested during the start-up period.
- C. The Contractor, subcontractors, and equipment suppliers are expected to have skilled technicians to ensure that the system performs as designed. If the Architect/Engineer is requested to visit the job site for the purpose of trouble shooting, assisting in the satisfactory 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 material basis for services rendered at the Architect/Engineer's standard hourly rates in effect at the time the services are requested. The Contractor shall be responsible for making payment to the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

### 3.8 RECORD DOCUMENTS

- A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.
- B. Mark specifications to indicate approved substitutions, change orders, and actual equipment and materials used.
- C. This Contractor shall maintain at the job site, a separate and complete set of technology drawings which shall be clearly and permanently marked and noted in complete detail any changes made to the location and arrangement of equipment or made to the Technology Systems and wiring as a result of building construction conditions or as a result of instructions from the Architect or Engineer. 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 Architect/Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect/Engineer's hourly rates in effect at the time of work.
- D. Record actual routing of all conduits sized 2" or larger.
- E. The above record of changes shall be made available for the Architect and Engineer's examination during any regular work time.
- F. Upon completion of the job, and before final payment is made, This Contractor shall give the marked-up drawings to the Architect/Engineer.

### 3.9 ADJUST AND CLEAN

- A. Contractor shall thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project.

- B. Contractor shall clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from equipment.
- C. Contractor shall remove all rubbish, debris, etc., accumulated during the Contractor's operations from the premises.

END OF SECTION



**STATEMENT INDICATING READINESS FOR FINAL JOBSITE OBSERVATION**

To assist the contractor in a timely close-out of the project, it is crucial that the final jobsite observation is not conducted prior to the project being ready. The contractor is required to review the completion status of the project at the time the observation is scheduled. This review, and the subsequent submittal of this form to the Architect/Engineer, shall indicate the contractor's agreement that the area of the project being requested for final observation is ready as defined below. The following list represents the degree of completeness required prior to requesting a final observation:

1. All cabling pathways (conduit sleeves, J-hooks, etc.) are installed and all cabling has been pulled through them.
2. All mechanical firestop products are installed and all other penetrations have been sealed.
3. All telecommunications jacks are installed in the faceplates.
4. All telecommunications cabling is pulled and at least 75% of all jacks have been terminated at the jack and at the telecom room.
5. Telecommunications testing is in progress and at least 25% of testing has been completed.
6. Telecommunications labeling has been provided on at least 25% of each type of component requiring a label.
7. All telecommunications related grounding is complete.

The project will be ready for final jobsite observation prior to the requested date of the observation according to the above list of requirements.

Prime Contractor: \_\_\_\_\_ By: \_\_\_\_\_

Requested Observation Date \_\_\_\_\_ Today's Date: \_\_\_\_\_

Contractor shall sign this readiness statement and transmit to Architect/Engineer at least 10 days prior to the requested date of observation.

It is understood that if the Architect/Engineer finds that the project is not complete as defined above and that the final jobsite observation cannot be completed on the requested date, the Architect/Engineer will return to the site at a later date. All additional visits to the site for the purposes of completing the final observation will be billed T&M to the Contractor at our standard hourly rates, including travel expenses or the contractor's retainage may be deducted for the same amount.

**Telecommunications – Proof of Certification**

There are specific Contractor qualification requirements for this project as defined in Section 27 05 00, which may include Manufacturer Certification and RCDD or CNIDP credentials. This Proof of Certification document, and the supporting documentation require herein, is required to be submitted at the time of bid to show compliance with the requirements of 27 05 00.

**Statement of Compliance:**

The named Contractor's base bid is a structured cabling solution from the connectivity manufacturer \_\_\_\_\_. Named Contractor is trained and certified, under the named manufacturer's formal certification program to provide and install all materials and work required by this project. Further, said Contractor is authorized, by the named manufacturer, to offer all product, labor and system assurance warranties required for this project by these contract documents.

The certification of this named manufacturer is valid, current and in effect as of the bid day of this project, the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

The named Contractor is not employing any other sub-contractor on the telecommunications portion of this project that does not also meet this certification requirement.

Contractor Company Name: \_\_\_\_\_

Authorized Representative: (print) \_\_\_\_\_

Date: \_\_\_\_\_ Manufacturer Certification Number (if any): \_\_\_\_\_

If this project requires RCDD certification, complete the following:

RCDD or CNIDP Name: \_\_\_\_\_ RCDD #: \_\_\_\_\_ Expiration: \_\_\_\_\_

Submit the following with the bid:

- This form.
- Proof of Manufacturer Certification indicated above.
- Proof of RCDD or CNIDP status.

**SECTION 27 05 05**  
**TECHNOLOGY DEMOLITION FOR REMODELING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Technology demolition.

**1.2 RELATED WORK**

- A. Section 27 05 00 - Basic Communications Systems Requirements.

**1.3 REFERENCES**

- A. NFPA 70 – National Electrical Code.

**PART 2 - PRODUCTS**

**2.1 MATERIALS AND EQUIPMENT**

- A. Materials and equipment for terminating, patching and cross connecting of existing telecommunications and security systems shall be as specified in individual Sections.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. THE DRAWINGS ARE INTENDED TO INDICATE THE SCOPE OF WORK REQUIRED AND DO NOT INDICATE EVERY OUTLET, BOX, CONDUIT, OR CABLE THAT MUST BE REMOVED.
- B. THE CONTRACTOR SHALL VISIT THE SITE PRIOR TO SUBMITTING A BID AND VERIFY EXISTING CONDITIONS AND SCOPE OF WORK.
- C. Where walls, ceilings, structures, etc., are indicated as being renovated on general drawings, the Contractor shall be responsible for the removal of all technology equipment including but not limited to: copper, fiber and coaxial cable, faceplates and jacks, raceways, racking and equipment mounted to the racking, etc., from the renovated area.
- D. Where ceilings, walls, structures, etc., are temporarily removed and replaced by others, this Contractor shall be responsible for the removal, storage, and replacement of equipment, devices, fixtures, raceways, wiring, systems, etc.
- E. Verify that abandoned wiring and equipment serve only abandoned equipment or facilities. Extend conduit and wire to facilities and equipment that will remain in operation following demolition. Extension of conduit and wire to equipment shall be compatible with the surrounding area.
- F. Coordinate scope of work with all other Contractors and the Owner at the project site. Schedule removal of equipment and technology service to avoid conflicts.

### 3.2 PREPARATION

- A. Not all services within the building will be inactive or abandoned. Verify abandonment status with the building owner, General Contractor and Architect/Engineer prior to demolition.
- B. Prior to commencing with demolition, a proposed implementation narrative with schedule shall be submitted to the Architect/Engineer for approval.
- C. The contractor shall provide proof that only qualified personnel with extensive telecommunications experience will perform the demolition. No laborers will be allowed in the cable removal process.
- D. The contractor shall coordinate with owner to verify all cabling, patch cords and cross connects have been removed from active equipment that is to remain during the duration of the renovation.
- E. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on active equipment, use technicians experienced in such operations. Assume all equipment and systems must remain operational unless specifically noted otherwise on drawings.

### 3.3 DEMOLITION AND EXTENSION OF EXISTING TECHNOLOGY WORK

- A. Demolish and extend existing technology work under provisions of Division 1 of Architectural Specifications and this Section.
- B. Some cabling within the ceiling space may serve other building tenants; care shall be exercised to prevent service interrupts.
- C. Remove, relocate, and extend existing installations to accommodate new construction.
- D. Remove abandoned low voltage cabling and raceway to source of cabling according to the NEC. Refer to the NEC for definition of Abandoned Communications Cabling.
- E. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces. Remove all associated clamps, hangers, supports, etc. associated with raceway removal.
- F. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is removed. Patch openings created from removal of devices to match surrounding finishes.
- G. Disconnect and remove abandoned patch panels, blocks and other distribution equipment.
- H. Repair adjacent construction and finishes damaged during demolition and extension work. Patch openings to match existing surrounding finishes.
- I. Maintain access to existing technology installations that remain active. Modify installation or provide access panels as appropriate.
- J. Extend existing installations using materials and methods compatible with existing technology installations, or as specified.
- K. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- L. This Contractor is responsible for all costs incurred in repair, relocations, or replacement of any cables, conduits, or other services if damaged without proper investigation.

3.4 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment that remain or are to be reused.
- B. Patch panels, blocks and other connectivity equipment: Clean exposed surfaces and check tightness of connections. Re-terminate any loose connections; the contractor shall notify the Architect/Engineer of any permanently damaged or unusable equipment.
- C. TECHNOLOGY ITEMS (E.G., PATCH PANELS, EQUIPMENT RACKS, JACKS, FACEPLATES, BLOCKS, CABLING, ETC.) REMOVED AND NOT RELOCATED REMAIN THE PROPERTY OF THE OWNER. CONTRACTOR SHALL PLACE ITEMS RETAINED BY THE OWNER IN A LOCATION COORDINATED WITH THE OWNER. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE DISPOSAL OF MATERIAL THE OWNER DOES NOT WANT.

3.5 INSTALLATION

- A. Install relocated materials and equipment under the provisions of applicable Division 27 specifications.

END OF SECTION

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**SECTION 27 05 28**  
**INTERIOR COMMUNICATION PATHWAYS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, tests and services to install complete wire mesh support systems, conduits, sleeves, innerduct, etc. for an interior cabling plant as shown on the drawings.
- B. Wire mesh support systems are defined to include but are not limited to straight sections of continuous wire mesh, field formed horizontal and vertical bends, tees, drop outs, supports and accessories.

**1.2 RELATED WORK**

- A. Section 26 05 33 - Conduit and Boxes
- B. Section 27 05 00 - Basic Communications Systems Requirements

**1.3 QUALITY ASSURANCE**

- A. Refer to Section 27 05 00 for requirements.

**1.4 REFERENCES**

- A. ANSI/NFPA 70 - National Electrical Code

**1.5 SUBMITTALS**

- A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work the Contractor shall submit:
  - 1. Manufacturer's data covering all products proposed, including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.
  - 2. Manufacturer's installation instructions.

**1.6 DRAWINGS**

- A. The drawings, which constitute a part of these specifications, indicate the general route of the wire mesh support systems, conduit, sleeves, etc. Data presented on these drawings is as accurate as preliminary surveys and planning can determine until final equipment selection is made. Accuracy is not guaranteed and field verification of all dimensions, routing, etc., is required.

**PART 2 - PRODUCTS**

**2.1 CONDUIT**

- A. Refer to Section 26 05 33 for conduit requirements for this project.

**2.2 CABLE HANGERS AND SUPPORTS**

- A. Provide a non-continuous cable support system suitable for use with open cable.

B. Cable Hooks:

1. Construction: Flat bottom design with a minimum cable bearing surface of 1-5/8". Hooks shall have 90-degree radius edges.
2. All cable hook mounting hardware shall be recessed to prevent damage to cable during installation. Installed cabling shall be secured using a cable latch retainer that shall be removable and reusable.
3. Finish: Pre-galvanized steel, ASTM A653 suitable for general duty use zinc plated steel, ASTM B633 SC3 suitable for heavy duty use. Provide stainless steel AISI Type 304 hooks for corrosive locations.

PART 3 - EXECUTION

3.1 CABLE HOOK SUPPORT SYSTEM

- A. In areas where cabling is not supported by cable tray, ladder rack, enclosed wireway or installed in conduit, such cabling shall be supported by an approved cable hook support system.
- B. Refer to manufacturer's requirements for allowable fill capacity for selected cable hook. In no case shall a 40% fill capacity be exceeded.
- C. Cable hooks shall be securely mounted per manufacturer's instructions. In no case shall the side-to-side travel of any cable hook exceed 6".
- D. Cable hooks shall be selected based on the contractor's cable routing. Hooks shall be capable of supporting a minimum of 30 pounds with a safety factor of 3.
- E. Support spans shall be based on the manufacturer's load ratings. In no case shall a 5-foot span be exceeded.
- F. The resting and supporting of cabling on structural members shall not meet the requirements for cabling support specified herein.
- G. The use of tie-wraps or hook and loop type fasteners is specifically prohibited as a substitute for cable hooks specified herein.

3.2 CONDUIT AND CABLE ROUTING

- A. Refer to specification section 26 05 03 for additional requirements.
- B. All conduits shall be reamed and shall be installed with a nylon bushing.
- C. Maintain appropriate conduit bend radius at all times. For conduits with an internal diameter of 2" or less, maintain a bend radius of at least 6 times the internal diameter. For conduits with an internal diameter greater than 2", maintain a bend radius of at least 10 times the internal diameter.
- D. No conduit or sleeve containing more than two (2) cables shall exceed 40% fill ratio, regardless of length.
- E. Any conduit exceeding 90' in length or containing more than two (2) 90-degree bends shall contain a pull box sized per ANSI/TIA/EIA 569 requirements.
  1. A separate pull box is required for each 90' (or greater) length section.



2. A separate pull box is required after any two (2) consecutive 90-degree bends.
  3. Pull box shall be located in an area that maintains accessibility of box, including the ability to remove box lid without removal or relocation of any other materials.
- F. Any conduit with bends totaling 90 degrees or more shall have the fill capacity derated by 15% for each 90 degrees of cumulative bend.
- G. Cables installed in any conduits that do not meet the above requirements shall be replaced at the Contractor's expense, after the conduit condition has been remedied.

END OF SECTION

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**SECTION 27 05 53**  
**IDENTIFICATION AND ADMINISTRATION**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. This section describes the execution and administration requirements relating to the structured cabling system and its termination components and related subsystems.
- B. Identification and labeling.

**1.2 RELATED WORK**

- A. Section 27 05 00 – Basic Communications Systems Requirements

**1.3 QUALITY ASSURANCE**

- A. Refer to Section 27 05 00 for relevant standards.
- B. Perform all work in accordance with State of Detroit, Michigan standard.

**1.4 SUBMITTALS**

- A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work the Contractor shall submit:
  - 1. Documentation of labeling scheme.

**PART 2 - PRODUCTS**

**2.1 LABELING**

- A. Adhesive labels shall meet the requirements of UL 969 (Ref D-16) for legibility, defacement and adhesion. Exposure requirements of UL 969 for indoor and outdoor (as applicable) use shall be met.
- B. Insert labels shall meet the requirements of UL 969 for legibility, defacement and general exposure.
- C. Labeling shall be consistent for all common elements in the project. This consistency shall include label size, color, typeface and attachment method.
- D. Labels incorporating bar codes shall be either Code 39 conforming to USS-39 or Code 128 conforming to USS-128.
  - 1. All Code 39 bar codes shall have a ratio between 2.5:1 and 3.0:1. Provide a minimum “quiet zone” of 0.25” on each side of the bar code.
  - 2. A descriptive label for reading by personnel shall be provided with any bar code. Bar codes by themselves are not acceptable.

- E. Color Code: Observe the following requirements for color coding:
1. Labels on each end of a cable shall be the same color for each termination.
  2. Labels for cross-connects shall be two different colors at each termination fields, representative of the color of that field.
  3. Orange (Pantone 15C) shall be used for the demarcation point.
  4. Green (Pantone 353C) shall be used for the termination point of network connection on the facility side of the demarc.
  5. Purple (Pantone 264C) shall be used to identify the termination of cables from common equipment (PBX, computers, LANS, etc.)
  6. White shall be used to identify the first-level backbone termination in the main cross-connect.
  7. Gray (Pantone 422C) shall be used to identify the second-level backbone termination in the main cross-connect.
  8. Blue (Pantone 291C) shall be used to identify the termination of station cabling at the telecommunications closet and/or equipment room end of the cable.
  9. Brown (Pantone 465C) shall be used to identify the termination of the interbuilding backbone cable terminations.
  10. Yellow (Pantone 101C) shall be used to identify the termination of auxiliary circuits, alarms, maintenance, security, etc.
  11. Red (Pantone 184C) shall be used to identify the termination of key telephone systems.
  12. In facilities that do not contain a main cross-connect, the color white may be used to identify second-level backbone terminations.
- F. Tag all, CAT 6 cables at both the Communications Equipment Room and the information outlets using the following alphanumeric labeling system:
1. (Room Number) – (Cubicle number) - (Function +Jack Number).
  2. “Outlet Number” shall start with 1 in each room, with additional outlets in each room numbered sequentially.
  3. “Jack Number” shall start with 1 for the upper left jack in each outlet, increasing sequentially from left to right and top to bottom across the outlet face.
  4. “Use” shall be designated by the following:
    - a. “V” for voice (RJ-45)
    - b. “D” for data (RJ-45)
    - c. “C” for video (coax)
    - d. “M” for multimedia retrieval (coax)
    - e. “S” for speaker (RCA)
  5. Example #1: “106-1-1V” indicates the top left voice jack in outlet #1 in Room 106.

6. Example #2: "109-3-4D" indicates the bottom right data jack (assuming a 4-port faceplate) in outlet #3 in Room 109.

## 2.2 DOCUMENTATION/AS-BUILTS/RECORDS

### A. General:

1. Upon completion of the installation, the Contractor shall submit as-builts per the requirements of Section 27 05 00 and Division 1. Documentation shall include the items detailed in the subsections below.
2. All documentation, including hard copy and electronic forms shall become the property of the Owner.

### B. Record Drawings:

1. The drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons and drawing conventions used shall be consistent throughout all documentation provided.

## PART 3 - EXECUTION

### 3.1 IDENTIFICATION AND LABELING

#### A. Cable Labeling: horizontal cables shall be labeled at each end.

1. Provide additional cable labeling at each manhole and pull box.
2. Cables that are routed through multiple pathway segments shall contain reference to all pathway segments in the pathway linkage field.
3. Cables that differ only by performance class shall have a suitable marking or label to indicate the higher performance class. For example, station cabling utilizing the blue color, may include blue with a white stripe to indicate the higher performance class station cabling.

#### B. Information Outlet Labeling: Tag all voice and data jacks as defined herein.

#### C. Termination Hardware Labeling:

1. An identifier shall be provided at each termination hardware location or its label.

#### D. Records:

1. Cable Records: Provide cable identifier, cable type, conductor quantity, damaged conductor quantity, unterminated conductor quantity, available conductor quantity.
  - a. The cable type field shall include the manufacturer and manufacturer's catalog designations, including ratings.
  - b. Termination position linkage fields shall be included.

2. Termination Hardware Records: Provide hardware identifier, hardware type, damaged position numbers, available position numbers.
  - a. Provide linkages to termination position records, space records, and grounding records.
3. Termination Position Records: Provide termination position identifier, cable conductor numbers.
  - a. Provide linkages to cable records, termination position records, termination hardware records and space records.
4. Splice Records: Indicate the splice identifier and the type.
  - a. Provide linkages to cable records and space records.

END OF SECTION

**SECTION 27 11 00**  
**COMMUNICATION EQUIPMENT ROOMS (CER)**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. This section describes the products and execution requirements related to furnishing and installing equipment for communication equipment rooms.

**1.2 RELATED WORK**

- A. Section 27 05 00 - Basic Communications Systems Requirements
- B. Section 27 05 28 - Interior Communication Pathways
- C. Section 27 15 00 - Horizontal Cabling Requirements

**1.3 QUALITY ASSURANCE**

- A. Refer to Section 27 05 00 for applicable standards.

**1.4 SUBMITTALS**

- A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work the Contractor shall submit:
  - 1. Manufacturer's data covering all products including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.
  - 2. Manufacturer's installation instructions.

**PART 2 - PRODUCTS**

**2.1 PATCH PANELS**

- A. Where identified on the drawings in Communication Equipment Rooms, modular patch panels shall be furnished and installed by the Contractor for termination of copper cable.
- B. Copper cabling shall be terminated in Communication Equipment Rooms on modular patch panels consisting of a modular connector system incorporating modular jacks meeting the specifications for the jacks detailed in Section 27 15 00.
- C. The largest single modular patch panel configuration shall not exceed 24-Ports. Modular patch panels shall be fully populated (all ports occupied by jacks) and be provided in increments of no less than 12 jacks. High-density modular patch panels will not be accepted.
- D. The modular patch panel blocks shall have the ability to seat and cut eight (8) conductors (4 pairs) at a time and shall have the ability of terminating 22- through 26-gauge plastic insulated, solid and stranded copper conductors. Modular patch panel blocks shall be designed to maintain the cables' pair twists as closely as possible to the point of mechanical termination.
- E. Modular patch panels shall incorporate cable support and/or strain relief mechanisms to secure the horizontal cables at the termination block and to ensure that all manufacturers minimum bend radius specifications are adhered to.

## 2.2 COPPER PATCH CORDS

### A. Modular Patch Panel:

1. Provide Category 6 copper patch cords for 50% of all assigned ports on the modular patch panel. Of these cords, 60% shall be 3' in length and 40% shall be 5' in length. These patch cords shall be the cross-connect between the network electronics and the horizontal RJ-45 modular patch panel. Copper patch cords shall be equipped with a 4-pair RJ-45 connector on each end.
2. Refer to Section 27 15 00 for cable and connector performance requirements.
3. Patch cords shall not be made-up in the field.
4. Basis of Design (Refer to 27 17 20 for Acceptable Manufacturers):
  - a. Commscope Uniprise

## PART 3 - EXECUTION

### 3.1 CROSS CONNECT INSTALLATION

- A. Bend radius of cable shall not exceed 4 times the outside cable diameter or manufacturer's recommendation, whichever is less.
- B. Cables shall be neatly bundled and dressed to their respective panels and/or blocks. Each shall be fed by an individual bundle separated and dressed to the point of cable entrance into the rack and/or frame.
- C. The cable jacket shall be maintained as close as possible to the termination point.
- D. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that is visible without removing the bundle support.

### 3.2 CONDUITS AND CABLE ROUTING

- A. Refer to Section 26 05 33 for additional requirements.
- B. Where conduits enter a telecommunications room, conduits shall be terminated on the wall where shown on the contract documents. Conduits entering the room from the floor shall extend 3" above the floor slab 3" into the room below the raised floor.
- C. Where cabling rises vertically in a telecommunications rooms, provide vertical cable management to support the cabling from floor to ceiling level.
- D. All conduits shall be reamed and shall be installed with a nylon bushing.
- E. Maintain appropriate conduit bend radius at all times. For conduits with an internal diameter of 2" or less, maintain a bend radius of at least 6 times the internal diameter. For conduits with an internal diameter greater than 2", maintain a bend radius of at least 10 times the internal diameter.

END OF SECTION



**SECTION 27 15 00**  
**HORIZONTAL CABLING REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. This section describes the products and execution requirements relating to furnishing and installing horizontal communications cabling and termination components and related subsystems as part of a cabling plant. The cabling plant consists of copper cabling.

**1.2 RELATED WORK**

- A. Section 27 05 00 - Basic Communications Systems Requirements

**1.3 QUALITY ASSURANCE**

- A. Refer to Section 27 05 00 for relevant standards and plenum or non-plenum cable requirements.
- B. The channel shall be required to meet the performance requirements indicated herein. The manufacturer shall warranty the performance of their system to the required performance (and not just to the Standard, should the required performance exceed the Standard).
- C. Specific components of the channel shall be required, at a minimum, to meet the Standard component requirements for that particular component.
- D. The installing contractor must be certified by the manufacturer of the structured cabling system.

**1.4 SUBMITTALS**

- A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work the Contractor shall submit:
  - 1. Manufacturer's data covering all products proposed, including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.
  - 2. Manufacturer's installation instructions.

**PART 2 - PRODUCTS**

**2.1 HORIZONTAL CABLE**

- A. CAT 6 Enhanced Cable:
  - 1. The horizontal cable requirements must be met as well as the following channel requirements.
  - 2. CAT 6 cable shall terminate on rack-mounted modular patch panels in their respective communication equipment room as indicated on the drawings.
  - 3. Performance Tests shall be conducted using swept frequency testing through 250 MHz for the channel. All numbers given are for a 4-connection channel. Discrete frequency testing results at 250 MHz is not acceptable.

4. Performance data shall be characterized as “Guaranteed Headroom” and shall be warranted by the manufacturer to perform at guaranteed margins over ANSI/TIA/EIA-568-C.2. Performance data that is not warranted by the manufacturer will not be considered.
5. The structured cabling and connectivity must be provided by the same company. For the purpose of this specification that shall mean that the cabling and connectivity must be marketed, branded, supported, warranted, and distributed by the same company. Specifically, ally or partnerships between cabling manufacturers and connectivity manufacturers do not meet this requirement unless otherwise listed in Section 27 17 20 as an acceptable manufacturer. Specifically, products made by others through an OEM relationship are acceptable if the products are marketed, branded, supported, warranted, and distributed by the same company.
6. The 4-connector channel performance margins in the table below shall be guaranteed margins above ANSI/TIA/EIA-568-C.2:

Electrical Value (1 - 250 MHz)	Minimum Margin
Insertion Loss:	14.0%
NEXT:	7.0 dB
PS NEXT:	8.0 dB
ACR-F (ELFEXT):	8.0 dB
PS ACR-F (PS ELFEXT):	8.0 dB
Return Loss:	4.0 dB

7. The jacket color for CAT 6 cable shall be yellow for voice applications and greenfor data applications.
8. Basis of Design:
  - a. Commscope Uniprise
  - b. Refer to Section 27 17 20 for additional acceptable manufacturers.

## 2.2 CONNECTORS/COUPLERS/ADAPTERS

- A. Refer to Section 27 11 00 for requirements.

## 2.3 FACEPLATES/JACKS

- A. CAT 6 Jacks:
  1. CAT 6 horizontal cable shall each be terminated at their designated work area location on RJ-45 modular jacks. These modular jack assemblies shall snap into a modular mounting frame. The combined modular jack assembly is referred to as an information outlet.
  2. The same orientation and positioning of modular jacks shall be utilized throughout the installation. Prior to installation, the Contractor shall submit the proposed configuration for each information outlet type for review by the Architect/Engineer.
  3. Information outlet faceplates shall incorporate recessed designation strips at the top and bottom of the frame for identifying labels. Designation strips shall be fitted with clear plastic covers.
  4. Where standalone CAT 6 only modular jacks are identified, the information outlet faceplate shall be configured as to allow for the addition of one (1) additional modular jack (CAT 3,

CAT 5E, or CAT 6) to be installed to supplement each such modular jack as defined by this project. The installation of these supplemental modular jacks is NOT part of this project.

5. Any unused modular jack positions on an information outlet faceplate shall be fitted with a removable blank inserted into the opening.
6. The information outlet faceplate shall be constructed of high impact plastic (except where noted otherwise). The information outlet faceplate color shall (1) match the faceplate color used for other utilities in the building or (2) when installed in surface raceway (if applicable), match the color of that raceway.
7. Different faceplate and frame designs for locations, which include optical fiber cabling relative to those, that terminate only copper cabling are acceptable. Information outlets that incorporate optical fiber shall be compliant with the above requirements plus:
  - a. Be a low-profile assembly.
  - b. Incorporate a mechanism for storage of cable and fiber slack needed for termination.
  - c. Position the optical fiber couplings to face downward or at a downward angle to prevent contamination.
  - d. Incorporate a shroud that protects the optical fiber couplings from impact damage.
8. All information outlets and the associated modular jacks shall be of the same manufacturer throughout the project.
9. The CAT 6 modular jacks shall be non-keyed 8-pin modular jacks.
10. The interface between the modular jack and the horizontal cable shall be a 110-type termination block or insulation displacement type contact. Termination components shall be designed to maintain the horizontal cable's pair twists as closely as possible to the point of mechanical termination.
11. CAT 6 modular jacks shall be pinned per TIA-568B.
12. CAT 6 termination hardware shall, as a minimum, meet all the mechanical and electrical performance requirements of the following standards:
  - a. ANSI/TIA/EIA-568-A-5
  - b. ANSI/TIA/EIA-568A
  - c. ISO/IEC 11801
  - d. IEC 603-7
  - e. FCC PART 68 SUBPART F
13. The color for CAT 6 jacks shall be white for voice applications and orange for data applications. Alternately, a color-coded bezel or icon may be used to identify the CAT 6 modular jack.

## 2.4 COPPER WORK AREA CORDS

### A. RJ-45:

1. Provide the same quantity of Category 6 copper work area cords as copper patch panel cords specified in Section 27 11 00. Copper work area cords shall be equipped with an 8-pin modular RJ-45 connector on each end.
2. Work area cords shall be 10' in length.
3. Manufacturer of copper patch cable shall be the same as the manufacturer of the horizontal copper cable.

## PART 3 - EXECUTION

### 3.1 CABLE INSTALLATION REQUIREMENTS

#### A. Horizontal Cabling:

1. The maximum horizontal cable drop length for Data UTP shall not exceed 295 feet (90 meters) in order to meet data communications performance specifications. This length is measured from the termination panel in the wiring closet to the outlet and must include any slack required for the installation and termination. The Contractor is responsible for installing horizontal cabling in a fashion so as to avoid unnecessarily long runs. Any area that cannot be reached within the above constraints should be identified and reported to the Architect/Engineer prior to installation. Changes to the contract documents shall be approved by the Architect/Engineer.
2. All cable shall be free of tension at both ends. In cases where the cable must bear some stress, Kellum grips may be used to spread the strain over a longer length of cable.
3. Manufacturer's minimum bend radius specifications shall be observed in all instances.
4. Horizontal cabling installed as open cabling shall be supported at a maximum of 5' between supports. Refer to the specifications for required cable supports.
5. Horizontal cabling installed as open cable or in cable tray shall be bundled at not less than 10' intervals with hook-and-loop tie wraps. The use of plastic cable ties is strictly prohibited.
6. The maximum conduit fill for horizontal cabling shall not exceed 40% regardless of conduit length.
7. Cable sheaths shall be protected from damage from sharp edges. Where a cable passes over a sharp edge, a bushing or grommet shall be used to protect the cable.
8. A coil of 3 feet in each cable shall be placed in the ceiling at the last support (e.g., J-hook, bridle ring, etc.) before the cables enter a fishable wall, conduit, surface raceway or box. At any location where cables are installed into movable partition walls or modular furniture via a service pole, approximately 15-feet of slack shall be left in each horizontal cable under 250 feet in length to allow for change in the office layout without re-cabling. These "service loops" shall be secured at the last cable support before the cable leaves the ceiling and shall be coiled from 100% to 200% of the cable recommended minimum bend radius.

9. To reduce or eliminate EMI, the following minimum separation distances from 480V power lines shall be adhered to:
  - a. Twelve (12) inches from power lines of <5-kVa.
  - b. Eighteen (18) inches from high-voltage lighting (including fluorescent).
  - c. Thirty-nine (39) inches from power lines of 5-kVa or greater.
  - d. Thirty-nine (39) inches from transformers and motors.
10. Information outlets shown on floor plans with the subscript "W" are intended to be used for wall mounted telephones. Back boxes for wall mounted telephones shall not be located within 12" vertically, or horizontally, from any light switches, power receptacles, nurse call devices, thermostats, or any other architectural element that would otherwise prevent the installation of a wall mounted telephone on the mating lugs.

### 3.2 CABLE TERMINATION REQUIREMENTS

#### A. Cable Terminations - Data and voice UTP:

1. Modular patch panels shall be designed and installed in a fashion as to allow future horizontal cabling to be terminated on the panel without disruption to existing connections.
2. If the "last" patch (per rack) is greater than 50% utilized, one additional patch panel shall be provided for future use.
3. At information outlets and modular patch panels, the Contractor shall ensure that the twists in each cable pair are preserved to within 0.5-inch of the termination for data cables. The cable jacket shall be removed only to the extent required to make the termination.

END OF SECTION

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**SECTION 27 17 10  
TESTING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. This section describes the testing requirements relating to the structured cabling system and its termination components and related subsystems.

**1.2 RELATED WORK**

- A. Section 27 05 00 – Basic Communications Systems Requirements

**1.3 QUALITY ASSURANCE**

- A. Refer to Section 27 05 00 for relevant standards.

**PART 2 - PRODUCTS**

**2.1 TESTING COPPER**

- A. General Requirements:
  - 1. Perform acceptance tests as indicated below for each sub-system (e.g., backbone, horizontal, etc.) as it is completed.
  - 2. Supply all equipment and personnel necessary to conduct the acceptance tests. The method of testing shall be approved by the Architect/Engineer.
  - 3. Visually inspect all cabling and termination points to ensure that they are complete and conform to the wiring pattern defined herein. Provide the Architect/Engineer with a written certification that this inspection has been made.
  - 4. Conduct acceptance testing according to a schedule coordinated with the Owner/Architect/Engineer. Representatives of the Owner may be in attendance to witness the test procedures. Provide a minimum of one (1) week's advance notice to the Architect/Engineer to allow for such participation. The notification shall include a written description of the proposed conduct of the tests, including copies of blank test result sheets to be used.
  - 5. Tests related to connected equipment of others shall only be done with the permission and presence of the Contractor involved. The Contractor shall ascertain that testing only is required to prove the wiring connections are correct.
  - 6. Provide test results and describe the conduct of the tests including the date of the tests, the equipment used, and the procedures followed. At the request of the Architect/Engineer, provide copies of the original test results in their native format.
  - 7. All cabling shall be 100% fault-free unless noted otherwise. If any cable is found to be outside the specification defined herein, that cable and the associated termination(s) shall be replaced at the expense of the Contractor. The applicable tests shall then be repeated.
  - 8. Should it be found by the Architect/Engineer that the materials or any portion thereof

furnished and installed under this Contract fail to comply with the specifications and drawings with respect or regard to the quality, amount, or value of materials, appliances, or labor used in the work, it shall be rejected and replaced by the Contractor and all work disturbed by changes necessitated in consequence of said defects or imperfections shall be made good at the Contractor's expense.

a. CAT 6 Cable:

- 1) Testing shall be from the modular jack at the information outlet to the modular patch panel in the communication equipment room.
- 2) Horizontal cable shall be free of shorts within the pairs, and be verified for continuity, pair validity and polarity, and conductor position on the modular jack (e.g., wire map). Any defective, split, or mis-positioned pairs must be identified and corrected.
- 3) CAT 6 horizontal cable shall be tested to 250 MHz as defined by TIA/EIA-568-C.2. Measurements shall be of the "Basic Link" including cabling and modular jacks at the information outlet and modular patch panel. Parameters to be tested must include:
  - a) Wire Map
  - b) Length
  - c) NEXT Loss (Pair-to-Pair)
  - d) NEXT (Power Sum)
  - e) ELFEXT (Pair-to-Pair)
  - f) ELFEXT (Power Sum)
  - g) Return Loss
  - h) Attenuation
  - i) Propagation Delay
  - j) Delay Skew
- 4) The maximum length of horizontal cable shall not exceed 295 feet (90m), which allows 33 feet (10 m) for technology equipment and modular patch cords.
- 5) To establish testing baselines, cable samples of known length and of the cable type and lot installed shall be tested. The cable may be terminated with an eight-position CAT 6 modular connector (8-pin) to facilitate testing. Nominal Velocity of Propagation (NVP) and nominal attenuation values shall be calculated based on this test and be utilized during the testing of the installed cable plant. This requirement can be waived if NVP and nominal attenuation data is available from the cable manufacturer for the exact cable type under test.
- 6) CAT 6 horizontal cable testing shall be performed using a test instrument designed for testing to 250 MHz or higher. Test records shall verify, "PASS" on each cable and display the specified parameters, comparing test values with standards based "templates" integral to the unit. Test records that report a PASS\*, FAIL\*, or FAIL result for any of the parameters will not be accepted.
- 7) In the event results of the tests are not satisfactory, the Contractor shall make adjustments, replacements, and changes as necessary and shall then repeat the test or tests that disclosed faulty or defective material,



equipment, or installation methods, and shall make additional tests as the Architect/Engineer deems necessary at no additional expense to the project or user agency.

## 2.2 DOCUMENTATION/AS-BUILTS/RECORDS

### A. General:

1. Upon completion of the installation, submit as-builts per the requirements of Section 27 05 00 and Division 1. Documentation shall include the items detailed in the subsections below.
2. All documentation, including hard copy and electronic forms, shall become the property of the Owner.
3. The Architect/Engineer may request that a 10% random field retest be conducted on the cable system at no additional cost to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the Contractor, additional testing can be requested to the extent determined necessary by the Architect/Engineer, including a 100% retest. This retest shall be at no additional cost to the Owner.

### B. Copper Media Test Data:

1. Test results shall include a record of test frequencies, cable type, conductor pair and cable (or Outlet) I.D., measurement direction, test equipment type, model and serial number, date, reference setup, and crew member name(s).
2. Printouts generated for each cable by the wire test instrument shall be submitted as part of the documentation package. The Contractor shall furnish this information in electronic form (USB thumb drive). The thumb drive shall contain the electronic equivalent of the test results as defined by the bid specification and be in the tester's native format as well as summaries of each test in pdf format. Provide a licensed copy of the software required to view and print the data that is provided in a proprietary format. Furnish one (1) copy of the data and display (if applicable) software.

### C. Record Drawings:

1. The drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided.

## PART 3 - EXECUTION

NOT APPLICABLE

END OF SECTION

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**SECTION 27 17 20**  
**SUPPORT AND WARRANTY**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. This section describes support and warranty requirements relating to the structured cabling system and related subsystems.

**1.2 RELATED WORK**

- A. Section 27 05 00 – Basic Technology Systems Requirements.

**1.3 QUALITY ASSURANCE**

- A. Refer to Section 27 05 00 for relevant standards.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURER REQUIREMENTS**

- A. The Basis of Design for all structured cabling components is listed in the individual Division 27 sections. Alternative acceptable manufacturers will be accepted for this project.

- 1. Exceptions:

- a. CAT 3 copper ( $\geq$ 25-pair).
    - b. Optical fiber.

- B. Additional acceptable manufacturers for horizontal cabling:

- 1. Belden Data Twist 6000e
  - 2. Hubbell NEXTSPEED
  - 3. Superior-Essex/Ortronics NextGain CAT6EX
  - 4. Leviton Lanmark-2000

**2.2 WARRANTY**

- A. A twenty (20) year Product Installation Warranty shall be provided for the structured cabling system as described in the contract documents.
- B. The Product Installation Warranty shall cover the replacement or repair of the defective product(s) and labor for the replacement or repair of such defective product(s).
- C. Upon successful completion of the installation and subsequent inspection, the Owner shall be provided with a numbered certificate from the manufacturing company registering the installation.

PART 3 - EXECUTION

NOT APPLICABLE

END OF SECTION

**SECTION 28 31 01**  
**FIRE ALARM AND DETECTION SYSTEMS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Fire alarm and detection systems

**1.2 RELATED WORK**

- A. Section 26 05 53 – Electrical Identification: Refer to electrical identification for color and identification labeling requirements.

**1.3 QUALITY ASSURANCE**

- A. Manufacturer: Company specializing in smoke detection and fire alarm systems with ten years' experience.
- B. Installer: A factory-authorized Electrical or Security Contractor licensed with the State and local jurisdiction with five years' experience in the design, installation, and maintenance of fire alarm systems by that manufacturer.
- C. Qualifications: The person managing/overseeing the preparation of shop drawings and the system installation/programming/testing shall be trained and certified by the system manufacturer and shall be Fire Alarm Certified by NICET, minimum Level 2. This person's name and certification number shall appear on the start-up and testing reports.

**1.4 REFERENCES**

- A. ASME A17.1 - Safety Code for Elevators and Escalators
- B. NFPA 70 - National Electrical Code
- C. NFPA 72 - National Fire Alarm and Signaling Code
- D. NFPA 101 - Life Safety Code
- E. UL 2017 – General Purpose Signaling Devices and Systems

**1.5 SUBMITTALS**

- A. Submit shop drawings and product data under provisions of Section 26 05 00 and as noted below.
  - 1. Failure to comply with all the following and all the provisions in 26 05 00 will result in the shop drawing submittal being rejected without review.
  - 2. Failure to submit the fire alarm without all requirements fulfilled in a single comprehensive submittal will be grounds to require a complete resubmittal.
- B. Provide product catalog data sheets as shop drawings.
  - 1. Provide a product catalog data sheet for each item shown on the Electrical Symbols List and for each piece of equipment that is not shown on the drawings but required for the operation of the system.
  - 2. Where a particular Electrical Symbols List item has one or more variations (such as those denoted by subscripts, etc.) a separate additional product catalog data sheet shall be

provided for each variation that requires a different part number to be ordered. The corresponding Electrical Symbols List symbol shall be shown on the top of each sheet.

3. Where multiple items and options are shown on one data sheet, the part number and options of the item to be used shall be clearly denoted.
- C. Submit CAD floor plans as shop drawings:
1. The complete layout of the entire system, device addresses, auxiliary equipment, and manufacturer's wiring requirements shall be shown.
  2. Indicate the precise routing of notification appliance circuits under the provisions of circuit survivability. Refer to "Wiring" under Part 3 - Execution of this specification section for requirements.
  3. A legend or key shall be provided to show which symbols shown on the submittal floor plans correspond with symbols shown on the Contract Documents.
- D. About all fire alarm circuits, provide the following: manufacturer's wiring requirements (manufacturer, type, size, etc.) and voltage drop calculations.
- E. Provide installation and maintenance manuals under provisions of Section 26 05 00.
- F. Submit manufacturer's certificate that system meets or exceeds specified requirements.
- G. Provide information on the system batteries as follows: total battery capacity, total capacity used by all devices on this project, total available future capacity.
- H. Voice Alarm Communication System: Submit equipment rack or console layout, grounding schematic, amplifier power calculations, and wiring diagram.
- I. Submit photocopy proof of NICET certification of the person overseeing the preparation of drawings and installation/testing.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 26 05 00.
- B. Store and protect products under provisions of Section 26 05 00.

#### 1.7 REGULATORY REQUIREMENTS

- A. System: UL or FM Global listed.
- B. Conform to requirements of NFPA 101.
- C. Conform to requirements of Americans with Disabilities Act (ADA).
- D. Conform to UL 864 Fire Alarm, UL 1076 Security, UL2017 General Signaling, and UL 2572 Mass Notification Communications.

#### 1.8 SYSTEM DESCRIPTION

- A. Performance Statement: This specification section and the accompanying fire alarm specific design documents describe the minimum material quality, required features, and operational requirements of the system. These documents do not convey every wire that must be installed and every

equipment connection that must be made. Based on the equipment described and the performance required of the system, as presented in these documents, the Vendor and the Contractor are solely responsible for determining all wiring, programming and miscellaneous equipment required for a complete and operational system.

- B. This section of the specifications includes the furnishing, installation and connection of the microprocessor controlled, intelligent reporting, fire alarm equipment required to form a complete coordinated system that is ready for operation. It shall include, but is not limited to, alarm initiating devices, voice evacuation equipment, control panels, auxiliary control devices, annunciators, power supplies, and wiring as indicated on the drawings and specified herein.
- C. Fire Alarm System: NFPA 72; Automatic and manual fire alarm system, non-coded, analog-addressable with automatic sensitivity control of certain detectors, multiplexed signal transmission.
- D. Campus Ethernet IP Network: A complete fire alarm and mass notification Ethernet network shall be provided. The network shall be Class X, Resilient Ethernet Protocol (REP) 100BaseTX / 100 Mbps that shall be able to operate with any single break and self-restoring network communications. Each building shall contain an independent building fire alarm / voice communications system, with full command and control from the campus command center. In no case shall read only network annunciation be acceptable as the only networking function.
- E. Voice Communication: The facility shall have an emergency voice alarm communication system. The digitized recorded voice message shall notify occupants that a fire condition has been reported. Emergency manual voice override shall be provided.
- F. System Supervision: Provide electrically supervised system, with supervised Signal Line Circuit (SLC) and Notification Appliance Circuit (NAC). Occurrence of single ground or open condition in initiating or signaling circuit places circuit in TROUBLE mode. Component or power supply failure places system in TROUBLE mode.
- G. Alarm Reset: Key-accessible RESET function resets alarm system out of ALARM if alarm initiating circuits have cleared.
- H. Lamp Test: Manual LAMP TEST function causes alarm indication at each zone at fire alarm control panel and at annunciator panels.
- I. Drawings: Only device layouts and some equipment have been shown on the contract drawings. Wiring and additional equipment to make a complete and functioning system has not been shown but shall be submitted on the shop drawings.

#### 1.9 PROJECT RECORD DOCUMENTS

- A. Submit documents under the provisions of Section 26 05 00.
- B. Include location of end-of-line devices.
- C. Provide a CAD drawing of each area of the building (minimum scale of 1/16" = 1'-0") showing each device on the project and its address. The devices shall be shown in their installed location and shall be labeled with the same nomenclature as is used in the fire alarm panel programming.
- D. Submit test results of sound pressure level (dBA) and intelligibility (STI) with the rooms tested designated on the floor plan. Notification devices shall have the tap wattage designated.

#### 1.10 OPERATION AND MAINTENANCE DATA

- A. Submit data under provisions of Section 26 05 00.

- B. Include operating instructions, and maintenance and repair procedures.
- C. Include results of testing of all devices and functions.
- D. Include manufacturer's representative's letter stating that system is operational.
- E. Include the CAD floor plan drawings.
- F. Include shop drawings as reviewed by the Architect/Engineer and the local Authority Having Jurisdiction.

#### 1.11 WARRANTY

- A. Provide one (1) year warranty on all materials and labor from Date of Substantial Completion.
- B. Warranty requirements shall include furnishing and installing all software upgrades issued by the manufacturer during the one (1) year warranty period.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

- A. National Time and Signal
- B. Simplex
- C. Siemens Fire Safety

#### 2.2 [FAP-1]: FIRE ALARM CONTROL PANEL (FAP)

- A. Control Panel: Modular, power-limited electronic design. Provide flush or surface wall-mounted enclosure as shown on plans. Enclosure shall be minimum 0.060 steel with provisions for electrical conduit connections into the sides and top. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators.
- B. Each Signaling Line Circuit (SLC loop) shall not be loaded over 80% of the maximum device capacity. For example, in the minimum system capacity column listed below, if the fire alarm manufacturer's system capacity of analog sensors per loop is 99 devices, then no more than 79 devices shall be wired on that loop. The minimum system capacity shall be as follows:

Minimum Total Addressable Points:	250	500	2000
Minimum Total SLC loops (including board, ready for field connections):	5	2	4
Panel Expansion Capability, Minimum Total SLC loops:	10		

- C. Signal Line Circuit (SLC) and Notification Appliance Circuit (NAC) Boards:
  - 1. Each board shall communicate directly with each addressable analog sensor and binary input to determine normal, alarm, or trouble conditions. Analog signals would be used for automatic test and determination of maintenance requirements.
  - 2. Each board shall contain its own microprocessor and shall be provided to monitor addressable inputs and to control addressable outputs (addressable relays). The board shall



communicate and provide power to all devices on its loop over a single pair of wires, except where 4-wire devices require a separate power circuit.

3. Pathway Class A: Circuits capable of transmitting an alarm signal during an open or a non-simultaneous single ground fault on a circuit conductor wiring system. Wiring of outgoing and return conductors shall be physically separated by a minimum of 50 feet or by a two-hour rated enclosure.
4. Pathway Survivability Level 2: Pathway survivability includes one or more of the following:
  - a. Listed 2-hour fire-rated circuit integrity (CI) or fire-resistive cable.
  - b. Pathway installed in a 2-hour fire-rated enclosure or assembly.

D. Central Processing Unit:

1. The central processing unit (CPU) shall communicate with the monitor and control all other modules in the panel. Removal, disconnection or failure of any control panel module shall be detected and reported to the CPU.
2. The CPU shall execute all control-by-event programs for specific action to be taken if a designated situation is detected in the system. A real-time system clock for time annotations on the display and printer shall be included.
3. All power for the unit shall be supervised and supplied by the FAP.

E. Display:

1. The board shall provide all controls and indicators used by the system operator and may also be used to program all control panel parameters.
2. The board shall provide an alphanumeric array for display of custom alphanumeric labels for all addressable points. It shall also provide indicators for AC Power, System Alarm, System Trouble, Display Trouble and Signal Silence.
3. Displayed descriptions of addressable points shall include actual room names/numbers selected by the Owner. This information shall be obtained prior to programming. Room names/numbers shown on floor plans shall not be used.
4. The board shall provide a touch key-pad with control capability to command all system functions and entry of any alphanumeric information. Twenty different passwords with four levels of security shall be supported to prevent unauthorized manual control or programming.

F. Memory: The CPU and display interface board shall be augmented by non-volatile field programmable memory. EPROM memory will also be allowed provided the memory is burned in with minimum expansion capability equal to the total system capacity of the panel. Memory shall not be lost upon primary and secondary power failure.

G. Power Supply:

1. Input power shall be 120 VAC, 60 Hertz. Output power shall be as noted on the device specifications and drawings. Each component of the fire alarm system requiring 120 VAC input power shall be served from a dedicated emergency branch circuit. Provide two #12 conductors and one #12 ground in 3/4" conduit to a dedicated 20A/1P circuit breaker with a red handle and a manufacturer's standard handle lock-on device. Identify/label breaker

and branch circuit in accordance with NFPA requirements and Specification Section 26 05 53.

2. Adequate to supply 125% of all control panel and peripheral power needs as well as 125% of power required for all external audio-visual devices. The power supply may be increased as needed by adding additional modular expansion power supplies. Over-current protections shall be provided on all power outputs.
3. All power supplies shall be designed and installed to meet UL and NFPA requirements for power-limited operation on all external initiating and indicating circuits.
4. The power supply shall provide integral charger for use with internal batteries. Battery capacity shall be sufficient for operation of the entire system for 24 hours in a non-alarm state followed by alarm mode for 15 minutes, plus 25% spare capacity for future devices.

H. Surge Protection:

1. All fire alarm control panels, NAC panels, etc. shall be provided with a surge protection device (SPD). The SPD shall be UL listed to Standard 1449 Rev 3. The unit should be clearly labeled in accordance with Identification Section 26 05 53. The SPD shall have thermal fuses to protect against fire in short circuit conditions. The unit shall provide visual indication that the unit is protecting and functioning.
2. Any communications or signaling circuits associated with the fire alarm system, which leave or enter a facility, shall be provided with a surge protection device. The devices shall be as recommended by the fire alarm system manufacturer.

I. [VCC-1]: Digitized Voice Command Center (VCC):

1. The Digitized Voice Command Center (VCC) shall contain all equipment required for all audio control, signaling, and supervisory functions. This shall include digital voice units, speaker zone indication, microphones.
2. Function: The Voice Command Center equipment shall perform the following functions:
  - a. Operate as a supervised single dual channel automatic digitized voice evacuation system with manual emergency voice communication system.
  - b. Dual channel speaker circuits shall be arranged such that there is a minimum of one (1) speaker circuit per floor of the building or smoke zone, whichever is greater.
  - c. Audibly and visually annunciate the active or trouble condition of every signal circuit.
  - d. Audibly and visually annunciate any trouble condition of tone generators and digital voice units required for normal operation of the system.
  - e. Provide all-call activities through activation of a single control switch.
  - f. Provide automatic, digitally recorded voice messages and tones.
3. Audio Amplifiers:
  - a. The audio amplifiers will provide a single dual channel audio power at 25/70 volts RMS for distribution to speaker circuits.

- b. Provide multiple audio amplifiers mounted in the transponder or in the main fire alarm control panel, either to supply incremental audio power, or to function as an automatically switched backup amplifier(s).
  - c. The audio amplifier shall include an integral power supply, and shall provide the following controls and indicators:
    - 1) Normal Audio Level LED
    - 2) Incorrect Audio Level LED
    - 3) Battery Trouble LED
    - 4) Amplifier Trouble LED
    - 5) Audio Amplifier Gain Adjust
  - d. Includes audio input and amplified output supervision backup input and automatic switchover function, if primary amplifier should fail.
  - e. Amplifier shall be backed up in groups (one amplifier backs up several). Failure of any one amplifier in the system shall not degrade system performance in any way.
4. Audio Message Generator (Digitized Voice):
- a. Each initiating zone or intelligent device shall interface with an emergency voice communication system capable of transmitting a digitized voice message to all speakers in the building.
  - b. Actuation of any alarm initiating device shall cause a digitized message to sound over the speakers. The message shall be repeated four (4) times.
  - c. A built-in microphone shall be provided to allow paging through speaker circuits.
  - d. The audio message generator shall have the following controls and indicators to allow for proper operator understanding and control:
    - 1) All Call LED
    - 2) On-Line LED
    - 3) All Call Switch
5. Voice Messages:
- a. A pre-programmed custom digital voice message shall be used for notification appliance speaker circuits. The messages shall be approved by the Authority Having Jurisdiction (AHJ).
  - b. Message shall be preceded by a tone and message shall be repeated four times until silenced.
  - c. Primary messages shall be annunciated in the zone of fire alarm and adjoining areas' evacuation signaling zones, and the secondary message in all other evacuation signaling zones.
  - d. Message shall be as shown in the following table. These messages are not intended to specify the exact wording required, but to specify the minimum information conveyed by the message:

## 2.3 SIGNALING LINE CIRCUIT DEVICES

### A. **[FA-120]:** Smoke Detectors:

1. Analog Photoelectric Type Sensor: Shall use the photoelectric principle to measure smoke density and send data to the control panel representing the analog level of smoke density measured.
2. Each smoke detector shall connect directly to an SLC loop.
3. Each detector shall be mounted, where shown on the drawings, on a twist-lock base with all mounting hardware provided. Provide a two-piece head/base design.
4. Each detector shall have a manual switching means to set the internal identifying code (address) of that detector, which the control panel shall use to identify its address with the type of sensor connected.
5. Dual alarm and power indicators shall be provided that flash under normal conditions and remain continuous under alarm or trouble conditions. Remote indicator terminals shall be provided. Provide a remote LED indicator device if detector is not visible from a floor standing position.
6. A test means shall be provided to simulate an alarm condition.
7. Where operation is noted as required below 32°F and/or above 120°F, a conventional device shall be installed with a unique monitor module located in the nearest available location with maintained temperatures between 32°F and 120°F.
8. Audible sounder detector base for sleeping room applications:
  - a. The audible base shall sound an alarm in the local room in UL2017 operation and UL484 for general evacuation. The unit shall be programmable by the main control panel for the duration of operation.
  - b. The audible sounder base shall sound Temporal 3 (fire) or Temporal 4 (CO alarm) and be at 75 dB at 10 feet.
9. A subscript is used to identify the device with a specific sequence of operation as follows: E=Elevator Recall, S=Sleeping/Patient Room, D=HVAC Control, A=Atrium, SW=Stairwell, CR=Computer Room, SD=Smoke Dampers, DH=Door Hold Release, FD=Fire Door Release, MP=Medical Procedure Room.

### B. Manual Pull Stations:

1. Manual stations shall match the description on the drawings (refer to the General Electrical Equipment Schedule). The stations shall be mounted where shown on the drawings and be provided with all necessary mounting hardware. Use surface mount only on precast concrete or structure.
2. **[FA-130]:** Addressable, double action, reset key lock, semi-flush mount, red high abuse plastic or cast metal construction with white lettering.
3. Manual stations shall connect directly to an SLC loop. Stations shall provide address setting means using rotary decimal or DIP switches.

4. Where operation is noted as required below 32°F and/or above 120°F, a conventional device shall be installed with a unique monitor module located in the nearest available location, with maintained temperatures between 32°F and 120°F.

C. Heat Detectors:

1. **[FA-140]:** Combination rate of rise and 135°F fixed temperature analog thermal type sensor. Factory programmed to alarm at 135°F and at 15°F per minute rate-of-rise. Sensor shall measure heat level and send data to the control panel representing the analog level of thermal measurement and rate-of-rise.
  - a. A subscript is used to identify the device with a specific sequence of operation as follows: E=Elevator Shutdown.
2. Provide a two-piece head/base design, with a manual switching means to set the internal identifying code (address) of that detector, which the control panel shall use to identify its address with the type of sensor connected.
3. Heat detectors shall connect directly to SLC loops. Where fixed temperature or explosion proof detectors are used, one monitor module may be used to monitor all detectors in one room/area as shown on the drawings.
4. Detectors shall be mounted, where shown on the drawings, on a twist-lock base with all mounting hardware provided.
5. Provide a remote LED indicator device if detector is not visible from a floor-standing position.
6. Dual alarm and power indicators shall be provided that flash under normal conditions and remain continuous under alarm or trouble conditions. A connection for attachment of a remote indicator shall be provided.
7. A test means shall be provided to simulate an alarm condition.
8. Where operation is noted as required below 32°F and/or above 120°F, a conventional device shall be installed with a unique monitor module located in the nearest available location with maintained temperatures between 32°F and 120°F.

D. **[FA-160]:** Monitor Modules:

1. Monitor Module shall connect directly to an SLC loop and receive power from a separate 24 VDC circuit. It shall interface initiating devices with the control panel using Style D or Style B circuits. Contractor option: Use an interface module (2-wire operation) for Style B circuits connected to normally-open dry contacts, such as a flow switch.
2. The module shall be mounted in an enclosure located in an accessible service location as near as possible to the device(s) being monitored, or where shown on the drawings. All mounting hardware shall be provided.
3. The module shall supply the required power to operate the monitored device(s).
4. The module shall provide address setting means using rotary decimal or DIP switches.

E. **[FA-161]:** Addressable Relays:

1. Relay that represents an addressable control point used primarily for the control of auxiliary devices as indicated on the drawings. Contractor to provide additional slave relay(s), as required, rated for the electrical load being controlled (contractor to match voltage, amps, etc.).
2. Relay shall connect directly to an SLC loop and receive power from a separate 24 VDC circuit.
3. The relay shall be mounted in an enclosure located in an accessible service location as near as possible to the device(s) being controlled, unless otherwise shown on the drawings. All mounting hardware shall be provided.
4. The relay shall supply 24 VDC power to the device(s) being controlled, unless otherwise indicated on the drawings.

2.4 NOTIFICATION APPLIANCE DEVICES

A. Device Color:

1. Wall Mounted: White housing with red lettering or pictogram.
2. Ceiling Mounted: White housing with red lettering or pictogram.

B. Visual Alarm Devices:

1. **[FA-200]:** Wall mounted.
2. **[FA-201]:** Ceiling mounted.
3. High intensity (candela rating as scheduled on the drawings) xenon strobe or equivalent under a lens. Candela rating shall be visible from exterior of the device.
  - a. Candela Ratings: V1=15, V3=30, V7=75, VH=110, VS=177.
4. The maximum pulse duration shall be 0.2 seconds with a maximum duty cycle of 40%. The flash rate shall be 1 Hz. Where more than two strobes are visible from any one location, the fire alarm visual devices shall be synchronized.
5. Device, housing, and backbox shall be UL listed for fire alarm/emergency applications.

C. **[FA-210]:** Audio (Speaker) Alarm Devices - Wall Mounted:

1. Sound rating shall be dependent on the tap (wattage) setting. Tap settings shall be available in 3 dBA increments. A minimum of four (4) tap settings should be available to allow field adjustment of the sound output across a minimum range of 78 to 87 dBA, 400Hz to 4KHz (6 dBA cutoff) frequency range.
2. Speakers shall operate on a 25V RMS system, unless otherwise noted on drawings.
3. Speakers shall clearly reproduce a signal consisting of a live or prerecorded human voice with voice intelligibility.
4. Speaker, housing, and backbox shall be UL listed for fire alarm/emergency applications.

D. **[FA-230]:** Audio (Speaker) Alarm Devices - Ceiling Mounted

1. 4" speaker, round housing, flush mounted (provide tile bridge where applicable).
2. Sound rating shall be dependent on the tap (wattage) setting. Tap settings shall be available in 3 dBA increments. A minimum of four (4) tap settings should be available to allow field adjustment of the sound output across a minimum range of 78 to 87 dBA, 400Hz to 4KHz (6 dBA cutoff) frequency range. Speakers shall operate on a 25V RMS system, unless otherwise noted on drawings.
3. Speakers shall clearly reproduce a signal consisting of a live or prerecorded human voice and background music with voice intelligibility.
4. Speaker, housing, and backbox shall be UL listed for fire alarm/emergency applications.

E. Combination Audio (Voice) and Visual Notification Device:

1. **[FA-211]:** Wall mounted.
2. **[FA-231]:** Ceiling mounted.
3. Combine speaker and visual components into a single device. Refer to the corresponding paragraphs above for requirements of each component.

2.5 **[NEP-#]:** NAC EXTENDER PANELS (NEP)

- A. As shown on the plans or as a Contractor's option if not shown, furnish and install NAC extender panels as necessary to provide remote power supply for notification appliance circuits (NAC). Contractor shall indicate quantity and locations of each NEP on the shop drawing submittals.
- B. Each NEP shall be self-contained remote power supply with batteries, and battery charger mounted in a surface lockable cabinet. Battery capacity shall be sufficient for operation for 24 60 hours in a non-alarm state followed by alarm for 15 minutes, plus 25% spare capacity for future devices. Each NEP provides a minimum of up to 4 outputs, 2A continuous, or 6A full load total capacity.
- C. Power for each NEP shall be from a local 120 VAC emergency circuit. Provide two #12 conductors and one #12 ground in 1/2" conduit to each NEP from a dedicated 20A/1P circuit breaker with a red handle and a manufacturer's standard handle lock-on device. Coordinate panel and circuit number with Architect/Engineer prior to installation.
- D. NAC extender panels may be installed only in locations coordinated with the Architect/Engineer.
- E. Mounting: Surface.

2.6 ANNUNCIATION

A. **[FAA-1]:** Remote LCD Annunciators:

1. Auxiliary annunciators shall indicate alarm and trouble conditions visually and audibly as shown on the drawings. Provide local TROUBLE ACKNOWLEDGE, TEST, and ALARM SILENCE capability. Minimum 80-character display.
2. Communications and power to the annunciators shall be supervised. The annunciator shall receive power from the fire alarm control panel.
3. A single key switch shall enable all switches on the annunciator.

- 4. Mounting: Surface.
- B. **[FA-241]:** Fire Alarm Remote Indicator:
  - 1. Red LED type.
  - 2. Mounts flush to a single gang box.
- C. **[FA-242]:** Fire Alarm Remote Indicator and Test Switch:
  - 1. Red LED type.
  - 2. Key switch test selector.
  - 3. Mounts flush to a single gang box.

## 2.7 ETHERNET NETWORK

- A. Campus Ethernet IP Network: A complete fire alarm and mass notification Ethernet network shall be provided. The network shall be Class X wiring, Resilient Ethernet Protocol (REP) 100BaseTX / 100 Mbps that shall be able to operate with any single break and restore network communications.
- B. The IP network shall be fiber optic cable, single or multi-mode fiber. The TCP/IP network switches shall be industrial grade managed switching hubs. Network switches shall be UL864 listed, shall provide a minimum of four (4) or a maximum of eight (8) 10/100 Mbps shielded RJ-45 connectors for Ethernet connections, and selectable multi-mode or single-mode fiber ports. The switches shall operate on a nominal 24 VDC supplied from a battery backed up fire alarm control panel or booster power supply to ensure power to the switch is always available. Switches shall provide LED indicators for data rate, activity/link integrity, power, and loop detection.
- C. IP Monitor and Relay Module: The IP relay/input module shall have a minimum of four (4) dry contact inputs and four (4) dry contact outputs. The relay output shall be rated at 0.5 amps at 24 VDC. This unit shall be monitored and controlled by the graphics workstation to operate functions and/or operations/activations on any fire alarm network system connected to the GEGW. The module shall be UL2572 and UL864 listed.
- D. Voice Over IP Module Encoder/Decoder: Each control panel audio source connected to the LAN/WAN network interface shall consist of a supervised audio decoder capable of decoding MP3, WMA, G.700, and PCM data streams in HTTP, UDP, or RTP format. Audio decoder shall operate on filtered-regulated 24 VDC power derived from the panel power supply. Power shall be supplied directly from the FACP to ensure reliable and monitored power. UL 2572 and UL864 listed.

## 2.8 CONNECTIONS TO AUXILIARY DEVICES PROVIDED BY OTHERS

- A. **[FA-260]:** Flow Switch:
  - 1. Connection to flow switch to monitor fire protection flow switch or discharge output contacts. Normally open dry contacts for fire alarm interface. Furnished and installed by MC; wired by EC.
- B. **[FA-261]:** Monitor Switch:
  - 1. Connection to monitor switch to monitor fire protection system supervisory switches or output contacts. Normally open dry contacts for fire alarm interface. Furnished and installed by MC; wired by EC.



## 2.9 WIRING

- A. Fire alarm wiring/cabling shall be furnished and installed by the Contractor in accordance with the manufacturer's recommendations and pursuant to National Fire Codes. Cabling shall be UL listed and labeled as complying with NFPA 70, Article 760 for power-limited fire alarm signal service.
- B. Approved manufacturers of fire alarm cable:
  - 1. Comtran Corp.
  - 2. Helix/HiTemp Cables, Inc.
  - 3. Rockbestos-Suprenant Cable Corp.
  - 4. West Penn Wire/CDT.
  - 5. Radix.

## PART 3 - EXECUTION

### 3.1 SEQUENCES OF FIRE ALARM OPERATION

- A. General:
  - 1. Refer to the Fire Alarm Operation Matrix on the drawings for basic requirements and system operation.
  - 2. All system output programs assigned via control-by-event equations to be activated by the particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.
- B. Panel/Annunciator Alarm, Trouble, Supervisory Indication:
  - 1. Appropriate system Alarm, Trouble, or Supervisory LED shall flash at the control panel, transponder, and annunciator locations.
  - 2. A local signal in the control panel shall sound.
  - 3. The LCD display shall indicate all information associated with the condition, including the name of the item, type of device and its location within the protected premises.
  - 4. History storage equipment shall log the information associated with the fire alarm control panel (FAP) condition, along with the time and date.
  - 5. Transmit the appropriate signal (supervisory, trouble, alarm) to the central station via the digital communicator.
  - 6. Transmit the appropriate signal (supervisory, trouble, alarm) to the building automation system via addressable relays tied to contact monitors on the system.
- C. Audible Alarms Sequence:
  - 1. Audible alarms within the floor or fire/smoke compartment where the emergency signal originated and in adjacent areas floors shall sound.
- D. Visual Alarms Sequence:
  - 1. Visual alarms within the floor or fire/smoke compartment where the emergency signal originated and in adjacent areas floors shall flash.

E. Elevator Recall Sequence:

1. Elevator recall sequences shall meet the requirements of ASME/ANSI A17.1 and NFPA 72.
2. Upon signal from a smoke detector in the machine room, hoistway, or any elevator lobby other than the "designated level" the fire alarm shall utilize an addressable relay to signal the elevator to recall to the designated level as determined by the Authority Having Jurisdiction.
3. Upon signal from a smoke detector in the elevator lobby of the "designated level," the fire alarm system shall utilize an addressable relay to signal the elevator to recall to the "alternate level" as determined by the Authority Having Jurisdiction.
4. All elevators, throughout the building, shall be recalled simultaneously.

F. Elevator Shutdown Sequence:

1. Elevator shutdown shall meet the requirements of ASME/ANSI A17.1.
2. All elevators that share the same hoistway, machine room, or lobby shall be shut down simultaneously. Elevators served by different machine rooms, hoistways, and lobbies shall continue to operate.
3. The fire alarm system shall utilize an addressable relay to energize the shunt trip of the main elevator breaker, disconnecting power to the elevator.

3.2 INSTALLATION

A. Install system in accordance with manufacturer's instructions and referenced codes.

B. Fire Alarm Control Panel:

1. Install the control panel where shown on the drawings.
2. All expansion compartments, if required, shall be located at the control panel.
3. Install the voice command center in the location as indicated on the drawings. This location should be primary fire department "attack" location. Coordinate with the local fire department prior to submitting shop drawings.
4. The fire alarm voice prerecorded messages shall be verified by the Contractor, as approved by the Owner, prior to the shop drawing submittal process.

C. Devices:

1. General:

- a. All ceiling-mounted devices shall be located where shown on the reflected ceiling and floor plans. If not shown on the reflected ceiling or reflected floor drawings, the devices shall be installed in the relative locations shown on the floor drawings in a neat and uniform pattern.
- b. All devices shall be coordinated with luminaires, diffusers, sprinkler heads, piping and other obstructions to maintain a neat and operable installation. Mounting locations and spacing shall not exceed the requirements of NFPA 72.

- c. Where the devices are to be installed in a grid type ceiling system, the detectors shall be centered in the ceiling tile.
  - d. The location of all fire alarm devices shall be coordinated with other devices mounted in the proximity. Where a conflict arises with other items or with architectural elements that will not allow the device to be mounted at the location or height shown, the Contractor shall adjust location of device so that new location meets all requirements in NFPA 72 and all applicable building codes.
- 2. Per the requirements of NFPA, detector heads shall not be installed until after the final construction cleaning unless required by the local Authority Having Jurisdiction (AHJ). If detector heads must be installed prior to final cleaning (for partial occupancy, to monitor finished areas or as otherwise required by the AHJ), they shall not be installed until after the fire alarm panel is installed, with wires terminated, ready for operation. Any detector head installed prior to the final construction cleaning shall be removed and cleaned prior to closeout.
- 3. Protection of Fire Alarm System:
  - a. A smoke detector shall be installed within the vicinity of the main fire alarm panel and every NAC extender panel per NFPA 72. A heat detector may be substituted when a smoke detector is not appropriate for the environment of installation.
- 4. Analog Smoke and Heat Detectors:
  - a. In elevator shafts and elevator equipment rooms, provide a heat detector for elevator shutdown within 2' of every sprinkler head. Coordinate with fire protection contractor.
- 5. Manual Pull Stations:
  - a. Stations shall be located where shown and at the height noted on the drawings.
- 6. Addressable Relays and Monitor Modules:
  - a. Modules shall be located as near to the respective monitor or control devices as possible, unless otherwise indicated on the drawings.
  - b. All modules shall be mounted in or on a junction box in an accessible location.
  - c. Where not visible from a floor standing position, a remote indicator shall be installed to allow inspection of the device status from a local floor standing location.
- 7. SLC Loop Isolation Modules:
  - a. Isolation modules shall be installed to limit the number of addressable devices that are incapacitated by a circuit fault.
  - b. Install all Isolation Modules within the fire alarm control panel, unless otherwise indicated on the drawings. Refer to the fire alarm riser diagram for requirements. Refer to the floor plans for areas served by separate isolation modules.
- 8. Notification Appliance Devices:
  - a. Devices shall be located where shown on the drawings.

- b. Wall-mounted audio, visual and audio/visual alarm devices shall be mounted as denoted on the drawings.

D. Annunciators:

- 1. Remote Annunciators: The annunciators shall be located where shown on the drawings and approved by the fire marshal.

E. Wiring:

- 1. Fire alarm wiring/cabling shall be provided by the Contractor in accordance with the manufacturer's recommendations and pursuant to National Fire Codes.
- 2. Wiring shall be installed in conduit. Refer to Identification Section 26 05 13 for color and identification requirements.
- 3. All junction boxes with SLC and NAC circuits shall be identified on cover. Refer to Identification Section 26 05 13 for color and identification requirements.
- 4. Partial evacuation or relocation of occupants is the standard operating procedure for this facility in the event of an alarm. Therefore, all notification appliance circuits (NAC), including circuits serving NAC extender panels (NEP) and other network communication circuits, must be installed and protected in accordance with the "circuit survivability" requirements described in NFPA 72. The contractor shall maintain the following:
  - a. NACs serving separate evacuation signaling zones shall be routed separately such that they are no less than 4 feet apart when run horizontally and 1 foot apart when run vertically. They may come simultaneously only within 10 feet of the control panel.
  - b. NACs passing through other evacuation signaling zone(s) shall be installed in conduit and routed through the 2-hour fire-rated chase(s) or enclosure(s) identified on the drawings or shall be NEC classified CIC cable (Fire Alarm Circuit Integrity) installed in conduit. Provide CIC cable meeting UL requirements for 2-hour listing.
    - 1) The CIC cable system shall be installed in a conduit system meeting all requirements of its UL-listed installation system (conduit, boxes, connectors, etc.).
- 5. Fire Alarm Power Branch Circuits: Building wiring as specified in Section 26 05 13.
- 6. Notification Appliance Circuits shall provide the features listed below. These requirements may require separate circuits for visual and audible devices.
  - a. Fire alarm temporal audible notification for all audio appliances.
  - b. Synchronization of all visual devices where two or more devices are visible from the same location.
  - c. Ability to silence audible alarm while maintaining visual device operation.
- 7. Notification Appliance Circuits shall not span floors.
- 8. Signal line circuits connecting devices shall not span floors.

9. No wiring other than that directly associated with fire alarm detection, alarm or auxiliary fire protection functions shall be in fire alarm conduits. Wiring splices shall be avoided to the extent possible, and if needed, they shall be made only in junction boxes, and enclosed by plastic wire nut type connectors. Transposing or changing color coding of wires shall not be permitted. All conductors in conduit containing more than one wire shall be labeled on each end, in all junction boxes, and at each device with "E-Z Markers" or equivalent. Conductors in cabinets shall be carefully formed and harnessed so that each drops off directly opposite to its terminal. Cabinet terminals shall be numbered and coded, and no unterminated conductors are permitted in cabinets or control panels. All controls, function switches, etc. shall be clearly labeled on all equipment panels.
- F. Fire Alarm Cabling Color Code: Provide circuit conductors with insulation color coding as follows, or using colored tape at each conductor termination and in each junction box.
  1. Power branch circuit conductors: In accordance with Section 26 05 53.
  2. Signaling line circuit: Overall red jacket with black and red conductors.
  3. DC power supply circuit: Overall red jacket with violet and brown conductors.
  4. Notification appliance circuit: Overall red jacket with blue and white conductors.
  5. Central station trip circuit: Orange conductors.
  6. Central station fire alarm loop: Black and white conductors.
- G. Devices surface mounted in finished areas shall be mounted on surface backboxes furnished by fire alarm equipment supplier. Backboxes shall be painted to match device, shall be the same shape and size as the device shall not have visible knockouts.
- H. Make conduit and wiring connections to door release devices, sprinkler flow and pressure switches, sprinkler valve monitor switches, fire suppression system control panels, duct analog smoke detectors and all other system devices shown or noted on the Contract Documents or required in the manufacturer's product data and shop drawings.

### 3.3 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 26 05 00.
- B. Test in accordance with NFPA 72, Chapter 14 and local fire department requirements. Submit documentation with O & M manuals in accordance with Section 14.6 of the Code.
- C. Contractor shall test and adjust the fire alarm system as follows:
  1. Speaker taps shall be adjusted to the lowest tap setting which achieves a sound level higher than or equal to the greatest of the following:
    - a. 70dBA.
    - b. 15 dBA above ambient levels as indicated in NFPA 72 Table A.18.4.3.
    - c. 15 dBA above measured ambient. 5 dBA above the maximum measured sound level with duration of more than 60 seconds.
    - d. As specified on the drawings.
  2. Sound level measurement procedure shall meet the following requirements:
    - a. All measurements shall use the 'A' weighted, dBA, sound measurement scale.

- b. All measurements shall be taken after furnishings, wall coverings and floor coverings are in place.
- c. All measurements shall be taken after fixed equipment (HVAC units, etc.) producing ambient noise is installed and is in operation.
- d. Final ambient sound measurements shall be taken during occupancy and the units shall be re-adjusted at that time, if necessary.
- e. All sound level measurements shall be taken at a height of 5' above the finished floor level.
- f. Measurements shall be taken in every unique room. If there are multiple rooms, which have the identical dimensions and function, 10%, or a minimum of 2 rooms shall be tested. The results from the rooms tested shall be averaged and the remaining rooms may be adjusted per the average.
- g. Measurements shall be taken on a 20' x 20' grid and the results for all points taken shall be averaged. If the room is smaller than 20' x 20' a minimum of two measurements are required.
- h. Measurements shall be taken halfway between speakers or halfway between a speaker and the wall. No measurements shall be taken at the extreme edges of the room, nor directly under speakers.

D. Additionally, test the voice alarm communication system intelligibility per IEC 60849:

- 1. The following acoustically distinguishable spaces shall be tested: All unique rooms shall be tested. If there are multiple rooms with the identical dimensions and function, 10%, or a minimum of two (2) rooms, shall be tested. The results from the rooms tested shall be averaged, and the remaining rooms may be adjusted per the average.
- 2. Utilize equipment designed to test per IEC 60849 per the equipment manufacturer's instructions. This equipment includes a signal generator, which is input to the fire alarm system and a portable measurement device. This equipment is available from Simplex Grinnell or Gold Line.
- 3. When testing for intelligibility, the quantity and location of the measurement points shall be the same as the points used for measurement of dBA level.
- 4. Provide a room by room report, showing the average dBA level and STI for each room tested, the number and location of. The report shall be presented to the Architect/Engineer in an Excel .xls file.

3.4 MANUFACTURER'S FIELD SERVICES

- A. Provide manufacturer's field services under provisions of Section 26 05 00.
- B. Include services of certified technician to supervise installation, adjustments, final connections, and system testing.
- C. Note that room numbers depicted on the architectural/engineering drawings will not necessarily reflect the actual room (signage) numbers that the Owner selects. The Contractor and fire alarm manufacturer shall coordinate the actual room numbers as the Owner directs to identify each device. This list shall be a part of the floor plan record drawing to be turned in at the project closeout.

3.5 SYSTEM TRAINING

- A. System training shall be performed under provisions of Section 26 05 00.
- B. Minimum on-site training times shall be:
  - 1. System Operators: One (1) day.

END OF SECTION

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