

Mechanical, Electrical, and Plumbing Specifications

Manufacturing and Office Additions to:
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ENGINEER

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DISCLAIMER

It is hereby stated, pursuant to Missouri Revised Statutes Section 327.411, that the specifications intended to be authenticated by Conway Duncan, Inc. and the undersigned's seal are limited to the specification sections listed in the following Table of Contents and we hereby disclaim any responsibility for all other specification sections relating to or intended to be used for any part of this project.

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DIVISION 15 – MECHANICAL

SECTION 15010 – BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The following shall apply to this Section:
 - 1. Drawings.
 - 2. General Provisions of the Contract.
 - 3. Solicitation Documents.
 - 4. General Conditions.
 - 5. Supplementary Conditions.
 - 6. Division 1.

1.02 WORK INCLUDES

- A. The work to be performed under this Division shall include all labor, materials, equipment, transportation, construction plant, and facilities necessary to provide a complete and operable system. The Contractor shall examine all Drawings and all Sections of the Specifications and shall be responsible for ascertaining to what extent other Drawings and Sections affect the work herein specified.

1.03 CODES, REGULATIONS, AND STANDARDS

- A. All work must be performed in accordance with the requirements of local, county, state and national codes and regulations including the requirements of the current edition of the following:
 - 1. International Building Code (IBC).
 - 2. International Fuel Gas Code (IFGC).
 - 3. International Mechanical Code (IMC).
 - 4. International Energy Conservation Code (IECC).
 - 5. International Plumbing Code (IPC).
 - 6. National Electrical Code (NEC).
 - 7. Occupational Safety and Health Administration (OSHA) Act of 1970.
 - 8. National Fire Protection Association (NFPA) 13, 14, 17/17A, 72, 72E, 54, 96, 101
 - 9. For work not specifically listed above, use codes and standards of the NFPA.
- B. All equipment, apparatus and systems shall be rated, tested, fabricated and/or installed in accordance with the applicable industry standard mentioned. The following list will serve to clarify abbreviations that appear in other sections of this specification:
 - 1. AABC Associated Air Balance Council.
 - 2. ADC Air Diffusion Council.
 - 3. AGA American Gas Association.

4.	AMCA	Air Moving and Conditioning Association.
5.	ANSI	American National Standards Institute.
6.	ARI	Air Conditioning and Refrigeration Institute.
7.	ASE	Association of Safety Engineers.
8.	ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers.
9.	ASME	American Society of Mechanical Engineers.
10.	ASSE	American Society of Sanitary Engineering.
11.	ASTM	American Society for Testing and Materials.
12.	AWWA	American Water Works Association.
13.	EPA	Environmental Protection Agency.
14.	FM	Factory Mutual.
15.	FS	Federal Specifications.
16.	IBR	Institute of Boiler and Radiator Manufacturers.
17.	IEEE	Institute of Electrical and Electronics Engineers.
18.	MCAA	Mechanical Contractors' Association of America.
19.	NEBB	National Environmental Balancing Bureau.
20.	NEMA	National Electrical Manufacturers Association.
21.	NFPA	National Fire Protection Association.
22.	NSC	National Safety Council.
23.	NSF	National Sanitation Foundation.
24.	SBI	Steel Boiler Institute Industry.
25.	SMACNA	Sheet Metal and Air Conditioning Contractors National Association.
26.	UL	Underwriters' Laboratories.
27.	USCFCCCHR	University of Southern California Foundation for Cross Connection Control and Hydraulic Research.

1.04 SUBMITTALS

- A. As soon as possible and within thirty (30) days after the award of the contract and before beginning the fabrication of any material or the installation of any equipment, a complete schedule of the materials and equipment proposed for installation shall be submitted to the Engineer for approval. This schedule shall include manufacturers' names, catalog data, diagrams, drawings and other descriptive data as required or requested by the Engineer.
- B. All items of materials and equipment used for the project shall be submitted.
- C. Submittals shall be assembled in an orderly manner and shall include a title page with space for the Engineer's approval stamp and remarks. It shall also contain a concise listing of all items being submitted. Submit six (6) copies as follows: Architect (for records); Engineer (for records); Owner (for records); and three (3) copies for Contractor's use.
- D. Asbestos Free Material/Product: Prior to approval of the material/product to be used, the manufacturer/supplier shall furnish the Engineer with written certification that the material/product contains no asbestos. This certificate is mandatory before approval will be issued. Submittals furnished without the asbestos-free certification will be returned to the Contractor with no action taken until such certification is provided.

1.05 SUBSTITUTION OF EQUIPMENT

- A. All proposed substitutions for specified products on this project require approval in advance of bidding. Approval will not be granted after award of contract. See Substitution Request Form in the bidding documents at the beginning of these specifications for the appropriate approval form. If no form is found, submit by mail, or hand-carried on contractor's or supplier's letterhead. **DO NOT FAX.** Substitutions must be submitted for review at least five (5) working days prior to the bid date to be considered.
- B. It is incumbent on the Contractor to submit technical data that will fully establish the equality of the proposed substitute equipment with that listed and evidence to substantiate the availability of the required repair and maintenance service. Each request for substitution shall be accompanied by the following information for each piece of equipment:
1. Statement indicating that this substituted equipment will not increase the contract cost nor extend the completion date.
 2. Manufacturer's name and model number.
 3. Catalog cut sheets, diagrams and other data published by the manufacturer with the particular model identified and the pertinent design data for that model highlighted or underlined for easy reference.
 4. Each request for substitution shall also include the following information relating to service maintenance and repair:
 - a. Name, address and telephone number of nearest factory authorized technical representative.
 - b. Name, address and telephone number of firm(s) qualified to perform preventive maintenance, minor or major repairs in the locale of the project.
 - c. Name, address and telephone number of firm(s) from whom spare parts and major components are available.
 - d. Building name and address, and the name, address and telephone number of its owner's representative where equipment of the same manufacturer as requested for substitution has been installed and in operation for two or more years. Two or more such installations shall be listed and the location should be in the vicinity of the proposed project.
- C. In the event of Engineer's approval of a substitution of equipment, the requesting entity will be notified by telephonic message or FAX by the Engineer (or authorized representative), and/or by the issuance of an amendment to the contract documents incorporating the equipment by name and model number.

1.06 CONTRACT DRAWINGS

- A. The layout shown on the Contract Drawings is necessarily diagrammatic but shall be followed as closely as actual construction and as other work will allow. The dimensions of work as shown on the Contract Drawings are not as-built dimensions. No measurements shall be scaled from the drawings and used as definite dimensions for laying out or fitting work in place.
- B. The layout of manufactured equipment as shown on the drawings shall be checked and the exact location shall be determined from the dimensions of equipment shop drawings approved by the Engineer.

1.07 DEFINITIONS

- A. FURNISH: The term furnish means supply and deliver to the Project Site, ready for unloading, unpacking, assembly, installation and similar operations.
- B. INSTALL: The term install describes operations at the Project Site including the actual unloading, unpacking, assembly, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations.
- C. PROVIDE: The term provides means to furnish and install, complete and ready for intended use.

1.08 MAINTENANCE MANUAL AND OPERATING INSTRUCTIONS

- A. Upon completion of the work, Contractors shall provide the Engineer with two copies of maintenance manuals for all equipment furnished and installed under his work.
- B. Manuals shall be in substantial 3-ring binders with project name and number inscribed on face and hinged back. Manuals shall include roster of all training session attendees. The manuals shall, however, first be approved by the Engineer. The manuals shall include, but not be limited to manufacturer's lubricating and operating instructions and parts list and serial numbers for all operating machinery, including drive information, and motor horsepower, amperage, and voltage readings on all phases, valve chart, sequence of operation, index following the order listed in the specifications, warranties in the name of the Installation, and a list of manufacturers, service firms and subcontractors names and telephone numbers.
- C. Training attendance rosters for each training session shall be included in manuals. Roster will identify training subject, date, attendees name, job title, and telephone number.
- D. All switches, controls, and safety devices shall be clearly and permanently marked with embossed or printed plates as to purpose and as to operation and shall be tested in the presence of the Owner designated representative to ensure that he understands their function and purpose.

- E. Upon completion of the work, Contractors shall put the systems into service. Contractors shall be entirely responsible for the equipment during all testing operations including the lubricating and turning on and off of such apparatus.

1.09 PROJECT RECORD AND CLOSEOUT DOCUMENTS

- A. See Division 1 for red lining of all documents during construction to reflect “as-built” conditions.
- B. In addition to the requirements specified in Division 1, indicate the following installed conditions:
 - 1. Ductwork mains and branches, size and location, for both exterior and interior; locations of dampers and other control devices; filters, boxes, and terminal units requiring periodic maintenance or repair.
 - 2. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Refer to Section 15190 - “MECHANICAL IDENTIFICATION.” Indicate actual inverts and horizontal locations of underground piping.
 - 3. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 - 4. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
 - 5. Contract Modifications, actual equipment and materials installed.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

1.11 GUARANTEES AND WARRANTIES

- A. Submit to the Owner, two copies of all warranties and guarantees specified in the General Conditions, Supplementary Conditions, the individual sections of the specifications, or as provided by the various subcontractors and material suppliers. All such documents shall show the name and location of the project and the name of the purchaser.
- B. The Contractor shall provide to the Owner a non-prorated guarantee of all materials and workmanship for a period of not less than one year from the date of the Owner’s final certificate.
- C. The Contractor shall be responsible for enforcing all special or extended guarantees required in individual sections of the specifications that might be provided by various subcontractors or material suppliers.

- D. Acceptance of the work under this Division shall be subject to the conditions that all installed systems, equipment, apparatus, and appliances included in the work shall operate and perform as designed, and as selected with respect to efficiency, capacity and quietness and shall operate and perform without producing objectionable noise within occupied areas of the building.
- E. Acceptance of the work shall also be subject to the conditions that any time within one year after date of final payment, any defective part of the work resulting from the supply of faulty workmanship or material shall be immediately amended, repaired or replaced as a part of the contract work without cost to the Owner.
- F. This guarantee shall be extended to include the capacity and integrated performance of the component parts of the various systems in strict accordance with the true intent and purpose of the specification. The contractor shall conduct such tests as are herein specified or as may be required by the Engineer to demonstrate the capacity and performance ability of the various systems to maintain specified conditions.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.01 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in Divisions 2 through 16 for rough-in requirements.

3.02 MECHANICAL INSTALLATIONS

- A. Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:
 - 1. Coordinate mechanical systems, equipment, and materials installation with other building components.
 - 2. Verify all dimensions by field measurements.
 - 3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
 - 4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
7. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
10. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
11. Install access panel or doors where equipment, fire dampers or balancing dampers are concealed behind finished surfaces.
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.03 DEFECTIVE WORK AND MATERIAL

- A. All materials or work found to be defective or not in strict conformity with the drawings or different from requirements of the drawings and specifications or defaced or injured through negligence of Contractor or his employees, or through action of fire or weather will be rejected and shall be immediately removed from premises by Contractor and satisfactory materials and work substituted without delay.
- B. All defective work or imperfect work shall be corrected immediately on notice from Engineer. No previous inspection or certificate on account shall be held to relieve Contractor from his obligation to furnish sound materials and to perform good and satisfactory work.

3.04 COOPERATION AND COORDINATION

- A. Contractor shall confer with other contractors at the site before installing his work to avoid interferences so that maximum head room and clearances may be maintained. In event that interferences develop between work of various contractors, Engineer's decision will be final and no additional compensation will be allowed for changes required.
- B. Particular attention shall be paid to situations where recessed equipment, pipes and lights occur, or where the work of several trades occurs together above suspended ceilings, in pipe shafts or in areas where space is limited.
- C. All fixtures, equipment, devices, switches, outlets, pumps, etc., shall be positioned to avoid all interferences with and to assure proper coordination with work of all other trades, cases, partitions, wall, floor and ceiling patterns, architectural features, etc. All recessed devices, fixtures, etc., shall be coordinated with all wall, floor and ceiling patterns. Engineer will reconcile conflicts and adjustments where such adjustments are warranted.

3.05 CUTTING AND PATCHING

- A. Perform cutting and patching in accordance with Division 1. In addition to the requirements specified in Division 1, the following requirements apply:
 - 1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
- B. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
 - 1. Uncover work to provide for installation of ill-timed work.
 - 2. Remove and replace defective work.
 - 3. Remove and replace work not conforming to requirements of the Contract Documents.
 - 4. Remove samples of installed work as specified for testing.
- C. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
- D. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
 - 1. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.
 - a. Refer to Division 1 for definition of "Experienced Installer."

3.06 PROTECTION OF EQUIPMENT AND SYSTEMS

- A. Contractor shall keep all his respective pipe openings closed by means of plugs or caps to prevent entrance of foreign matter during construction and cover all fixtures, equipment, and apparatus as required to protect them against dirt, water, chemical or mechanical damage both before and after installation. Any such fixtures, equipment or apparatus damaged prior to final acceptance of the work shall be restored to its original condition or replaced by Contractor at no cost to Owner.

END OF SECTION 15010

DIVISION 15 – MECHANICAL

SECTION 15013 - CLEANING, TESTING AND ADJUSTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The following shall apply to this Section:
 - 1. Drawings.
 - 2. General Provisions of the Contract.
 - 3. Solicitation Documents.
 - 4. General Conditions.
 - 5. Supplementary Conditions.
 - 6. Division 1.

1.02 WORK INCLUDES

- A. This section of the specifications includes the cleaning and the testing and the adjusting of all various plumbing and hydronic systems and equipment for mechanical strength, leakage and performance.
- B. The Contractor shall provide for testing and balancing of the HVAC air distribution systems per Section 15990 - "TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS".
- C. Upon completion of the work, the Contractor shall make such tests as are hereinafter specified or as may be required by the Engineer.
- D. Certificates, where such are required, shall be executed and turned over to the Engineer.

1.03 GENERAL REQUIREMENTS

- A. The Contractor shall provide all apparatus, temporary piping, connections or any other requirements necessary and shall take all due precautions to prevent damage to the building and its contents as may be incurred during tests. The Contractor shall repair or make good at his own expense any damage to the building and/or its contents resulting from tests.
- B. Elements of the various systems, equipment, etc, which might be damaged during testing shall be removed (or otherwise protected) for the period of the test and replaced thereafter.
- C. Any leaks, defects, or deficiencies discovered as a result of the tests shall be immediately repaired or made good, and tests shall be repeated until test requirements are fully complied with. Defective materials shall be replaced. Caulking, puttying or painting to correct leaks in pipe or pipe joints will not be permitted.

1.04 PERFORMANCE TESTS

- A. Operating tests to determine performance shall be conducted of each completed system and its associated equipment.
- B. Where major items of Owner-furnished equipment are included in a system, it is the Contractor's responsibility to have a factory representative available when required.
- C. The Contractor shall be responsible for notifying the Owner in writing of the test date sufficiently in advance to allow the timely request for the representative. In the event that testing cannot proceed immediately upon the arrival of the factory representative, and if the delay incurred is due to incomplete work or improper preparation of the work by the Contractor, the Contractor shall bear all costs of the factory representative for the period of the delay.
- D. Performance tests shall be conducted in a manner that will demonstrate satisfactorily the ability of the systems and equipment to perform as specified under design conditions.

1.05 MECHANICAL STRENGTH AND LEAKAGE TESTS

- A. All tests hereinafter specified shall be conducted before backfilling, insulating, or other form of concealment is completed.
- B. It is desirable that each system be tested in its entirety but the various systems may be tested in sections as may be required to expedite the work of other trades.

1.06 CLEANING EQUIPMENT AND SYSTEM

- A. All equipment, piping systems and duct systems shall be thoroughly cleaned internally and externally before being placed in service.
- B. The Contractor is charged with the responsibility for maintaining all systems and equipment clean and free of foreign matter during the processes of assembly and erection.
- C. Pipe strainers and air filters shall be cleaned and serviced immediately prior to final inspection.
- D. When flushing systems, all control, thermal and other elements subject to blocking by foreign matter shall be removed.
- E. When piping systems are flushed with fluids other than that normally contained, the Contractor shall take adequate precautions to insure that the normal contents of the piping will not be contaminated when placed in service.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 15013

DIVISION 15 – MECHANICAL

SECTION 15050 – MATERIALS AND METHODS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The following shall apply to this Section:
 - 1. Drawings.
 - 2. General Provisions of the Contract.
 - 3. Solicitation Documents.
 - 4. General Conditions.
 - 5. Supplementary Conditions.
 - 6. Division 1.

1.02 WORK INCLUDES

- A. Provide all material as specified in this Section.

1.03 RELATED WORK

- A. Division 1 - General Conditions.
- B. Division 7 - Through Penetration Firestop Systems
- C. Section 15010 - "BASIC MECHANICAL REQUIREMENTS".
- D. Section 15067 - "TESTING PIPING SYSTEMS".
- E. Section 15100 - "VALVES".
- F. Section 15400 - "PLUMBING".

1.04 SUBMITTALS

- A. Submit shop drawings in accordance with Section 15010 - "BASIC MECHANICAL REQUIREMENTS" for the following devices:
 - 1. Pipe hangers and supports.
 - 2. Valves.
 - 3. Strainers.
 - 4. Pressure gauges.
 - 5. Thermometers.

- B. Submit certificates of compliance for valves specified under this section.

1.05 QUALITY ASSURANCE

- A. Each major component of equipment shall have the manufacturer's name, address, model number and rating on a plate securely affixed in a conspicuous place. Code ratings, labels or other data which are die-stamped or otherwise affixed to the surface of the equipment shall be in easily visible location.

1.06 PRODUCT DELIVERY STORAGE AND HANDLING

- A. Follow manufacturer's directions in delivery, storage, protection and handling of all equipment and materials.
- B. Deliver and store equipment and materials to the site in original containers, suitably sheltered from the elements and mechanical injury, but readily accessible for inspection until installed.
- C. Items subject to moisture damage shall be stored in dry, heated spaces.
- D. Ascertain, from examination of architectural drawings, whether any special temporary access openings in the building(s) will be required for admission of apparatus furnished under this Division.
- E. Heavy machinery, equipment and heavy parts thereof shall be brought into building or onto premise by a machinery moving concern acceptable to Engineer.
- F. Machinery movers shall not rig, tie to, or rest weight upon any building member of any part of building premises or make use of any stairway until specific permission is obtained from Engineer.
- G. Permission to rig to or in any way make use of any part of building premises shall not relieve Installer of responsibility for any damage resulting from, or because of said rigging or use.

1.07 PROTECTION

- A. Keep pipe openings closed by means of plugs or caps to prevent entrance of foreign matter, and cover all fixtures, equipment and apparatus as required to protect them against dirt, water, chemical or mechanical damage both before and after installation.
- B. Fixtures, equipment or apparatus damaged prior to final acceptance of work shall be restored to original condition or replaced by Installer.
- C. Equipment shall be inherently safe and moving parts shall be covered with guards which meet OSHA requirements.

- D. Provide protective guards for devices such as or similar to thermostats, valves, and switches which are so located as to be readily subject to tampering, accidental damage, or vandalism.
- E. Safety railings.

PART 2 - PRODUCTS

2.01 VALVES

- A. Refer to Section 15100 - "VALVES".

2.02 HANGERS, SUPPORTS, AND INSERTS

- A. Hangers and supports shall conform to the recommendations of Standard Practice SP.58 of the Manufacturers' Standardization Society of the Valve and Fitting Industry.
- B. All hangers for insulated piping shall be oversized to allow the insulation to run through the hanger uninterrupted. Insulation shall be protected from crushing by sheet metal shields.
- C. Where several pipes occur at the same elevation, trapeze type hangers may be used. Trapeze hangers shall be made of 2" x 2" structural steel angles with legs down. All copper tubing supports shall be copper plated or insulated from dissimilar materials.
- D. Hanger rods shall conform to the following:

<u>Pipe Size</u>	<u>Rod Diameter</u>
Up to 2"	3/8"
2½" to 5"	1/2"
6" to 10"	5/8"

Trapeze hanger rods shall be of sufficient size to carry weight of trapeze channel, piping and contents, insulation supports and an additional 200 lb. load.

- E. Wire or perforated strap iron hangers, expansion anchors, and power actuated fasteners will not be permitted.

2.03 SLEEVES

- A. Provide pipe sleeves for all penetrations of piping through walls.
- B. Floor sleeves (for floors above grade) shall be standard weight galvanized steel pipe or PVC pipe with bottom set flush with surface below and top extending 1" above finished floor (3" in mechanical equipment rooms). Seal around pipe and pipe sleeve with fire resistant waterproofing caulking materials. See division 7 for caulking specifications.

- C. Wall sleeves for exterior foundation walls shall be cast iron fabricated sleeves flush with wall inside and outside. Caulk with oakum and lead wool or otherwise adequately waterproof opening between pipe and sleeve.
- D. Wall sleeves for masonry walls shall be standard weight galvanized steel pipe flush with all surfaces.
- E. Wall sleeves for interior partitions and ceilings shall be 20 gauge galvanized steel with lock joints.
- F. Sleeves for piping that is to be insulated shall be large enough to allow insulation to pass through the sleeve. Refer to Section 15250 - "PIPE INSULATION" for specific thicknesses of insulation.
- G. Pack the space between the interior surface of all sleeves and pipes or pipe insulation with fire resistant sound and waterproofing caulking materials. See division 7 for caulking specifications.

2.04 ESCUTCHEONS

- A. Provide set-screw chrome plated escutcheons (not friction-dependent) on all exposed pipe or pipe insulation passing through or into finished walls, partitions, ceiling and floors. Escutcheons at insulated pipes shall be large enough to encircle insulation without penetrating vapor barrier or jacket.

2.05 INDUSTRIAL TYPE THERMOMETERS

- A. Industrial type thermometers shall be the adjustable angle type with 9" case and a minimum stem length of 6" insertion in piping.
- B. Casing shall be cast aluminum with double strength glass, white face with dark graduations.
- C. Element shall be a red reading organic liquid filled tube and brass stem.
- D. Provide separable brass sockets for all thermometers in piping systems. Provide extension sockets when installed in insulated piping.

2.06 PRESSURE GAUGES

- A. Ranges of gauges shall be two times indicated operating pressure or 5 PSIG above relief valve setting. Verify ranges on shop drawings.
- B. Gauges shall be 4½" dial gauges encased in an aluminum die-cast housing with a threaded access cover and glass crystal. The gauge body shall be water and dust tight with back flange.
- C. Movements shall be rotary geared stainless steel with Grade "A" phosphor bronze Bourdon tube rated from 30" vacuum to 1000 PSIG maximum. Accuracy shall be within 1% of the scale range.

2.07 MOTORS

- A. For each item of equipment requiring electric drive, provide a motor having starting and running characteristics consistent with torque and speed requirements of the driven machinery.
- B. Motors shall be of ample size to operate continuously at their proper load and speed without causing noise, vibration or temperature rise in excess of their rating.
- C. Motors shall be of sufficient size as to be non-overloading throughout entire capacity range of the driven equipment.
- D. Motors $\frac{1}{2}$ HP and smaller shall be designed for 120 volts, single phase, 60 hertz operation, and shall have the following: capacitor start and run, 40EC continuous temperature rise, open-drip-proof, permanently lubricated sealed bearings.
- E. Motors $\frac{3}{4}$ HP and larger shall be suitable for voltage as specified under Division 16; 3 phase, 60 hertz operation, shall be squirrel cage type NEMA design B, low current in-rush and normal starting torque, quiet operating, 40EC. continuous rise and shall be equipped with permanently lubricated sealed bearings, unless otherwise specified.
- F. Efficiency: All motors as available shall be "Energy Efficient", provide motors with higher efficiency than "average standard industry motors", in accordance with IEEE Standard 112, test method B.

2.08 STARTERS

- A. Where possible, motor starters shall be integral to the equipment being supplied and of the same manufacturer as specified under Division 16.
- B. Unless otherwise noted, separately mounted motor starters will be provided under Division 16.
- C. Starter heater coil sizes shall be determined by motor nameplate.
- D. Motor starter control circuits and devices shall be 24 volt, 60 hertz unless indicated otherwise on the plans.
- E. Contactors shall be similar to starters.
- F. Automatically started equipment shall have starter with hand-off-auto switch. Manually operated electrical equipment shall have start-stop buttons, unless otherwise indicated on drawings.
- G. Coordinate with work under Division 16 to ensure proper motor starting and circuit protection is provided in compliance with code requirements.
- H. Assume responsibility for compliance with code requirements where groups of motors require circuit protection per NEC. Article 430.

- I. Provide auxiliary contacts where required for interlocking, intermittent starting, pilot control, remote control, motor shut-down and safety features.

2.09 AUXILIARY DEVICES

- A. Each trade providing equipment requiring automatic control or remote control shall provide all proper pilot devices to perform the particular duty specified for the driven equipment. In no case shall safety devices be bypassed.
- B. Coordinate automatic control work and the work of Division 16.

2.10 CONDUIT AND WIRING

- A. Wiring systems provided under Division 15 shall be as specified in Division 16.
- B. All electrical terminals shall be labeled.
- C. Provide wiring diagrams inside each cabinet.
- D. Conduit shall comply with all requirements of Division 16.
- E. Final connections to equipment shall be flexible.

2.11 BELT AND COUPLING GUARDS

- A. Guards shall be provided for all belt-driven units and at chains, gears, couplings, keys, projecting set screws, and other rotating or moving parts. Belt guards shall be made to enclose both pulleys and belts on exposed sides, and shall be constructed of galvanized steel top, bottom, and sides with expanded metal front. Entire assembly shall be rigidly supported with all necessary supplementary steel, and shall be provided for greasing, oiling, adjusting, checking of equipment, etc. Provide coupling guards on direct connected units. Guards shall be readily accessible and designed for easy removal for service and shall comply with U.L. Safety Requirements.

2.12 ACCEPTABLE MANUFACTURERS

- A. Hangers, Supports, and Inserts (insulated or non-insulated piping)
 - 1. Elcen - 12X.
 - 2. Grinnell - #65.
- B. Industrial Type Thermometers
 - 1. Palmer Instruments, Inc.
 - 2. Trerice Co.
 - 3. Weksler Instruments Corp.
- C. Gauges
 - 1. Ashcroft.
 - 2. Marsh.

3. Marshalltown.

PART 3 - EXECUTION

3.01 EXCAVATION AND BACKFILLING

- A. The Contractor shall do all excavation and backfilling and rock excavation required for installation of all of the work requiring excavation, and shall provide all necessary sheeting and bracing required to properly protect his workmen and facilitate the work.
- B. Pipe trenches shall be excavated to lines and grades as shown on drawings or as approved by the Engineer. Over-excavated or unfirm ground shall be brought up to the proper level with sand, or with pit run gravel, thoroughly compacted in place. Width of trench shall be such as to readily permit making of joints.
- C. Backfill for a depth of 6" above the top of the pipe shall be sand or crushed rock, free from rocks or other foreign materials, and shall be placed and hand tamped uniformly so as to avoid damaging or disturbing the alignment of the pipe. Completely backfill top of trench with selected backfill.
- D. All excess excavated material resulting from this work shall be deposited by the Contractor in an approved location.
- E. The Contractor shall establish and maintain all elevations and lines required for the installation of sewers and water lines.
- F. Sheet and brace trenches and remove water as necessary to fully protect workmen and permit proper installation of the work. Comply with local regulations or, in the absence thereof, with the provisions of the "Manual of Accident Prevention on Construction," of the Associated General Contractors of America, Inc. Under no circumstances lay pipe or install appurtenances in water; keep the trench free from water until pipe joints have been completed.

3.02 JOINTING OF PIPING

- A. Threads shall be full and clean cut, and ends of pipe shall be reamed. When screwed joints are assembled, the male thread shall be thoroughly coated with appropriate thread compound to serve as a joint sealer and as a prime coat of paint for the exposed threads (Teflon tape may be used at Contractor's option). Care shall be taken to keep all other foreign matter from entering the interior of the piping. Each section of pipe and all fittings shall be carefully inspected for dirt, grease, or other foreign matter on the inside and where necessary they shall be properly cleaned before assembly.
- B. Soldered or brazed joints made with fittings having pre-inserted rings of solder or brazing alloy shall have the tube and fittings cleaned bright and fluxed. The joint shall be heated sufficiently to make a tight connection. Tubes and fittings without such rings, shall be cleaned bright, fluxed and heated until the solder is drawn into the joint by capillarity and the connection is tight. Flux shall be water soluble binder flux. In potable water systems, the use of solder and flux exceeding 0.2 percent lead content is prohibited.

3.03 EXPANSION AND CONTRACTION

- A. Provisions shall be made for expansion and contraction in all piping. Piping shall be installed in a manner such that joints will not develop leaks. All expansion shall be taken up by swing-connections, and the Contractor shall be responsible for the installation of these connections whether or not they are shown on the Drawings with specific means for relieving expansion and contraction. Slip-type expansion joints shall not be used. Particular care must be exercised at branches on underground piping to allow free movement at branch connection to main.

3.04 INSTALLATION OF PIPING

- A. Piping shall be installed on long continuous lengths, with a minimum number of joints. Joints, where necessary shall be carefully made to insure against leakage.
- B. All piping shall be firmly supported using hangers, brackets and braces to prevent sagging and/or lateral movement. All hangers, brackets, and other supports shall be securely fastened to the construction as may be required and in a manner acceptable to the Engineer. All piping shall be installed to maintain maximum head room. Nothing shall be suspended from the roof deck.
- C. Arrangement of all piping shall be as shown on plans. It is especially necessary that all mains be installed with view to accessibility in case of repair and location of pipe lines and spacing between same shall be so made that there will be no conflict between pipe lines by the several trades.
- D. Contractor shall give careful consideration to clearances and locations of lines and type of fittings used to obtain these clearances. Provide maximum headroom in all cases. Piping shall be installed parallel to building walls and at a height so as not to obstruct any portion of a window, light fixture, doorway, pipe tunnel or passageway. Ascertain from the drawings heights of all suspended ceilings, size of all pipe shafts in which piping is to be concealed, and location and size of structural members in and adjacent to all pipe shafts.
- E. Where interferences develop in the field, Contractor shall offset or reroute piping as required to clear such interferences. In all cases consult architectural drawings for exact location of pipe spaces, ceiling heights, or other architectural details before installing piping.
- F. Under no circumstances shall the size of piping shown on the drawings be changed without written approval of the Engineer.
- G. Provide eccentric reducers where required for proper drainage or venting of horizontal pipe lines. Reducing fittings shall be used for all changes of pipe size and bushings shall not, under any circumstances, be used.
- H. Unions or flanges are to be installed on the equipment side of all valves in pipe connections from mains to equipment, to enable equipment to be drained and disconnected without necessitating the draining of mains.

- I. Valves must be arranged for easy access and be within easy reach and the piping shall be arranged to accomplish this.

3.05 WELDING

- A. When welding is to be performed, precautionary measures must be taken to prevent fire. Provide water barrels and fire buckets or 2½ gal., water pump extinguisher, in close proximity to welding work. All piping shall be shop-fabricated to the greatest extent practicable.
- B. Welded joints shall be made by the oxy-acetylene or electric process in accordance with Code for Pressure Piping ANSI B31.1.
- C. Filler metal for the oxy-acetylene welding process shall conform to the American Society for Testing and Materials Specification for Iron and Steel Gas-Welding Rods, ASTM Designation A251-46T, Classification GA60. Filler metals for the metallic arc welding process shall conform to the American Society for Testing and Materials Specification for Mild Steel Arc-Welding Electrodes, ASTM Designation A233-58T. Classification of electrodes shall be one of the following: E6010, E6015, E7016, E7018.
- D. Welds shall be of the single vee butt type for which the pipe shall be mill leveled to 45E to within 1/16" of the inside wall surface.
- E. The abutting ends of the joints shall be separated before welding to permit complete fusion to the bottom without overlapping, tacked in two or more points to maintain alignment, and welded. All welding shall be continuous around the pipe.
- F. Welds shall be of sound weld metal, thoroughly fused into the ends of the pipe and to the bottom of the vee, and shall be built up in excess of the pipe wall to give a reinforcement of one-quarter (¼) the pipe wall thickness and in such a manner that one weld metal will present a gradual increase in thickness from the surface of the pipe to the center of the weld. The minimum width of the weld shall be 2½ times the pipe wall thickness.
- G. The fillet welds for flanges of fittings shall be fused into the pipe and plate for a minimum distance of 1½ times the pipe wall thickness and shall be built up to present a minimum throat thickness of depth of weld of 1¼ times the pipe wall thickness.
- H. Welding ells shall be used at all turns in welded pipe lines; no mitered ells will be approved.
- I. Where welded mains are 3" in size or larger and branches are 2" in size and smaller, branch connections shall be made up with "Thread-O-Lets" as manufactured by Bonney Forge, Tube Turns or Tube Line, Inc. Welding tees or Weld-O-Lets shall be used for all other branch connection, unless specifically agreed otherwise with the Engineer for a specific case.
- J. Welded piping shall be subject to a hydrostatic test of not less than 100 psi, or of 1½ times the working pressure whichever is the greater at which pressure all welded joints shall be hammered with a three pound hammer, the blows being struck with a sufficient force to jar the pipe and joint, but not so hard as to injure the piping. All welds must pass this test without showing leaks or any defects.

- K. Welding shall be done with high quality modern welding equipment by competent operators, and in a thorough, first class, workmanlike manner. Preparation, fabrication welding and installation shall be in accordance with ANSI B31.3 - 1962.
- L. The Contractor shall be required to furnish proof of the competency of each welding operator, and shall at the request of the Engineer, have all or any of such welding operators pass a standard qualification test such as A.S.M.E., A.W.S. or Hartford Insurance Company procedure and tests.

3.06 HANGERS, SUPPORTS AND INSERTS

- A. Provide all hangers, supports, bracing, inserts, beams, anchors, guides, sleeves and miscellaneous steel for the proper support, alignment, expansion and contraction of piping and equipment.
- B. Hanger supports shall be securely fastened to structural members by approved beam clamps and clips, concrete inserts, anchors, or other appropriate methods agreed upon with the Engineer.
- C. Maximum spacing of hangers and supports for steel and copper piping shall be as follows:

<u>Pipe Size</u>	<u>Spacing</u>
½" thru 1¼"	Not over 6'-0"
1½" and up	Not over 8'-0"

- D. Cast iron or bell and spigot piping shall be supported at every joint.
- E. Additional hangers and supports shall be provided to minimize undesirable stress on valve bodies, other fittings and equipment.
- F. Provide all supplemental angles, channels and plates of adequate sizes where bracing or supports are required for piping between structural members.

3.07 OPENINGS IN CONSTRUCTION

- A. All cutting or provision of openings that may be necessary for the installation of this work shall be done by the Contractor, and all patching and repairing shall be done by workmen competent in the trade required. The Contractor shall be responsible for arranging the work so that minimum cutting will be required.

3.08 CONCRETE EQUIPMENT PADS

- A. The Contractor shall supply all concrete pads and machine bases required for his equipment unless specifically shown to be furnished otherwise.
- B. Concrete supplied for machine bases shall be as specified under Division 3. Pads for pumps and fans shall be doweled to slab floors with one (1) ¼ in. steel rod per sq. ft. of pad. Dowels shall project a minimum of 2" into the slab and 2" into the pad. All other

pads shall be of 4" high, 2" high, or other dimensions as indicated. Pads shall have chamfered edges and equipment anchors.

3.09 VALVES

- A. Install ball valves with the stem above body in accessible position.
- B. The necessary valves shall be installed within the systems to provide required shut-off and flow control service and to allow isolation for inspection, maintenance and repair of each piece of equipment, fixture and branch service loop.
- C. Each valve shall be installed so that it is easily accessible for operation, visual inspection and preventative maintenance.

3.10 MOTORS

- A. Unattached electric motors (motors furnished loose with equipment) shall be set by the Contractor. Motors shall be leveled and aligned on bases and foundation pads in strict accordance with the manufacturer's instructions and their recommended tolerances before any electrical connections are made. After all connections have been made and just prior to placing each motor in operation, levels and alignment shall be re-checked. All necessary adjustments shall be made to assure that the thrust is balanced, that shaft rotates freely when turned by hand. All final connections to motor shall be made under Division 16.

3.11 THERMOMETERS AND GAUGES

- A. Thermometers and Gauges: Install thermometers and gauges in piping systems and duct systems as shown. Thermometers and gauges for each major equipment item shall be readily readable from one position while standing on floor or through the ceiling access panel. Gauges shall not be installed until systems are cleaned.

3.12 CLEANING THE PIPING SYSTEMS

- A. Before pipe covering is applied and final tests are made, flush the water piping systems thoroughly to remove grit, sand, oil, etc., for as long a time as is required to thoroughly clean the apparatus and piping. Make the required temporary connections for this purpose.
- B. Care must be taken not to get dirt, grease, etc., upon the floors or walls. Any damage done shall be promptly repaired.
- C. After the period of these operations, any defects or damages that may have developed in the equipment and apparatus as a result of the cleaning process or the operation of the system shall be made good, and the apparatus put in first class working order.

END OF SECTION 15050

DIVISION 15 – MECHANICAL
SECTION 15067 - TESTING PIPING SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The following shall apply to this Section:
 - 1. Drawings.
 - 2. General Provisions of the Contract.
 - 3. Solicitation Documents.
 - 4. General Conditions.
 - 5. Supplementary Conditions.
 - 6. Division 1.

1.02 WORK INCLUDES

- A. Provide pressure tests on soil, waste and vent piping systems.
- B. Provide pressure tests on domestic cold and hot water piping systems.
- C. Provide pressure tests on natural gas piping systems.
- D. Provide pressure tests on compressed air piping systems.

1.03 RELATED WORK

- A. Division 1 - General Conditions.
- B. Section 15050 - "MATERIALS AND METHODS".
- C. Section 15250 - "PIPE INSULATION".
- D. Section 15400 - "PLUMBING".

1.04 SUBMITTALS

- A. Submit three (3) copies of all testing reports to the Engineer.

1.05 QUALITY ASSURANCE

- A. Notify Engineer three days prior to the tests, who will in turn notify other interested parties.

- B. All tests shall be performed and all piping defects shall be corrected prior to insulating, inaccessible concealing or backfilling. Leaks shall be repaired; all repaired piping shall be retested. All defective pipe, materials and workmanship shall be removed and replaced and tests shall be repeated until systems are proven entirely tight.
- C. The tests shall not be performed until after cleaning the piping systems.

PART 2 - PRODUCTS

2.01 TESTING MATERIALS

- A. All materials, pumps, compressors and equipment required for testing shall be provided by the Contractor installing the piping system.
- B. Where water is used in hydrostatic testing, only potable water shall be used.

PART 3 - EXECUTION

3.01 TESTING OF PIPING SYSTEM - GENERAL

- A. Devices or equipment, or parts thereof, gauges thermometers, etc., which may be damaged by test pressures shall be removed or protected during tests.
- B. Fabricated piping shall not be connected to equipment until testing has been completed. Before applying test pressure, provide restraining devices as required to prevent distortion of piping system during testing.
- C. Welding and screwed joints and other potential leak sources of the systems to be hydrostatically tested shall be painted with a powdered blue chalk and water mixture and allow to dry before testing begins.
- D. All joints in the piping systems shall be inspected during the test period. All defective joints shall be removed, repaired and replaced.
- E. Where air is used for pressure testing, the air pressure shall be gradually applied. All leak sources shall be checked for leaks by applying a coating of soap suds to the source.
- F. After tests have been completed and piping systems proven tight, piping and equipment shall be tested for complete drainage through unions, caps, plugs, faucets or hose valves at low points. If piping and equipment do not drain properly, piping and equipment shall be re-graded and drain points added until system can be completely drained. Systems shall be left dry in freezing weather.

3.02 SOIL, WASTE AND VENT PIPING SYSTEM

- A. Stacks and underfloor sewers of all kinds shall be tested by capping outlets 5'-0" outside building wall, capping all connections, providing a 10'-0" high tight pipe extension and filling with water to top of extension. Water shall remain in each system for at least 2

hours without dropping more than 1". Leaks shall be repaired and tests repeated until system is proven watertight. System may be tested in sections, but every joint between sections must be tested.

3.03 DOMESTIC COLD AND HOT WATER PIPING SYSTEMS

- A. Domestic cold and hot water piping systems shall be hydrostatically tested to a pressure of 100 psig registered at ground floor level. Testing shall be considered complete when systems hold the test pressure for a minimum period of one hour without variation in pressure except that which is due to changes in temperature. Testing shall be performed with potable water.

3.04 GAS PIPING SYSTEMS

- A. Gas piping shall be tested with an inert gas and in accordance with the International Fuel Gas Code.

3.05 COMPRESSED AIR PIPING SYSTEMS

- A. Compressed air piping systems shall be tested to a pressure of 100 psig registered at ground floor level or at 1.5 anticipated operating pressure whichever is greater. Testing shall be considered complete when systems hold the test pressure for a minimum period of one hour without variation in pressure except that which is due to changes in temperature. Testing shall be performed with compressed air.

END OF SECTION 15067

DIVISION 15 – MECHANICAL

SECTION 15100 - VALVES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The following shall apply to this Section:
 - 1. Drawings.
 - 2. General Provisions of the Contract.
 - 3. Solicitation Documents.
 - 4. General Conditions.
 - 5. Supplementary Conditions.
 - 6. Division 1.

1.02 WORK INCLUDES

- A. This Section includes general duty valves common to most mechanical piping systems.
 - 1. Special purpose valves are specified in individual piping system specifications.

1.03 RELATED WORK

- A. Section 15010 - “BASIC MECHANICAL REQUIREMENTS”.
- B. Section 15050 - “MATERIALS AND METHODS”.

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 15010 - “BASIC MECHANICAL REQUIREMENTS”:
 - 1. Product data, including body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.

1.05 QUALITY ASSURANCE

- A. Single Source Responsibility: Comply with the requirements specified in Division 1.
- B. American Society of Mechanical Engineers (ASME) Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Preparation For Transport: Prepare valves for shipping as follows:

1. Ensure valves are dry and internally protected against rust and corrosion.
 2. Protect valve ends against damage to threads, flange faces, and weld-end preps.
- B. Storage: Use the following precautions during storage:
1. Do not remove valve end protectors unless necessary for inspection; then reinstall for storage.
 2. Protect valves from weather. Store valves indoors. Maintain valve temperature higher than the ambient dew point temperature.

PART 2 PRODUCTS

2.01 VALVE FEATURES - GENERAL

- A. Pressure and Temperature Ratings: As scheduled and required to suit system pressures and temperatures.
- B. Isolation Valves: Valves 2" and smaller shall be ball valves. Valves 2½" and larger shall be butterfly valves. Isolation valves shall be the same size as upstream pipe
- C. Circuit Balancing Valves: Valves shall be globe valves. Circuit balancing valves shall be one pipe size smaller than the upstream pipe, unless otherwise indicated.
- D. Operators: Provide the following special operator features:
1. Hand wheels, fastened to valve stem, for valves other than quarter turn.
 2. Lever handles, on quarter-turn valves 6" and smaller, except for plug valves.
 3. Motorized valve operators shall be provided by the same manufacturer as the corresponding valve.
- E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.
- F. End Connections: As indicated in the valve specifications.
1. Threads: Comply with ANSI B1.20.1.
 2. Flanges: Comply with ANSI B16.1 for cast iron, ANSI B16.5 for steel, and ANSI B16.24 for bronze valves.
 3. Solder-Joint: Comply with ANSI B16.18.

- a. Caution: Where soldered end connections are used, use solder having a melting point below 840EF. for globe, and check valves; below 421EF. for ball valves.

2.02 GATE VALVES

- A. **Gate valves are not allowed.**

2.03 BALL VALVES

- A. Ball Valves: 150 psi rating, saturated steam pressure, 400 psi WOG pressure; two-piece construction; with bronze body conforming to ASTM B 62, standard (or regular) port, chrome-plated brass ball, replaceable “Teflon” or “TFE” seats and seals, blowout-proof stem, and vinyl-covered steel handle. Provide solder ends for condenser water, chilled water, and domestic hot and cold water service.

2.04 BUTTERFLY VALVES

- A. Butterfly Valves: 200 psi rating, MSS SP-67, Lug-style; cast-iron body conforming to ASTM A 126, Class B. Provide valves with field replaceable EPDM sleeve, nickel-plated ductile iron disc (except aluminum bronze disc for valves installed in condenser water piping), stainless steel stem, and EPDM O-ring stem seals. Provide lever operators with locks for sizes 2 through 6 inches and gear operators with position indicator for sizes 8 through 24 inches.

2.05 CHECK VALVES

- A. Swing Check Valves: MSS SP-80; Class 125, cast-bronze body and cap conforming to ASTM B 62; with horizontal swing, Y-pattern, and bronze disc; and having threaded or solder ends. Provide Class 150 valves meeting the above specifications, with threaded end connections, where system pressure requires or where Class 125 valves are not available.
- B. Wafer Check Valves: Class 250, cast-iron body; with replaceable bronze seat, and non-slam design lapped and balanced twin bronze flappers and stainless steel trim and torsion spring. Provide valves designed to open and close at approximately one foot differential pressure.

2.06 GLOBE VALVES

- A. Globe Valves (2” and smaller): Type 2, Class 150, bronze.
- B. Globe Valves (2½” and larger): Type 1, Class 250, cast iron.

2.07 ACCEPTABLE MANUFACTURERS

- A. Valves:
 - 1. Bell and Gossett.

2. Crane
3. Grinnell.
4. Keystone.
5. Nibco.

6. Stockham.
7. Victaulic.
8. Watts.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine valve interior through the end ports for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks used to prevent disc movement during shipping and handling.
- B. Prior to valve installation, examine the piping for cleanliness, freedom from foreign materials, and proper alignment.
- C. Replace defective valves with new valves.

3.02 VALVE ENDS SELECTION

- A. Select valves with the following ends or types of pipe/tube connections:
 1. Copper Tube Size, 2" and Smaller: Solder ends.
 2. Steel Pipe Sizes, 2" and Smaller: threaded or grooved end.
 3. Steel Pipe Sizes 2½" and Larger: grooved end or flanged.

3.03 VALVE INSTALLATIONS

- A. Refer to piping system specification sections for specific valve applications and arrangements.
 1. Locate valves for easy access and provide separate support where necessary.
 2. Install valves and unions for each fixture and item of equipment arranged to allow equipment removal without system shutdown. Unions are not required on flanged devices.
 3. Install valves in horizontal piping with stem at or above the center of the pipe.
 4. Install valves in a position to allow full stem movement.

- B. Installation of Check Valves: Install for proper direction of flow as follows:
 - 1. Swing Check Valves: Horizontal position with hinge pin level.
 - 2. Wafer Check Valves: Horizontal or vertical position, between flanges.

3.04 SOLDER CONNECTIONS

- A. Cut tube square and to exact lengths.
- B. Clean end of tube to depth of valve socket with steel wool, sand cloth, or a steel wire brush to a bright finish. Clean valve socket in same manner.
- C. Apply proper soldering flux in an even coat to inside of valve socket and outside of tube.
- D. Open globe valves to full open position.
- E. Remove the cap and disc holder of swing check valves having composition discs.
- F. Insert tube into valve socket, making sure the end rests against the shoulder inside valve. Rotate tube or valve slightly to ensure even distribution of the flux.
- G. Apply heat evenly to outside of valve around joint until solder will melt upon contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

3.05 THREADED CONNECTIONS

- A. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).
- B. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

3.06 FLANGED CONNECTIONS

- A. Align flange surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.
- B. For dead-end service, butterfly valves require flanges both upstream and downstream for proper shutoff and retention.

3.07 FIELD QUALITY CONTROL

- A. Tests: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust or replace packing to stop leaks; replace valves if leak persists.

3.08 ADJUSTING AND CLEANING

- A. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or insulation.

END OF SECTION 15100

DIVISION 15 – MECHANICAL

SECTION 15190 - MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The following shall apply to this Section:
 - 1. Drawings.
 - 2. General Provisions of the Contract.
 - 3. Solicitation Documents.
 - 4. General Conditions.
 - 5. Supplementary Conditions.
 - 6. Division 1.

1.02 WORK INCLUDES

- A. Provide identification of all systems and equipment installed under Division 15.

1.03 RELATED WORK

- A. Division 1 - General Conditions.
- B. Section 15010 - “BASIC MECHANICAL REQUIREMENTS”.

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer’s technical product data and installation instructions for each identification material and device required in accordance with Section 15010 - “BASIC MECHANICAL REQUIREMENTS.”
- B. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.

1.05 QUALITY ASSURANCE

- A. Manufacturer’s Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service.
- B. Codes and Standards:
 - 1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

PART 2 - PRODUCTS

2.01 PLASTIC PIPE MARKERS

- A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1.
- B. Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, complying with ANSI A13.1.
- C. Small Pipes: For external diameters less than 6" (including insulation if any), provide full-band pipe markers, extending 360° around pipe at each location, fastened by one of the following methods:
 - 1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
 - 2. Adhesive lap joint in pipe marker overlap.

2.02 UNDERGROUND-TYPE PLASTIC LINE MARKERS

- A. General: Manufacturer's standard permanent, bright-colored, continuous-printed detectable tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide tape with printing which most accurately indicates type of service of buried pipe.
 - 1. Provide multi-ply tape consisting of solid aluminum foil core between 2-layers of plastic tape.

2.03 ACCEPTABLE MANUFACTURERS

- A. Allen Systems, Inc.
- B. Brady (W.H.) Co.; Signmark Div.
- C. Industrial Safety Supply Co., Inc.
- D. Seton Name Plate Corp.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.02 PIPING SYSTEM IDENTIFICATION

- A. General: Install pipe markers on each piping system, and include arrows to show normal direction of flow.

- B. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.
1. Near each valve and control device.
 2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
 3. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.
 4. At access doors, manholes and similar access points which permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment.
 7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

3.03 UNDERGROUND PIPING IDENTIFICATION

- A. General: During back-filling/top-soiling of underground gas piping, install continuous underground-type detectable type line marker, located directly over buried line at 6" to 8" below finished grade.

END OF SECTION 15190

DIVISION 15 – MECHANICAL

SECTION 15300 - WET-PIPE SPRINKLER SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The following shall apply to this Section:
 - 1. Drawings.
 - 2. General Provisions of the Contract.
 - 3. Solicitation Documents.
 - 4. General Conditions.
 - 5. Supplementary Conditions.
 - 6. Division 1.

1.02 WORK INCLUDES

- A. The wet-pipe sprinkler systems for buildings and structures.
- B. Products specified in this Section with installation not in Contract include sprinkler cabinets with spare sprinklers and sprinkler wrenches. Deliver to the Owner's maintenance personnel.

1.03 RELATED WORK

- A. Section 15010 - "BASIC MECHANICAL REQUIREMENTS".
- B. Section 16721 - "FIRE ALARM SYSTEM" for alarm devices not specified in this Section.

1.04 SUBMITTALS

- A. Submit product data for fire protection system components in accordance with Section 15010 - "BASIC MECHANICAL REQUIREMENTS." Include the following:
 - 1. Backflow preventers.
 - 2. Valves.
 - 3. Specialty valves, accessories, and devices.
 - 4. Alarm devices. Include electrical data.
 - 5. Fire hose and cabinet.

6. Fire department connections. Include type of fire department connection; number, size, type, and arrangement of inlets; size and direction of outlet; and finish.
 7. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other data.
- B. Sprinkler system drawings identified as “working plans,” prepared according to NFPA 13 and where applicable, NFPA 14. Submit required number of sets to authority having jurisdiction for review, comment, and approval. Include system hydraulic calculations. Plans and calculations shall be sealed by a registered professional engineer.
 - C. Test reports and certificates as described in NFPA 13. Include “Contractor’s Material & Test Certificate for Aboveground Piping” and “Contractor’s Material & Test Certificate for Underground Piping.”
 - D. Maintenance data for each type of fire protection specialty specified, for inclusion in Operating and Maintenance Manual specified in Division 1.
 - E. Two (2) copies of NFPA 25 “Standard for Inspection, Testing and Maintenance of Water Based Fire Protection Systems.” Deliver to Owner’s maintenance personnel.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Firms whose equipment, specialties, and accessories are listed by product name and manufacturer in the UL Fire Protection Equipment Directory and that conform to other requirements indicated.
- B. Listing and Labeling: For equipment, specialties, and accessories that are listed and labeled, refer to the NEC Article 100 for the definition of “Listed” and “Labeled”.
- C. Comply with requirements of authority having jurisdiction for submittals, approvals, materials, hose threads, installation, inspections, and testing.
- D. Designer: Submit shop drawings and design calculations prepared by either a NICET level III technician or a licensed engineer. When prepared by a licensed engineer, the drawings and calculations shall be sealed by the engineer. The shop drawings and calculations shall be reviewed by LaRose & Schober Engineering prior to the sprinkler system installation.
- E. Installer’s Qualifications: Firms qualified to install and alter fire protection piping, equipment, specialties, and accessories, and repair and service equipment. A qualified firm is one that is experienced (minimum of 5 previous projects similar in size and scope to this Project) in such work, familiar with precautions required, and in compliance with the requirements of the authority having jurisdiction. Submit evidence of qualifications to the Engineer upon request. Refer to Division 1 for definition of “Installer.”
- F. NFPA Standards: Equipment, specialties, accessories, installation, and testing complying with the following:

1. NFPA 13 “Standard for the Installation of Sprinkler Systems.”
2. NFPA 14 “Standard for the Installation of Standpipe, Private Hydrant and Hose Systems.”
3. NFPA 26 “Recommended Practice for the Supervision of Valves Controlling Water Supplies for Fire Protection.”
4. NFPA 70 “National Electrical Code.”

1.06 DEFINITIONS

- A. Pipe sizes used in this Section are nominal pipe size (NPS) specified in inches. Tube sizes are standard tube size specified in inches.
- B. Working plans as used in this Section refer to documents (including drawings and calculations) prepared pursuant to requirements in NFPA 13 for obtaining approval of authority having jurisdiction.
- C. Other definitions for fire protection systems are included in the referenced NFPA standards.

1.07 SYSTEM DESCRIPTION

- A. Wet Pipe Sprinkler System: A sprinkler system employing automatic sprinklers attached to a piping system containing water and connected to water supply so that water discharges immediately from sprinklers opened by heat from a fire.
- B. Sprinkler System Protection Limits: All spaces within areas indicated on the plans including closets, toilet and locker room areas, each landing of each stair, and special applications areas.
- C. Water Supply: The supply portion of the sprinkler system that provides the flow (gpm) and pressure (psi) required by the water based fire protection system. The water supply system consists of the piping up to and including the valve that isolates the sprinkler system from the water source.

1.08 SYSTEM PERFORMANCE REQUIREMENTS

- A. Design and obtain approval from authority having jurisdiction for fire protection systems specified.
- B. Minimum Pipe Sizes: Not smaller than sizes indicated for connection to water supply piping and system riser.
- C. Water Supply: Conduct tests on water supply as required to obtain hydraulic data needed to prepare design for hydraulically calculated systems.
- D. Hydraulically design sprinkler systems according to:

1. Sprinkler System Occupancy Hazard Classifications as indicated on the drawings.
 2. Minimum Density Requirements for Automatic Sprinkler System Hydraulic Design required by NFPA 13.
- E. Components and Installation: Piping systems with the following minimum working pressure ratings or as required by NFPA 13.
1. Sprinkler Systems: 175 psig (1200 kPa).

PART 2 PRODUCTS

2.01 PIPES AND TUBES

- A. Refer to Part 3 Article "Sprinkler and Standpipe System Piping Applications" and for identification of systems where pipe and fitting materials specified below are used.
- B. Ductile-Iron Pipe: AWWA C115, ductile-iron barrel with iron-alloy threaded flanges, 250-psig (1725 kPa) minimum working pressure rating, and AWWA C104 cement-mortar lining.
 1. Option: Pipe may be AWWA pattern, cut-grooved for grooved-coupling joints.
- C. Steel Pipe: ASTM A 53, Schedule 40 in sizes 6" (150 mm) and smaller and Schedule 30 in sizes 8" (200 mm) and larger, black and galvanized, plain and threaded ends, for welded, threaded, cut-groove, and rolled-groove joints.
- D. Steel Pipe: ASTM A 135, Schedule 10 through 5" (125 mm) sizes and NFPA 13 specified wall thickness for 6" (150 mm) through 10" (250 mm) sizes, with plain ends, black and galvanized, for rolled-groove and welded joints.
- E. Steel Pipe: ASTM A 135, threadable light wall, black and galvanized, for threaded joints.
- F. Steel Pipe: ASTM A 795, black and galvanized, for joints listed and for use with fittings for plain-end steel pipe.
 1. Type: Lightweight pipe, Schedule 10, for rolled-groove and welding joints.

2.02 PIPE AND TUBE FITTINGS

- A. Ductile-Iron and Gray-Iron Flanged Fittings: AWWA C110, 250-psig (1725 kPa) minimum pressure rating, with AWWA C104 cement-mortar lining.
- B. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threads according to ASME B1.20.1.
- C. Grooved-End Fittings for Ductile-Iron Pipe: ASTM A 536 ductile-iron or ASTM A 47 malleable-iron, AWWA pipe-size, designed to accept AWWA C606 grooved couplings.

Include cement lining or Food and Drug Administration (FDA)-approved interior coating.

- D. Steel Fittings: ASTM A 234/A 234M, seamless or welded; ASME B16.9, butt welding; or ASME B16.11, socket-welding type for welded joints.
- E. Steel Flanges and Flanged Fittings: ASME B16.5.
- F. Grooved-End Fittings for Steel Pipe: UL-listed and FM-approved, ASTM A 536, Grade 65-45-12 ductile-iron or ASTM A 47 Grade 32510 malleable-iron, with grooves or shoulders designed to accept grooved couplings.

2.03 JOINING MATERIALS

- A. Refer to Section 15050 - "MATERIALS AND METHODS" for joining materials not included in this Section.
- B. Flanged Joints for Ductile-Iron Pipe and Ductile-Iron or Cast-Iron Fittings: AWWA C115 ductile-iron or gray-iron pipe flanges, rubber gaskets, and high-strength steel bolts and nuts.
- C. Couplings for Grooved-End Steel Pipe and Grooved-End Ferrous Fittings: UL 213, AWWA C606, ASTM A 536 ductile-iron or ASTM A 47 malleable-iron housing, with enamel finish. Include synthetic-rubber gasket with central-cavity, pressure-responsive design; ASTM A 183 carbon-steel bolts and nuts; and locking pin, toggle, or lugs to secure grooved pipe and fittings.
- D. Couplings for Grooved-End Ductile-Iron Pipe and Fittings: UL 213, AWWA C606, ASTM A 536 ductile-iron housing, with enamel finish. Include synthetic-rubber gasket with central-cavity, pressure-responsive design, and ASTM A 183 carbon-steel bolts and nuts to secure grooved pipe and fittings.

2.04 FIRE PROTECTION SERVICE VALVES

- A. General: UL-listed and FM-approved, with 175-psig (1200 kPa) non-shock minimum working pressure rating.
 - 1. Option: Valves for use with grooved piping may be grooved type.
- B. Gate Valves, 2" (50 mm) and Smaller: UL 262
- C. Gate Valves, 2½" (65 mm) and Larger: UL 262
- D. Gate Valves, 2½" (65 mm) and Larger for Use with Indicator Posts: UL 262
- E. Indicator Posts: UL 789, with windows for target plates that indicate valve position, extension rod and coupling, locking device, and red enamel finish.
 - 1. Operation: Cast Hand Wheel.
- F. Swing Check Valves, 2½" (65 mm) and Larger: UL 312

- G. Ball Drip Valves: UL 1726

2.05 BACKFLOW PREVENTERS

- A. General: ASSE standard backflow preventers, of size indicated for maximum flow rate indicated and maximum pressure loss indicated.
1. Working Pressure: 150 psig (1035 kPa) minimum except where indicated otherwise.
 2. Bronze, cast-iron, steel, or stainless-steel body with flanged ends.
 3. Interior Lining: FDA-approved epoxy coating, for backflow preventers having cast iron or steel body.
 4. Interior Components: Corrosion-resistant materials.
- B. Double Check Backflow Prevention Assemblies: ASSE 1015, UL 312, USCFCCCHR, consisting of shutoff valves on inlet and outlet and strainer on inlet. Include test cocks with 2 positive-seating check valves for continuous pressure application.
1. Pressure Loss: 5 psig (35 kPa) maximum, through middle third of flow range.

2.06 SPRINKLERS

- A. Automatic Sprinklers: With heat-responsive element conforming to:
1. UL 199, for applications except residential.
 2. UL 1767, for early-suppression, fast-response applications.
- B. Sprinkler types and categories are as indicated and as required by application. Furnish automatic sprinklers with nominal ½" (12.7 mm) orifice for "Ordinary" temperature classification rating except where otherwise indicated and required by application.
- C. Sprinkler types, features, and options include:
1. Flush (concealed) ceiling sprinklers, including escutcheon.
 2. Pendent, dry-type sprinklers.
 3. Upright sprinklers.
- D. Sprinkler Finishes: Chrome-plated and bronze.
- E. Sprinkler Escutcheons: Materials, types, and finishes for following sprinkler mounting applications. Escutcheons for concealed sprinklers are specified with sprinklers.
1. Ceiling Mounting: Chrome-plated steel, 1- piece, flat.

- F. Sprinkler Cabinets: Finished steel cabinet and hinged cover, with space for minimum of 6 spare sprinklers plus sprinkler wrench, suitable for wall mounting. Include number of sprinklers required by NFPA 13 and 1 wrench for sprinklers. Include separate cabinet with sprinklers and wrench for each style sprinkler on Project.

2.07 SPECIALTY SPRINKLER FITTINGS

- A. Specialty Fittings: UL-listed and FM-approved, made of steel, ductile-iron, or other materials compatible with system materials and applications where used.
- B. Locking-Lug Fittings: UL 213, ductile-iron body with locking-lug ends, for use with plain-end steel pipe.
- C. Mechanical-"T" Fittings: UL 213, ductile-iron housing with pressure-responsive gasket, bolts, and threaded or locking-lug outlet.
- D. Mechanical-Cross Fittings: UL 213, ductile-iron housing with pressure-responsive gaskets, bolts, and threaded or locking-lug outlets.
- E. Drop-Nipple Fittings: UL 1474, with threaded inlet, threaded outlet, and seals; adjustable.
- F. Sprinkler Alarm Test Fittings: Ductile-iron housing with 1½" (40 mm) inlet and outlet, integral test valves, combination orifice and sight glass, and threaded or locking-lug ends.
- G. Flexible Stainless Steel Hose: Assemblies shall be constructed of 100% type 304 stainless steel, have of fully welded non-mechanical fittings and be encapsulated with braided steel. Products shall meet NFPA 13, FM1637 and UL 2443 requirements.

2.08 FIRE DEPARTMENT CONNECTIONS

- A. Fire Department Connections: UL 405, cast-brass body; NH-standard thread inlets according to NFPA 1963 and matching local fire department threads; and threaded NPS outlet. Include lugged cap, gasket, and chain; lugged swivel connection and drop clappers for each hose connection inlet; and round wall escutcheon plate with marking "AUTO SPKR."

2.09 HOSE AND VALVE CABINETS

- A. Hose and valve cabinets shall be located and configured as indicated on the plans.
- B. All cabinets shall be provided with a bright red finish.

2.10 ALARM DEVICES

- A. Alarm Devices: Types and sizes that will match piping and equipment connections.

- B. Electric Alarm Bells: UL Listed, 6" round and designed for horizontal or vertical installation. Polarized, mount to 4" square outlet box, high-efficiency motor driven striker, red finish; on outdoor installations provide a weatherproof back box. Provide bells with voltage as required (See Fire Protection Drawings).
- C. Supervisory Switches: UL 753, for valves, electrical supervision type, SPDT (single-pole, double-throw), normally closed contacts, designed to signal controlled valve in other than full open position (See Fire Protection Drawings).

2.11 PRESSURE GAUGES

- A. Pressure Gauges: UL 393, 3½" to 4½" (90 to 115 mm) diameter dial with dial range of 0-250 psig (0-1600 kPa).

2.12 ACCEPTABLE MANUFACTURERS

- A. Backflow Preventers:
 - 1. Ames Co., Inc.
 - 2. Cla-Val Co.
 - 3. Conbraco Industries, Inc.
 - 4. Febco.
 - 5. Hersey Products, Inc., Grinnell Corp.
 - 6. Watts Regulator Co.
 - 7. Wilkins Regulator Div., Zurn Industries, Inc.
- B. Fire Department Connections:
 - 1. Badger-Powhatan, Figgie International Co.
 - 2. Croker Div., Fire-End and Croker Corp.
 - 3. Elkhart Brass Mfg. Co., Inc.
 - 4. Firematic Sprinkler Devices, Inc.
 - 5. Gem Sprinkler Co. Div., Grinnell Corp.
 - 6. Guardian Fire Equipment, Inc.
 - 7. Potter-Roemer Div., Smith Industries, Inc.
 - 8. Reliable Automatic Sprinkler Co., Inc.
 - 9. Sierra Fire Equipment Co.
- C. Fire Protection Service Gate and Check Valves:
 - 1. Gem Sprinkler Co. Div., Grinnell Corp.
 - 2. Kennedy Valve Div., McWane, Inc.
 - 3. Nibco, Inc.
 - 4. Stockham Valves and Fittings, Inc.
 - 5. Victaulic Company of America.
- D. Grooved Couplings for AWWA Ductile-Iron Piping:
 - 1. Gustin-Bacon Div., Tyler Pipe Subsid., Tyler Corp.
 - 2. Victaulic Company of America.

- E. Grooved Couplings for Steel Piping:
1. Grinnell Supply Sales Co., Grinnell Corp.
 2. Gustin-Bacon Div., Tyler Pipe Subsid., Tyler Corp.
 3. Sprink-Line by Sprink, Inc.
 4. Stockham Valves and Fittings, Inc.
 5. Victaulic Company of America.
- F. Indicator Posts and Valves:
1. Clow Valve Co. Div., McWane, Inc.
 2. Gem Sprinkler Co. Div., Grinnell Corp.
 3. Kennedy Valve Div., McWane, Inc.
 4. Nibco, Inc.
 5. Stockham Valves and Fittings, Inc.
 6. Waterous Co.
- G. Specialty Valves and Electric Alarm Bells:
1. Central Sprinkler Corp.
 2. Firematic Sprinkler Devices, Inc.
 3. Gem Sprinkler Co. Div., Grinnell Corp.
 4. Globe Fire Sprinkler Corp.
 5. Reliable Automatic Sprinkler Co., Inc.
 6. Star Sprinkler Corp.
 7. Viking Corp.
- H. Sprinklers:
1. Central Sprinkler Corp.
 2. Firematic Sprinkler Devices, Inc.
 3. Gem Sprinkler Co. Div., Grinnell Corp.
 4. Globe Fire Sprinkler Corp.
 5. Reliable Automatic Sprinkler Co., Inc.
 6. Star Sprinkler Corp.
 7. Viking Corp.
- I. Flexible Stainless Steel Hose:
1. Flexhead Industries, Inc.
- J. Water Flow Indicators and Supervisory Switches:
1. Gamewell Co.
 2. Gem Sprinkler Co. Div., Grinnell Corp.
 3. Potter Electric Signal Co.
 4. Reliable Automatic Sprinkler Co., Inc.
 5. System Sensor Div., Pittway Corp.

6. Victaulic Company of America.
7. Watts Regulator Co.

PART 3 EXECUTION

3.01 SPRINKLER AND STANDPIPE SYSTEM PIPING APPLICATIONS

- A. Refer to Part 2 of this Section for detailed specifications on pipe and fittings products listed below. Use pipe, tube, fittings, and joining methods according to the following applications. Piping may be joined with flanges instead of indicated joints. Use grooved-end fittings with grooved couplings that are made by the same manufacturer and that comply with listing when used together for grooved-coupling joints.
- B. Pipe Between Fire Department Connections and Check Valves: Use galvanized-steel pipe instead of black-steel pipe when steel pipe is specified for applications below. Do not use welded joints.
- C. Sizes 2" (50 mm) and Smaller: ASTM A 53, A 135, or A 795; threadable light wall pipe, Schedule 40 steel pipe with cut-groove ends, grooved-end steel pipe fittings, and grooved-coupling joints; or with threaded joints and fittings.
- D. Sizes 2½" (65 mm) to 6" (150 mm): ASTM A 135 or A 795, Schedule 10 steel pipe with rolled-groove ends, grooved-end steel pipe fittings, and grooved-coupling joints.

3.02 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 1. Shutoff Duty: Use gate, ball, or butterfly valves.
 2. Throttling Duty: Use globe, ball, or butterfly valves.

3.03 JOINT CONSTRUCTION

- A. Refer to Section 15050 - "MATERIALS AND METHODS" for basic piping joint construction.
- B. Grooved-End Pipe and Grooved-End Fitting Joints: Use grooved-end fittings and grooved-couplings that are made by the same manufacturer and that are listed for use together. Groove pipe and assemble joints with grooved-coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
 1. Groove Type: Cut.
 2. Groove Type: Rolled.
- C. Locking-Lug Joints: Follow manufacturer's written instructions.

- D. Dissimilar Materials Piping Joints: Make joints using adapters compatible with both piping materials.

3.04 SERVICE ENTRANCE PIPING

- A. Connect fire protection piping to water service piping of size and in location indicated for service entrance to building. Water service piping is specified in Section 02700 - "UTILITIES."
- B. Install shutoff valve, backflow preventer, pressure gauge, drain, and other accessories indicated at connection to water supply piping.

3.05 PIPING INSTALLATIONS

- A. Refer to Section 15050 - "MATERIALS AND METHODS" for basic piping installation.
- B. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate general location and arrangement of piping. Install piping as indicated, as far as practical. All piping shall be installed as high as possible.
 - 1. Deviations from approved "working plans" for sprinkler piping require written approval from authority with jurisdiction. File written approval with the Engineer prior to deviating from approved "working plans."
- C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes 2" (50 mm) and smaller. Unions are not required on flanged devices or in piping installations using grooved couplings.
- E. Install flanges or flange adapters on valves, apparatus, and equipment having 2½" (65 mm) and larger connections.
- F. Install "Inspector's Test Connections" in sprinkler piping, complete with shutoff valve, sized and located according to NFPA 13.
- G. Install sprinkler piping with drains for complete system drainage.
- H. Install ball drip valves to drain piping between fire department connections and check valves, and where indicated. Drain to floor drain or outside building.
- I. Install alarm devices in piping systems.
- J. Hangers and Supports: Comply with NFPA 13.
 - 1. Install hanger and support spacing and locations for steel piping joined with grooved mechanical couplings according to manufacturer's written instructions for rigid systems.

- K. Install pressure gauges on riser or feed main. Include pressure gauges with connection not less than ¼" (7 mm) and with soft metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they will not be subject to freezing.

3.06 SPECIALTY SPRINKLER FITTING INSTALLATIONS

- A. Install specialty sprinkler fittings according to manufacturer's written instructions.

3.07 VALVE INSTALLATIONS

- A. Refer to Section 15100 - "VALVES" for installation of general duty-valves. Install fire-protection specialty valves, trim, fittings, controls, and specialties according to NFPA 13, manufacturer's written instructions, and the authority having jurisdiction.
- B. Gate Valves: Install fire-protection service valves supervised-open, located to control sources of water supply except from fire department connections. Where there is more than 1 control valve, provide permanently marked identification signs indicating portion of system controlled by each valve.
- C. Alarm Check Valves: Install valves in vertical position for proper direction of flow, including bypass check valve and retard chamber drain line connection.

3.08 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated. Comply with plumbing code and authority having jurisdiction. Do not install bypass around backflow preventer.

3.09 SPRINKLER APPLICATIONS

- A. Rooms without Ceilings: Upright sprinklers.
- B. Rooms with Suspended Ceilings: Flush (concealed) sprinklers.
- C. Wall Mounting: Sidewall sprinklers.
- D. Spaces Subject to Freezing: Upright or pendent dry type.
- E. Special Applications: Use extended-coverage, flow-control, and quick-response sprinklers where indicated.
- F. Sprinkler Finishes: Use sprinklers with following finishes:
 - 1. Upright and Sidewall Sprinklers: Chrome-plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view.

3.10 SPRINKLER INSTALLATIONS

- A. Install sprinklers in suspended ceilings in center of acoustical panels and tiles where spacing permits.

- B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers supplied from heated space.

3.11 STAINLESS STEEL FLEXIBLE HOSE INSTALLATIONS

- A. Install hose assemblies in strict compliance with the manufacturer's instructions.

3.12 FIRE DEPARTMENT CONNECTION INSTALLATIONS

- A. Install fire department connections of types and features indicated in locations indicated.
- B. Install ball drip valves at each check valve for fire department connection to mains and where indicated. Drain to floor drain or outside building.

3.13 CONNECTIONS

- A. Connect water supplies to standpipe and sprinkler systems. Include backflow preventers.
- B. Electrical Connections: Power wiring is specified in Division 16.
- C. Connect alarm devices to fire alarm system.

3.14 FIELD QUALITY CONTROL

- A. Perform field acceptance tests of each fire protection system.
 - 1. Flush, test, and inspect sprinkler piping systems according to NFPA 13 Chapter "System Acceptance."
- B. Replace piping system components that do not pass test procedures specified, then retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
- C. Report test results promptly and in writing to authority having jurisdiction when required.

3.15 CLEANING

- A. Clean dirt and debris from sprinklers. Replace sprinklers having paint other than factory finish with new sprinklers. Cleaning and reuse of painted sprinklers is prohibited.

3.16 COMMISSIONING

- A. Starting Procedures: Follow manufacturer's written procedures. If no procedures are prescribed by manufacturer, proceed as follows:
 - 1. Verify that specialty valves, trim, fittings, controls, and accessories have been installed correctly and operate correctly.
 - 2. Verify that specified tests of piping are complete.

3. Check that damaged sprinklers and sprinklers with paint or coating not specified have been replaced with new, correct type of sprinklers.
 4. Check that sprinklers are correct type, have correct finish and temperature ratings, and have guards where required for applications.
 5. Check that potable water supplies have correct type of backflow preventer.
 6. Check that hose valves and fire department connections have threads compatible with local fire department equipment and have correct pressure rating.
 7. Fill wet-pipe sprinkler systems with water.
 8. Adjust operating controls and pressure settings.
- B. Coordinate with fire alarm system tests. Operate systems as required.

3.17 DEMONSTRATION

- A. Demonstrate equipment, specialties, and accessories. Review operating and maintenance information.

END OF SECTION 15300

DIVISION 15 – MECHANICAL

SECTION 15400 - PLUMBING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The following shall apply to this Section:
 - 1. Drawings.
 - 2. General Provisions of the Contract.
 - 3. Solicitation Documents.
 - 4. General Conditions.
 - 5. Supplementary Conditions.
 - 6. Division 1.

1.02 WORK INCLUDES

- A. All piping, fittings, meters, valves, hangers and other accessories specified or shown on the drawings for a complete plumbing system.
- B. Sanitary waste and vent piping water drainage system, including all necessary excavating and backfilling to 5'-0" outside building foundation, unless stated otherwise.

1.03 SUBMITTALS

- A. Submit certificates of compliance for pipe, fittings and valves specified under this section.
- B. Submit shop drawings in accordance with Section 15010 - "BASIC MECHANICAL REQUIREMENTS" for the following equipment:
 - 1. Floor drains.
 - 2. Cleanouts.
 - 3. Hose bibbs.
 - 4. Thermostatic tempering valves.
 - 5. Water heaters.
- C. Provide all identification, operating instructions, parts lists, wiring and control diagrams for all equipment installed under this section.

1.04 QUALITY ASSURANCE

- A. Codes and Standards: Comply with current edition of following:
 - 1. Pipe and fittings shall conform to applicable ANSI, AWWA, ASTM, and USASI standards referenced for those products.
- B. No plumbing fixture, special equipment, device or piping shall be installed which will provide cross connection or interconnection between distributing supply for drinking water or domestic water and polluted supply or waste so as to make possible backflow or back-siphonage of sewage or polluted water into potable water supply system.
- C. Where possibility of back-siphonage exists, water supplied to fixture shall be introduced through a suitable vacuum breaker installed at code minimum distance above fixture.
- D. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

PART 2 - PRODUCTS

2.01 DOMESTIC COLD AND HOT WATER PIPING SYSTEMS

- A. All piping and fittings shall be manufactured in the United States. Each length of pipe and each fitting shall be marked with the manufacturer's name or trademark and the specification code to which it conforms.
- B. Install water hammer arrestors where indicated on the drawings. Air chambers are not acceptable.
- C. All supply connections to plumbing fixtures and equipment shall be galvanized or copper piping up to face of wall and chromium plated brass piping and fittings for exposed connections. Supply piping shall have screwed connections on both ends for piping through wall. Each fixture shall have a shut off valve at the fixture.
- D. Each water connection to a plumbing fixture or item of equipment having a submerged inlet or hose end attached shall be provided with a vacuum breaker to prevent back-siphoning of contaminated water into the drinking supply. Vacuum breaker shall be approved by local and state health authorities.

2.02 PIPE AND TUBE MATERIALS

- A. See Part 3 Article "Pipe and Fittings Applications" for the application of the following pipe, tube, and fitting materials and joining methods required for plumbing piping systems:
 - 1. Hard Copper Tube: ASTM B 88, Types K, and L, water tube, drawn temper.
 - 2. Soft Copper Tube: ASTM B 88, Types K and L, water tube, annealed temper.
 - 3. "DWV" Copper Tube: ASTM B75, Type DWV.

4. Hub and Spigot, Cast-Iron Soil Pipe: ASTM A 74, Service Class.
5. Hubless, Cast-Iron Soil Pipe: CISPI 301.
6. Poly (Vinyl Chloride) (PVC) Plastic, DWV Pipe: ASTM D 2665, Schedule 40; plain ends.
7. Schedule 40 Black Steel: A53 ERW, Grade B.
8. Schedule 10 Black Steel: A135 ERW or A795 ERW, Grade B.
9. Crosslinked Polyethylene Plastic Tubing (PEX): ASTM F877

2.03 PIPE AND TUBE FITTINGS

- A. Wrought-Copper, Solder-Joint Pressure Fittings: ASME B16.22.
- B. Copper Tube, Grooved-End Mechanical Fittings: ASTM B 75, copper tube and ASTM B 584 bronze castings.
- C. Copper Unions: ASME B16.18, cast-copper-alloy body, hexagonal stock, with ball-and-socket joint, metal-to-metal seating surfaces, and solder-joint, threaded, or solder-joint and threaded ends.
 1. Threaded Ends: Threads conforming to ASME B1.20.1.
- D. Mechanically Formed Outlets: Manufacturer's standard written procedure for forming tee-branch outlet from pipe and tube.
- E. Malleable-Iron Unions: ASME B16.39, Class 150 hexagonal stock, with ball-and-socket joint, metal-to-metal bronze seating surfaces, and female threaded ends having threads conforming to ASME B1.20.1.
- F. Malleable-Iron Threaded Fittings: ASME B16.39, Class 150, standard pattern, with threads conforming to ASME B1.20.1.
- G. Hub and Spigot, Cast-Iron Soil Pipe Fittings: ASTM A 74, Service Class.
- H. Hubless, Cast-Iron Soil Pipe Fittings: CISPI 301.
- I. Poly (Vinyl Chloride) (PVC) Plastic, DWV Pipe Fittings: ASTM D 2665, made to ASTM D 3311; socket-type; drain, waste, and vent pipe patterns.
- J. Poly (Vinyl Chloride) (PVC) Plastic, Schedule 40, Socket-Type Pipe Fittings: ASTM D 2466.
- K. Crosslinked Polyethylene Plastic Tubing (PEX), "Propex" expander type

2.04 JOINING MATERIALS

- A. Solder, brazing, and welding filler metals are specified in Part 3 of this Section.
- B. Cast-Iron Soil Pipe and Fittings: ASTM C 564 neoprene rubber gaskets and lubricant.
- C. Ductile-Iron Pipe and Ductile-Iron or Cast-Iron Fittings: The following materials apply:
 - 1. Push-On Joints: AWWA C111 rubber gaskets and lubricant.
 - 2. Mechanical Joints: AWWA C111 ductile-iron or gray-iron glands, high-strength steel bolts and nuts, and rubber gaskets.
 - 3. Flanged Joints: AWWA C115 ductile-iron or gray-iron pipe flanges, rubber gaskets, and high-strength steel bolts and nuts.
- D. Gasket-Type Couplings for Plain-End, Nonpressure System Pipe: Rubber or elastomeric compression gasket, made to match pipe inside diameter or hub and adjoining pipe outside diameter.
 - 1. Gaskets: ASTM C 564, rubber for cast-iron soil pipe and ASTM F 477, elastomeric seal for plastic pipe. Gaskets for dissimilar or other pipe materials shall be compatible with pipe materials being joined.
- E. Couplings for Grooved-End Copper Tube and Grooved-End Copper Fittings: ASTM A 536 ductile-iron or ASTM A 47 malleable-iron housing having copper-colored enamel finish, with synthetic-rubber gasket having central-cavity, pressure-responsive design and suitable for hot water, with ASTM A 183 carbon-steel bolts and nuts.
- F. Schedule 40 Black Steel Pipe and Fittings - 2" and Smaller: Screwed joints with malleable-iron threaded fittings.
- G. Schedule 40 Black Steel Pipe and Fittings - 2½" and Larger: Welded joints with standard weight welding fittings.
- H. Couplings for Schedule 10 Black Steel Pipe 2" and Larger: ASTM A 536 ductile-iron or ASTM A 47 malleable-iron housing having orange-colored enamel finish, with synthetic-rubber gasket having central-cavity, pressure-responsive design and suitable for hot water, with ASTM A 183 carbon-steel bolts and nuts.

2.05 PIPE SPECIALTIES

- A. Unions in copper pipe 2" and smaller shall be brass solder joint unions constructed for 150 psi working pressure.
- B. Unions in steel pipe 2" and smaller shall be screwed, malleable-iron, brass to steel type (F.S. WW-U-531c Class 1) for 150 psi working pressure.
- C. Unions 2½" in size and larger shall be companion flanges. (ANSI B16.1). Flanged unions shall be over welding nipples welded into pipelines.

- D. Flanges shall be forged steel flanges (ANSI B16.5) constructed for 150 psig working pressure. Bolts for flanged joints shall be made of bolt steel and shall have clean cut threads with upset square heads and semi-flush hexagonal cold pressed nuts (F.S. WW-F406b).
- E. Flange connections shall be made up with high pressure special type graphite 1/16" sheet packing (ANSI B16.21); or rubber, for temperature up to 200EF (F.S. HH-G-156 class A).
- F. Dielectric unions suitable for dielectric service shall be provided at pipe connections between steel or cast-iron piping and copper tubing.

2.06 GAS PIPING

- A. See Section 15488 - "NATURAL GAS PIPING" for gas piping materials.

2.07 FLOOR DRAINS

- A. Unless noted otherwise, floor drains shall conform to the following:
 - 1. Floor drains shall be 2" cast iron with a 5" satin nickel bronze vandal proof adjustable strainer.
 - 2. Floor drains in slab-on-grade-floors shall not be flashed, shall have black iron bodies with nickel bronze covers and strainers, and must be located to properly serve associated equipment and be accessible for cleaning as approved by the Engineer. Floor drains in floors above grade shall be flashed.
 - 3. Floor drains shall have covers and strainers securely fastened by countersunk, tamper-proof, brass machine screws.
 - 4. All floor drains shall have a 5" minimum strainer size. On floor drains larger than 2", strainer size shall be at least 3" larger than the drain size unless specifically shown otherwise on the drawings.
- B. All floor drains shall be by the same manufacturer.
- C. Furnish and install a deep seal "P" trap at each floor drain.

2.08 CLEANOUTS

- A. All cleanouts shall be by the same manufacturer.
 - 1. Exposed piping or piping above ceiling: Cast iron body ferrule with brass raised head, straight threaded coating plug having tapered shoulder.
 - 2. Concrete floors: Cast iron floor cleanout, adjustable threaded housing, round satin bronze scoriated top, bronze tapered plug, vandal proof.
 - 3. Tile floors: Cast iron floor cleanout, adjustable threaded housing, satin bronze top, recessed for tile bronze taper plug, vandal proof.

4. Walls: Pipe plug cleanout behind a stainless steel square access cover.
5. Carpeted floors: Cast iron floor cleanout, adjustable threaded housing, bronze taper plug satin bronze top with carpet marker. Jay R. Smith, Model No. 4020.
6. Outdoor: Coordinate placement of concrete pads with the general contractor, cast iron cleanout, adjustable threaded housing, round top, bronze tapered plug, vandal proof.

2.09 TRAPS

- A. Trap all fixtures having waste connections with a water seal placed as close to fixture as possible. Provide all required traps including traps not furnished in combination with fixture and equipment.
- B. Traps for lavatories or sinks shall be chrome plated 17 gauge brass unless noted otherwise on drawings.
- C. Traps for laboratory table sinks or other sinks which may contain acids or other chemicals shall be heavy duty polyethylene.

2.10 HOSE BIBBS

- A. Unless noted otherwise, hose bibbs shall be ¾" size, chrome plated, with removable T handle key, wall clamp and vacuum breaker.

2.11 THERMOSTATIC TEMPERING VALVES

- A. Water tempering valves (where shown on drawings) shall be rated for use for mixing water for showers or hand washing. They shall control the water temperature within $\pm 2\text{EF}$ of set point at any flow from zero to their maximum rating.

2.12 WATER HEATERS

- A. Unless noted otherwise on the drawings, all water heaters shall be the tank type, U.L. listed and in compliance with ASHRAE 90.1 for energy efficiency requirements. In addition, gas water heaters shall be AGA approved.
- B. Tank shall be glass-lined with a working pressure of 150 psi and shall be equipped with anode rod for cathodic protection. See plans for tank storage capacity.
- C. The heater shall have a steel jacket with baked enamel finish and shall be fully insulated. Heater shall be equipped with thermostat and automatic high temperature safety controls. Provide ASME pressure and temperature relief valve.

2.13 ACCEPTABLE MANUFACTURERS

- A. Water Hammer Arrestors
 1. Sioux Chief.

B. Unions (in copper pipe 2" and smaller)

1. Anaconda.
2. Chase Brass.
3. Mueller.

C. Flanged Unions

1. Craelap.
2. Grinnell.
3. Van Stone.

D. Flange Connections

1. Cranite.
2. Garlock.

E. Cleanouts and Floor Drains

1. Jay R. Smith.
2. Josam.
3. Wade.
4. Watts.
5. Zurn.

F. Hose Bibbs

1. Chicago Faucet.
2. Woodford.

G. Water Heaters

1. A.O. Smith.
2. Lockinvar.
3. State.
4. Bradford White.

PART 3 - EXECUTION

3.01 PIPE AND FITTINGS APPLICATIONS

A. Use pipe, tube, fittings, and joining methods for piping systems according to the following applications:

1. Domestic Water Distribution Piping Below Ground: Use the following:

- a. All interior domestic water piping shall be type "K" hard drawn copper tubing (SIL-FOS 2, FOS-FLO 7 or other silver brazing material). This is required for the water service line from the shut-off valve in the building to a point 5 feet outside the building.

- b. All copper piping shall be installed with wrought copper fittings. Field-fabricated "T-Drill" taps are acceptable on piping 1" and larger, if silver-brazed (above-ground piping only).
 - c. Soft temper copper tubing may be used for small pipe in concealed spaces only to permit bends for roughing in.
 - d. Do not use tin-lead solder on domestic water piping. Use only approved lead-free solder or brazing material.
2. Domestic Water Distribution Piping Above Ground: Use one of the following:
- a. ½" – 2" , Crosslinked Polyethylene Plastic Tubing (PEX), "Propex" expander type fittings.
 - b. 3" and larger, Hard copper tube, Type L; wrought-copper or cast-copper-alloy pressure fittings; copper unions; bronze flanges; and solder joints with Alloy Sn95 solder.
 - 1) Fittings Option: Mechanically formed outlets, brazing filler alloy, and brazed joints.
 - 2) Fittings Option: Grooved fittings for copper piping.
3. All Exterior Domestic Water Piping: Including the building water service from the point of connection to the utility service to a point 5 feet outside the building, use the following:
- a. ¾" - 1¼", schedule 40 PVC pipe with solvent-cemented joints.
 - b. 1½" - 3", SDR-21 PVC pipe (ASTM D2241) with rubber gasketed joints. Provide concrete blocking at all fittings.
 - c. 4" and larger, SDR-18 PC pipe (AWWA C-900) with rubber gasketed joints. Provide concrete blocking at all fittings.
4. Soil, Waste, and Vent Piping Below Ground: Use either of the following:
- a. Hub-and-spigot cast-iron soil pipe, hub-and spigot cast-iron soil pipe fittings, neoprene rubber gaskets, and compression joints.
 - b. Poly (vinyl chloride) (PVC) plastic DWV pipe; PVC socket-type drain, waste, and vent pipe pattern fittings; and solvent-cemented joints.
5. Soil, Waste and Vent Piping Above Ground: Use either of the following:
- a. Hubless cast-iron soil pipe; hubless cast-iron soil pipe fittings; stainless-steel, cast-iron, or FM-type heavy-duty couplings for hubless cast-iron soil pipe and fittings; and hubless joints.
 - b. Poly (vinyl chloride) (PVC) plastic DWV pipe; PVC socket-type drain, waste, and vent pipe pattern fittings; and solvent-cemented joints.

6. Compressed Air Piping Above Ground: Use the following:
- a. 2" and Smaller: Schedule 40 black steel pipe; malleable-iron threaded fittings; screwed joints.
 - b. 2½" and Larger: Schedule 40 black steel pipe; standard weight fittings; welded joints.
 - c. Alternate: 2" and Larger: Schedule 10 black steel grooved-end pipe; gasketed couplings for grooved-end pipe.

3.02 JOINTING OF PIPING

- A. Threads shall be full and clean cut, and ends of pipe shall be reamed. When screwed joints are assembled, the male thread shall be thoroughly coated with appropriate thread compound to serve as a joint sealer and as a prime coat of paint for the exposed threads. (Teflon tape may be used at Contractor's option.) Care shall be taken to keep all other foreign matter from entering the interior of the piping. Each section of pipe and all fittings shall be carefully inspected for dirt, grease, or other foreign matter on the inside and where necessary they shall be properly cleaned before assembly.
- B. Soldered or brazed joints made with fittings having pre-inserted rings of solder or brazing alloy shall have the tube and fittings cleaned bright and fluxed. The joint shall be heated sufficiently to make a tight connection. Tubes and fittings without such rings, shall be cleaned bright, fluxed and heated until the solder is drawn into the joint by capillary action and the connection is tight. Flux shall be water soluble binder flux. In potable water systems, the use of solder containing lead is prohibited.

3.03 EXPANSION AND CONTRACTION

- A. Provisions shall be made for expansion and contraction in all piping. Piping shall be installed in a manner such that joints will not develop leaks. All expansion shall be taken up by swing-connections, and the Contractor shall be responsible for the installation of these connections whether or not they are shown on the drawings with specific means for relieving expansion and contraction. Slip-type expansion joints shall not be used. Particular care must be exercised at branches on underground piping to allow free movement at branch connection to main.

3.04 INSTALLATION OF PIPING

- A. Piping shall be installed on long continuous lengths, with a minimum number of joints. Joints, where necessary shall be carefully made to insure against leakage.
- B. All piping shall be firmly supported using hangers, brackets and braces to prevent sagging and/or lateral movement. All hangers, brackets, and other supports shall be securely fastened to the construction as may be required and in a manner acceptable to the Engineer. All piping shall be installed to maintain maximum head room. Nothing shall be suspended from the roof deck. Piping installed on the structure (joists, etc.) shall be secured to the structure using pipe clamps, straps, etc.

- C. Arrangement of all piping shall be as shown on plans. It is especially necessary that all mains be installed with view to accessibility in case of repair and location of pipe lines and spacing between same shall be so made that there will be no conflict between pipe lines by the several trades.
- D. Contractor shall give careful consideration to clearances and locations of lines and type of fittings used to obtain these clearances. Provide maximum headroom in all cases. Piping shall be installed parallel to building walls and at a height so as not to obstruct any portion of a window, light fixture, doorway, pipe tunnel or passageway. Ascertain from the drawings heights of all suspended ceilings, size of all pipe shafts in which piping is to be concealed, and location and size of structural members in and adjacent to all pipe shafts.
- E. Where interferences develop in the field, Contractor shall offset or reroute piping as required to clear such interferences. In all cases consult architectural drawings for exact location of pipe spaces, ceiling heights, or other architectural details before installing piping.
- F. Under no circumstances shall the size of piping shown on the drawings be changed without written approval of the Engineer.
- G. Provide eccentric reducers where required for proper drainage or venting of horizontal pipe lines. Reducing fittings shall be used for all changes of pipe size and bushings shall not, under any circumstances, be used.
- H. Unions or flanges are to be installed on the equipment side of all valves in pipe connections from mains to equipment, to enable equipment to be drained and disconnected without necessitating the draining of mains.
- I. Valves must be arranged for easy access. The piping shall be arranged to accomplish this.

3.05 COLD AND HOT WATER PIPING SYSTEM

- A. Above grade water piping:
 - 1. Piping shall be run true, parallel with walls, centered in hangers and sleeves, securely supported by hangers or supports independently of connections and sleeves, anchored as required to control movement. Pipe and fittings arranged as called for and as required to permit free, unrestrained, noiseless expansion and contraction and freedom from strain on equipment.
 - 2. All screwed piping shall be carefully cut, reamed, threaded and worked into place with springing, using a small amount of prepared lubricant on the outside threads. Branch connections shall have three elbow spring pieces to allow for movement due to expansion.
 - 3. Valves and unions or flanges shall be suitably located to isolate each unit, branch circuit or section of piping to facilitate maintenance and/or removal of all equipment and apparatus.

4. All piping shall be installed so as to be free to expand without injury to equipment or building.
5. Plumbing water mains must pitch down to drain completely through fixtures or equipment below; provide accessible unions, brass plugs or hose valves at low points.
6. Plumbing water mains must pitch to vent completely through fixtures or equipment above.
7. All risers or down-feed drops shall be firmly supported and blocking done as necessary to prevent hammer due to vibration.
8. Provide a copper stub out where fixture supply line connections will be exposed.
9. Only supports specifically manufactured for support of plastic tubing are allowed. Tubing should be free to move within the support.
10. PEX tubing shall be supported every 32" minimum and at every bend and at all joints.
11. Provide pipe escutcheons in accordance with Section 15050 - "MATERIALS AND METHODS".

3.06 DISINFECTION OF DOMESTIC WATER SYSTEMS WITHIN THE BUILDING

A. General:

1. Before being placed in service and after testing is completed, all potable water piping shall be chlorinated as specified herein, in accordance with AWWA Standard C601-54 and as required by the local Health Department codes.
2. Chlorine may be applied by the use of chlorine gas-water mixture, direct chlorine-gas feed or a mixture of calcium hypochlorite and water. If calcium hypochlorite is used, it shall be equivalent to commercial products such as Perchloron, HTH or Maxochlor. The powder shall be mixed with water to form a paste thinned to a slurry and pumped or injected into the lines.
3. If direct chlorine-gas feed is used, it shall be fed with either a solution-feed chlorinator or by a pressure-feed chlorinator.
4. The lines and fixtures shall be flushed thoroughly after chlorination to remove all foreign matter.
5. Injection shall start only when all fixtures are connected and ready for operation.
6. A service cock or riser ($\frac{3}{4}$ " to at least $1\frac{1}{4}$ ") shall be provided by the Contractor and located at the point of connection to water service. The disinfecting agent shall be injected into and through the system from this cock or riser only.
7. Chlorine, either gas or liquid, or calcium hypochlorite (liquid or powdered) shall be used as a disinfecting agent as approved in federal and AWWA procedures.

8. The disinfecting agent shall be injected by a proportioning pump or device through the service cock or riser slowly and continuously at an even rate.
9. All outlets shall be fully opened and closed at least four times during injection and the residual checked with orthotolidine solution.
10. When the chlorine residual concentration indicated not less than 50 parts per million at all outlets, all fixtures and water supply valves shall be closed.
11. The residual shall then be retained for a period of not less than eight hours.
12. After retention, the residual upon checking at most outlets, shall not be less than ten parts per million. If less, the disinfection must be repeated as described above.
13. If satisfactory, all fixtures shall be flushed until residual or orthotolidine tests are not greater than the water supply.
14. Contractor shall furnish Engineer or his authorized representative with sterilization report indicating potable water to be safe from contamination.

3.07 FLUSHING WATER PIPING

- A. After the piping has been chlorinated, each run of pipe shall be thoroughly flushed out so as to remove all foreign matter from the lines. Flushing will ordinarily be done by opening drain valves along the lines.
- B. Sufficient flushing water shall be introduced into the mains to produce a velocity of not less than 4 ft. per second, and this flow rate shall be continued until the discharge is clean and clear and does not show evidences of silt or foreign matter when a sample is visually inspected.

3.08 SOIL, WASTE AND VENT DRAIN PIPING SYSTEM

- A. Size of soil, waste and vent stacks and branch piping shall be as indicated on the drawings, but in no case less than required by the provisions of the applicable codes.
- B. Where possible, sewers and branches shall pitch down $\frac{1}{4}$ " per 1'-0", but not less than 1%. Branches, arms and connections, shall be sloped $\frac{1}{4}$ " per 1'-0" where possible and provided with adequate hangers as specified elsewhere.
- C. Interior underground, underfloor, or on-ground piping shall be continuously bedded with depressions for hubs on compacted sand or gravel to undisturbed soil for a minimum depth of 6" under pipe.
- D. Connections to soil, waste and drain stacks shall be at 45E; those to vent stacks may be at 45E or 90E except vent stacks shall be connected at 45E to soil, waste or drain stack.
- E. Connections to stacks and sewers shall be arranged so that operation of any fixture will not cause fluctuation of water level in traps of other fixtures.

- F. Interior down spout shall be connected to roof drains; and provided with ample offsets or expansion joints below or integral with roof drains.
- G. All thread joints shall be made up with thread sealant applied to male thread only. Threads exposed after joints are made up shall be painted with thread sealant to prevent rust. Teflon tape may be used at Contractor's option.
- H. Junctions of screwed pipe to bell and spigot cast iron shall be made with ring or half coupling screwed to end of galvanized pipe to form spigot end.
- I. Junctions in all drainage lines shall be made with "Y" branches unless closeness of connection prevents it, in which case, where direction of flow is from horizontal to vertical, sanitary tees may be used upon the approval of the Engineer's superintendent.
- J. Compression joint installation for cast-iron soil pipe:
 - 1. Fold and insert the one piece neoprene rubber gasket into the hub which has been properly cleaned.
 - 2. Apply gasket lubricant to the spigot and inside of the gasket.
 - 3. Push, draw or drive the spigot into the gasketed hub with a pulling tool or suitable device.

3.09 STACKS

- A. Stacks shall impose no stress or strain on branches or connections, be plumb and straight and supported at base with 18" x 18" concrete or brick pier to undisturbed soil.
- B. Unless otherwise noted, soil, waste, drain, and vent stacks shall be concealed in walls, pipe chases, pipe shafts, etc., with cleanouts extended to accessible locations.

3.10 VENTING

- A. All plumbing fixtures shall be vented to prevent siphoning of traps. Venting shown on plans is minimum required and vents and vent stacks shall be increased in size and/or number and relocated as required, to prevent trap siphoning and to comply with applicable codes, ordinances, statutes, regulations of all governmental bodies, without increase in contract price.
- B. A vent stack shall be run parallel to each soil or waste stack to receive branch vents from fixtures and traps. Each vent stack shall originate from a soil or waste pipe at its base. Each soil or waste stack and each vent stack shall be carried through the roof. Where possible, soil, waste, or vent stacks shall be combined before passing through the roof so as to have as few roof openings as possible. Pipes running close to walls shall be offset away from such walls before passing through the roof to permit proper flashing. All vent pipes passing through the roof shall be sized as indicated on the drawings, and shall extend 12" above roof.
- C. All horizontal vent pipes shall grade up to meet the requirements of the local and state codes.

- D. Vent risers and branches shall connect to the soil and waste risers above waste of highest fixture.

3.11 CLEANOUTS

- A. Cleanouts for indoor sanitary drainage systems shall be installed not more than 50 feet apart, including the developed length of the cleanout pipe, in all horizontal drainage lines. Cleanouts shall be installed at such other points as may be necessary for adequate rodding out of drainage piping systems. Cleanouts shall be set flush with floor or wall surfaces.

3.12 INSTALLATION OF WATER HEATER

- A. General: Install water heater in accordance with manufacturer's installation instructions. Install unit plumb and level, firmly anchored in location indicated, and maintain manufacturer's recommended clearances. Install on 4" high concrete "housekeeping" pad. Provide a galvanized steel drain pan under the water heater. Pipe drain pan outlet to the nearest floor drain.
- B. Support: Orient so controls and devices needing service and maintenance have adequate access.

END OF SECTION 15400

DIVISION 15 – MECHANICAL

SECTION 15440 - PLUMBING FIXTURES AND TRIM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The following shall apply to this Section:
 - 1. Drawings.
 - 2. General Provisions of the Contract.
 - 3. Solicitation Documents.
 - 4. General Conditions.
 - 5. Supplementary Conditions.
 - 6. Division 1.

1.02 WORK INCLUDES

- A. All plumbing fixtures, including supply and waste fittings, stops, trim, brackets, carriers, etc. specified, shown on the drawings and required for a complete installation.
- B. All piping, fittings, valves, trim, stops, etc. specified, shown on the drawings and required for rough-in and final connection to owner-furnished equipment.

1.03 SUBMITTALS

- A. Submit shop drawings in accordance with Section 15010 - “BASIC MECHANICAL REQUIREMENTS” for the following:
 - 1. Plumbing fixtures and trim.
 - 2. Chair carriers.

1.04 QUALITY ASSURANCE

- A. Codes and Standards: Comply with current edition of the following:
 - 1. Vitreous china fixture, NBS-CS-CS20.
 - 2. Enameled iron fixtures, NBS-CS-CS77.
 - 3. Plumbing fixtures (land use), FS-WW-P-541.
- B. No plumbing fixture, special equipment, device or piping shall be installed which will provide cross connection or interconnection between potable water system and polluted water or sewage system so as to make possible backflow or back siphonage of sewage or polluted water into the potable water supply system.

- C. Where possibility of back siphonage exists, water supplied to fixture shall be introduced through a suitable vacuum breaker installed at code minimum height.
- D. The water system of electric water coolers shall be manufactured of pure copper components only (completely lead free material). The water ways shall not contain any internal plating or coatings. All joints shall be made using silver solder brazing alloy. No lead or soft solder shall be used.

PART 2 - PRODUCTS

2.01 PLUMBING FIXTURES AND TRIM

- A. All fixtures shall be vitreous china, acid resisting enamel cast iron or stainless steel as specified complete with brass piping, fittings, supplies, stops, flush pipes, trim and brackets. Exposed brass piping and fittings shall be chrome plated.
- B. Where manufacturer's numbers for a complete assembly are called for, such assembly shall be modified as specified in this section.
- C. Fixtures shall have water, drain, waste, soil, vent, and other connections as called for. Each water connection fixture shall have an air gap or vacuum breaker as required by local and state departments of health. Water connection sizes are minimum and must be increased to correspond to manufacturer's standards.
- D. Carriers for wall hung fixtures shall be selected for the particular fixture, piping arrangement and building conditions prevailing at each location.
- E. Where lavatories without legs are specified, each shall be supported on a chair type carrier with concealed arms.
- F. Special sinks, where wall hung, shall have equivalent chair carriers specifically designed for the fixture.
- G. Fixture Carriers:
 - 1. Lavatories and urinals shall be supported by floor mounted carriers. Urinal carriers may be omitted where urinals are mounted on masonry walls that are at least 6" thick.
 - 2. Urinal carriers shall be Jay R. Smith 600 series or approved equal, selected to fit the fixture.
 - 3. Lavatory carriers shall be Jay R. Smith 700 Series (floor mounted) or approved equal, selected to match fixtures.

2.02 ACCEPTABLE MANUFACTURERS

A. Brass

1. American Standard.
2. Chicago Faucet.
3. Delta.
4. Gerber Commercial.
5. Moen Commercial.
6. T & S Brass.
7. Zurn.

B. Drench Shower and Eyewash Units

1. Bradley.
2. Chicago Faucet.
3. Guardian
4. Haws.

C. Electric Water Coolers

1. Elkay.
2. Halsey-Taylor.
3. Oasis.

D. Flush Valves

1. Chicago Faucet.
2. Sloan.
3. Toto.
4. Zurn.

E. Mop Service Basins

1. Fiat.
2. Williams.

F. Seats

1. Beneke.
2. Church.
3. Olsonite.

G. Sinks

1. Elkay.
2. Just.
3. Moen.
4. Zurn.

H. Valves

1. Ames.
2. Apollo.
3. ASCO.
4. Febco.
5. Keystone.
6. Magnetrol.
7. Stockham.
8. Watts.

I. Water Closet Fixtures, Lavatories & Urinals

1. American Standard.
2. Crane.
3. Eljer.
4. Gerber Commercial.
5. Kohler.
6. Toto.
7. Zurn.

PART 3 - EXECUTION

3.01 PLUMBING FIXTURES AND TRIM

- A. All fixtures shall be set firm and true, connected to all piping services ready for use. Fixtures shall be installed per manufacturer's recommendations.
- B. Fixtures intended for accessibility to the handicapped or to meet ADA requirements shall be installed at recommended heights and with appropriate clearances. Report any conflicts or discrepancies to the Engineer. Flush valve and flush tank handles in handicap accessible spaces shall be located on the wide side of the space.
- C. Sinks and lavatories for handicapped access shall be installed with offset tailpieces and insulated traps.

3.02 OWNER FURNISHED EQUIPMENT

- A. Provide rough-ins and final connections to all Owner furnished equipment including shut off valves, piping, traps, etc. necessary to connect equipment after it has been installed in place.
- B. Install all faucets, sinks drains, tailpieces, overflows, traps, etc. furnished loose with all Owner furnished equipment.
- C. All exposed piping readily visible for Owner furnished equipment shall be chrome plated red brass pipe and fittings. Braces for support of exposed piping shall be chrome plated.

- D. Pending installation of Owner furnished equipment, all service lines shall be suitably capped, plugged and protected. All water lines shall be valved.
- E. Furnish vacuum breakers, pressure regulators solenoid valves, traps, piping, etc. as required for installation of equipment.

END OF SECTION 15440

DIVISION 15 – MECHANICAL
SECTION 15488 - NATURAL GAS PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The following shall apply to this Section:
 - 1. Drawings.
 - 2. General Provisions of the Contract.
 - 3. Solicitation Documents.
 - 4. General Conditions.
 - 5. Supplementary Conditions.
 - 6. Division 1.

1.02 WORK INCLUDES

- A. This Section includes piping, specialties, and accessories for Natural Gas piping systems within the building and outdoors.

1.03 RELATED WORK

- A. Section 15050 - "MATERIALS AND METHODS".

1.04 SUBMITTALS

- A. Submit the following in accordance to Section 15010 - "BASIC MECHANICAL REQUIREMENTS"
 - 1. Product data for each type of natural gas specialty and special-duty valve. Include pressure rating in psig, rated capacity in Cubic Feet Per Hour (CFH), and settings of selected models.
 - 2. Maintenance data for natural gas specialties and special-duty valves for inclusion in Operating and Maintenance Manuals.
 - 3. Test reports specified in "Field Quality Control" Article in Part 3.

1.05 QUALITY ASSURANCE

- A. Comply with the International Fuel Gas Code for gas piping materials, components, installations, inspection, testing and purging.
- B. Provide listing/approval stamp, label, or other marking on equipment made to specified standards.
- C. Listing and Labeling: Provide equipment and accessories that are listed and labeled.

1.06 DEFINITIONS

- A. Low- Pressure Gas Piping System: Operating at pressure of 7" W.C. to 2 psi, as indicated on drawings.
- B. Gas Service: Pipe from the street main to gas point of delivery for the building being served. Piping includes gas service piping, gas valve, service pressure regulator (by Utility Co.).
- C. Gas Piping System: Pipe within the building that conveys gas from point of delivery to points of usage. Piping includes dielectric fitting and gas valve immediately downstream from point of delivery.

PART 2 PRODUCTS

2.01 PIPES AND TUBES

- A. Refer to "Pipe Applications" Article in Part 3 for identification of systems where the following materials are used.
- B. Steel Pipe: ASTM A53, Type E, Electric-Resistance Welded or Type S, Seamless, Grade B, Schedule 40, black.

2.02 PIPE AND TUBE FITTINGS

- A. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threads conforming to ASME B1.20.1.
- B. Unions: ASME B16.39, Class 150, black malleable-iron; female pattern; brass-to-iron seat; ground joint.
- C. Steel Fittings: ASME B16.9, wrought steel, butt-welding type; and ASME B16.11, forged steel.
- D. Transition Fittings: Type, material, and end connections to match piping being joined.

2.03 JOINING MATERIALS

- A. Common Joining Materials: Refer to Section 15050 - "MATERIALS AND METHODS" for joining materials not included in this Section.

2.04 VALVES

- A. Manual Valves: Conform to standards listed, or where appropriate, valves according to ANSI Z21.15 and ANSI Z21.15a.
- B. Low-Pressure Gas Stops, 2" and Smaller: AGA-certified design for system pressure, with AGA stamp, plug or ball type, bronze body and bronze plug or chrome-plated brass ball. Include flat head, square head, or lever handle and threaded ends.

- C. Gas Valves, 2½" and Larger: MSS SP 78, Class 125 or 175 WOG, lubricated plug type, semisteel body, wrench operated, with flanged ends.

2.05 PIPING SPECIALTIES

- A. Gas Pressure Regulators: AGA Z21.80 Certified.
- B. Flexible Connectors: ANSI Z21.24 or ANSI Z21.24a, copper alloy.

2.06 ACCEPTABLE MANUFACTURERS

- A. Gas Pressure Regulators
 - 1. American Meter Co.
 - 2. Fisher Controls.
 - 3. Gas Energy, Inc., Subsid., Brooklyn Union Gas.
 - 4. Jordan Valve Div., Richards Industries, Inc.
 - 5. Lancaster by National Meter Parts, Inc.
 - 6. Maxitrol Co.
- B. Low-Pressure Gas Stops
 - 1. Hammond Valve Corp.
 - 2. Jomar International, Ltd.
 - 3. Lancaster by National Meter Parts, Inc.
 - 4. Rockford-Eclipse Div., Eclipse, Inc.
- C. Gas Valves, 2" and Smaller
 - 1. Homestead by Olson Technologies, Inc.
 - 2. Lancaster by National Meter Parts, Inc.
 - 3. Lunkenheimer Co.
 - 4. Milliken Valve Co., Inc.
 - 5. Mueller Co., A Grinnell Co.
 - 6. Mueller Steam Specialty Div., Core Industries, Inc.
 - 7. Nordstrum Valves, Inc.
 - 8. Rockford-Eclipse Div., Eclipse, Inc.

PART 3 EXECUTION

3.01 PREPARATION

- A. Precautions: Close equipment shutoff valves before turning off gas to the premises or section of piping. Perform leakage test as specified in "Field Quality Control" Article to determine that all equipment is turned off in the piping section to be affected.
- B. Comply with NFPA 54 "Prevention of Accidental Ignition."

3.02 SERVICE ENTRANCE PIPING

- A. Extend natural gas piping and connect to gas distribution system (gas service) piping in location and size indicated for gas service entrance to building.

3.03 PIPE APPLICATIONS

- A. Flanges, unions, transition and special fittings, and valves with pressure ratings same or higher than system pressure rating may be used in applications below, except where specified otherwise.
- B. Low-Pressure Natural Gas Piping Systems – Above Ground, Indoors & Outdoors: Use the following:
 - 1. 2" and Smaller: Schedule 40 black steel pipe; malleable-iron threaded fittings.
 - 2. 2½" and Larger: Schedule 40 black steel pipe; welded fittings.
- C. Low-Pressure Natural Gas Piping Systems – Underground: Use the following:
 - 1. All Sizes: Schedule 40 black steel pipe with an extruded plastic coating; and welded fittings. No threaded fittings will be permitted underground.

3.04 VALVE APPLICATIONS

- A. Provide low-pressure gas stops, tapered plug or ball type, for shutoff to appliances with 2" or smaller low-pressure gas supply.
- B. Provide valves for shutoff to appliances.
- C. Provide valves of sizes indicated for gas service piping, meters, mains, and where indicated.

3.05 JOINT CONSTRUCTION

- A. Refer to Section 15050 - "MATERIALS AND METHODS" for basic piping joint construction.
- B. Use materials suitable for natural gas service.

3.06 PIPING INSTALLATIONS

- A. Refer to Section 15050 - "MATERIALS AND METHODS" for basic piping installation requirements.
 - 1. Prohibited Locations: Do not install gas piping in return air plenums, or through air ducts, chimneys or flues.

- B. Drips and Sediment Traps: Install drips at points where condensate may collect. Include outlets of gas meters. Locate where readily accessible to permit cleaning and emptying. Do not install where condensate would be subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use minimum-length nipple of 3 pipe diameters, but not less than 3" long, and same size as connected pipe. Install with space between bottom of drip and floor for removal of plug or cap.
- C. Install gas piping at a uniform grade of ¼" in 15', upward toward risers. Install piping upward from service risers to equipment.
- D. Connect branch piping from top or side of horizontal piping.
- E. Install unions in pipes 2" and smaller, adjacent to each valve, at final connection to each piece of equipment and elsewhere as indicated. Unions are not required on flanged devices.
- F. Anchor piping to ensure proper direction of piping expansion and contraction. Install expansion joints, expansion loops and pipe guides as indicated.
- G. Install vent of gas pressure regulators pointing down, in accordance with manufacturer's instructions.
- H. All exposed piping (indoors and outdoors) shall be painted. See architectural specifications for product information.

3.07 HANGER AND SUPPORT INSTALLATION

- A. Refer to Section 15050 - "MATERIALS AND METHODS" for hanger and support devices.
- B. Support piping as follows:
 - 1. Horizontal ½" pipe: support every 4'-0"
 - 2. Horizontal ¾" or 1" pipe: support every 6'-0"
 - 3. Horizontal 1-1/4" or larger pipe: support every 8'-0"
 - 4. Vertical pipe support at every floor

3.08 VALVE INSTALLATION

- A. Install valves in accessible locations, protected from physical damage.
- B. Install a gas valve directly upstream of each gas pressure regulator.

3.09 CONNECTIONS

- A. Install gas piping next to gas-utilizing equipment and appliances to allow servicing and maintenance.
- B. Connect gas piping to gas-utilizing equipment and appliances with shutoff valves and unions. Make connections downstream of valves and unions, with flexible connectors where indicated.

3.10 TERMINAL EQUIPMENT CONNECTIONS

- A. Install a gas valve upstream and within 6' of each gas-utilizing appliance. Install a union or flanged connection downstream from the valve to permit removal of controls.
- B. Sediment Traps: Install tee fittings forming drips, as close as practical to gas appliance inlets. Cap or plug bottom outlet.

3.11 ELECTRICAL BONDING AND GROUNDING

- A. Install above ground portions of natural gas piping systems that are upstream from equipment shutoff valves, electrically continuous and bonded to a grounding electrode according to NFPA 70.
- B. Do not use gas piping as a grounding electrode.

3.12 FIELD QUALITY CONTROL

- A. Inspect, test, and purge natural gas systems according to NFPA 54, Part 4 "Gas Piping Inspection, Testing, and Purging" and local gas utility requirements.
- B. Repair leaks and defects with new materials, and retest system until satisfactory results are obtained.
- C. Report test results promptly and in writing to the Engineer.
- D. Verify capacities and pressure ratings of gas meters, regulators, valves, and specialties.
- E. Verify correct pressure settings for pressure regulators.
- F. Verify that specified piping tests are complete.

3.13 ADJUSTING

- A. Adjust controls and safety devices. Replace damaged and malfunctioning controls and safety devices.

END OF SECTION 15488

DIVISION 15 – MECHANICAL
SECTION 15670 - CONDENSING UNITS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The following shall apply to this Section:
 - 1. Drawings.
 - 2. General Provisions of the Contract.
 - 3. Solicitation Documents.
 - 4. General Conditions.
 - 5. Supplementary Conditions.
 - 6. Division 1.

1.02 WORK INCLUDES

- A. Air-cooled condensing units.

1.03 RELATED WORK

- A. Section 15050 - "MATERIALS AND METHODS".
- B. Section 15530 - "REFRIGERANT PIPING".
- C. Section 16010 - "BASIC ELECTRICAL REQUIREMENTS".

1.04 SUBMITTALS

- A. Submit shop drawings in accordance with Division 1.
- B. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights (shipping, installed, and operating), dimensions, required clearances, and methods of assembly of components, furnished specialties and accessories; and installation and start up instructions.
- C. Wiring Diagrams: Submit ladder-type wiring diagrams for power and control wiring required for final installation of condensing units and controls. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
- D. Operation and Maintenance Data: Submit maintenance data and parts list for each condensing unit, control, and accessory; including "trouble shooting" maintenance guide; plus servicing, and preventative maintenance procedures and schedule. Include this data and product data in maintenance manual; in accordance with requirements of Division 1.

1.05 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of condensing units, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
 - 2. Units with a nominal capacity less than 65,000 btu/h shall be tested and rated in accordance with ARI Standard 210/240 "Unitary Air-Conditioning and Air-Source Heat Pump Equipment".
 - 3. Units with a nominal capacity equal to or greater than 65,000 btu/h shall be tested and rated in accordance with ARI Standard 340/360 "Commercial and Industrial Unitary Air Conditioning and Heat Pump Equipment".
 - 4. Refrigeration system of condensing units shall be constructed in accordance with ASHRAE 15 "Safety Code for Mechanical Refrigeration".
 - 5. Condensing units shall meet or exceed the minimum efficiencies prescribed by the latest edition of ASHRAE 90.1 "Energy Standard for Buildings Except Low Rise Residential Buildings".
 - 6. NFPA 70 – National Electrical Code.
 - 7. Condensing units shall be listed by UL and have UL label affixed.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Handle condensing units and components carefully to prevent damage. Follow manufacturer's written instructions for rigging. Replace damaged condensing units or components.
- B. Store condensing units and components in clean dry place off the ground. Protect from weather, water, and physical damage.

1.07 SPECIAL PROJECT WARRANTY

- A. Warranty on Motor/Compressor: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, motors/compressors with inadequate or defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement is limited to component replacement only, and does not include labor for removal and reinstallation.
 - 1. Warranty Period: 5 years from date of substantial completion.

PART 2 - PRODUCTS

2.01 AIR-COOLED CONDENSING UNITS

- A. Factory-assembled and tested air-cooled condensing units, consisting of compressors, condenser coil, fans, motors, refrigerant reservoirs and operating controls. Capacity and electrical characteristics are scheduled on the drawings.
- B. Casing: Galvanized steel finished with baked enamel, complete with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Unit shall be complete with brass service valves, fittings and gauge ports on exterior of casing.
- C. Compressors: Compressors shall be R-410A scroll type with thermal overload protection, individually (tandem) circuited and carry a 1 year non-prorated warranty, from the date of original equipment shipment from the factory. Each compressor shall be furnished with a crankcase heater.
- D. Refrigerant Circuits: Where specified, two completely independent, non-connected refrigerant circuits shall be incorporated.
- E. Condenser: Coil shall have copper tubes and aluminum fins, complete with liquid accumulator and liquid subcooler. Aluminum propeller fans shall be direct driven, with permanently lubricated fan motor having thermal overload protection.
- F. Accessories:
 - 1. Head pressure control to modulate condenser fan motor speed for low ambient conditions (where scheduled).
 - 2. Low-voltage control transformer.

2.02 ACCEPTABLE MANUFACTURERS

- A. Carrier
- B. Lennox
- C. Trane
- D. York
- E. Aeon

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify roof structure, mounting supports, and membrane installations are completed to the proper point to allow installation of roof mounted units. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install condensing unit in accordance with manufacturer's installation instructions. Install unit plumb and level, firmly anchored in locations indicated and maintain manufacturer's recommended clearances on all sides.
- B. Support:
 - 1. Install ground-mounted unit on 4" thick reinforced concrete pad, 6" larger on each side than condensing unit. Concrete shall be as specified in Division 3. Coordinate installation of anchoring devices.

3.03 FIELD QUALITY CONTROL

- A. Testing:
 - 1. Charge systems with refrigerant and oil, and test for leaks. Repair leaks and replace lost refrigerant and oil.

3.04 DEMONSTRATION

- A. Start-up condensing unit, in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- B. Train Owner's personnel on start-up and shut-down procedures, troubleshooting procedures, servicing, and preventative maintenance schedule and procedures. Review with the Owner's personnel, the data contained in the Operating and Maintenance Manuals.

END OF SECTION 15670

DIVISION 15 – MECHANICAL
SECTION 15671 - HEAT PUMPS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The following shall apply to this Section:
 - 1. Drawings.
 - 2. General Provisions of the Contract.
 - 3. Solicitation Documents.
 - 4. General Conditions.
 - 5. Supplementary Conditions.
 - 6. Division 1.

1.02 WORK INCLUDES

- A. Air-cooled Heat Pumps.

1.03 RELATED WORK

- A. Section 15050 - "MATERIALS AND METHODS".
- B. Section 15530 - "REFRIGERANT PIPING".
- C. Section 16010 - "BASIC ELECTRICAL REQUIREMENTS".

1.04 SUBMITTALS

- A. Submit shop drawings in accordance with Division 1.
- B. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights (shipping, installed, and operating), dimensions, required clearances and methods of assembly of components, furnished specialties and accessories, installation and start up instructions.
- C. Wiring Diagrams: Submit ladder-type wiring diagrams for power and control wiring required for final installation of units and controls. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
- D. Operation and Maintenance Data: Submit maintenance data and parts list for each unit, control and accessory; including "trouble shooting" maintenance guide; plus servicing, and preventative maintenance procedures and schedule. Include this data and product data in maintenance manual; in accordance with requirements of Division 1.

1.05 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air cooled heat pumps, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
 - 2. Units up to 65,000 btu/h in capacity shall be tested and rated in accordance with ARI Standard 210/240 "Unitary Air-Conditioning and Air-Source Heat Pump Equipment".
 - 3. Units larger than 65,000 btu/h in capacity shall be tested and rated in accordance with ARI Standard 340/360 "Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment".
 - 4. Refrigeration system of condensing units shall be constructed in accordance with ASHRAE 15 "Safety Code for Mechanical Refrigeration".
 - 5. Unit minimum efficiency in the heating and cooling modes shall meet or exceed the efficiencies prescribed by the latest edition of ASHRAE 90.1 "Energy Standard for Buildings Except Low-Rise Residential Buildings".
 - 6. NFPA 70 - National Electrical Code.
 - 7. Units shall be listed by UL and have UL label.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Handle heat pumps and components carefully to prevent damage. Follow manufacturer's written instructions for rigging. Replace damaged condensing units or components.
- B. Store heat pumps and components in clean dry place off the ground. Protect from weather, water, and physical damage.

1.07 SPECIAL PROJECT WARRANTY

- A. Warranty on Motor/Compressor: Provide a written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, motors/compressors with inadequate or defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement is limited to component replacement only and does not include labor for removal and reinstallation.
 - 1. Warranty Period: 5 years from date of substantial completion.

PART 2 - PRODUCTS

2.01 HEAT PUMPS

- A. Factory-assembled and tested air-cooled heat pump units, consisting of compressors, coil, fans, motors, refrigerant reservoirs and operating controls. Capacities and electrical characteristics are scheduled on the drawings.
- B. Casing: Galvanized steel finished with baked enamel, complete with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Unit shall be complete with brass service valves, fittings and gauge ports on exterior of casing. Casing shall be constructed in a manner that protects the condenser coil from hail damage. Provide separate hail guards if necessary.
- C. Compressors: Compressors shall be R-410A scroll type with thermal overload protection, individually (tandem) circuited and carry a 1 year non-prorated warranty, from the date of original equipment shipment from the factory. Each compressor shall be furnished with a crankcase heater.
- D. Condenser Coil: Coil shall have copper tubes and aluminum fins, complete with liquid accumulator and liquid subcooler. Aluminum propeller fans shall be direct driven, with permanently lubricated fan motor having thermal overload protection.
- E. Accessories:
 - 1. Head pressure control to modulate condenser fan motor speed for low ambient conditions.
 - 2. Low-voltage control transformer.

2.02 ACCEPTABLE MANUFACTURERS

- A. Carrier
- B. Lennox
- C. Trane
- D. York
- E. Aeon

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify roof structure, mounting supports and membrane installations are completed to the proper point to allow installation of roof mounted units. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install heat pump unit in accordance with manufacturer's installation instructions. Install unit plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
- B. Support:
 - 1. Where ground mounted, install units on 4" thick reinforced concrete pad, 4" larger on each side than the unit. Concrete is specified in Division 3. Coordinate installation of anchoring devices.
 - 2. Where installed on the roof, refer to the plan for method of support.

3.03 FIELD QUALITY CONTROL

- A. Testing:
 - 1. Charge systems with refrigerant and oil and test for leaks. Repair leaks and replace lost refrigerant and oil.

3.04 DEMONSTRATION

- A. Start-up heat pump in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- B. Review with the Owner's personnel, the data contained in the Operating and Maintenance Manuals specified in Division 1.

END OF SECTION 15671

DIVISION 15 – MECHANICAL

SECTION 15724 – AIR HANDLING UNITS (5-20 TONS)

PART 1: GENERAL

1.01 WORK INCLUDED

- A. Factory-built air-handling units and components as indicated on the plans.

1.02 RELATED SECTIONS

- A. The requirements of the General Conditions, Supplementary Conditions, Division 1, and Drawings apply to all work herein.
- B. Requirements of the following sections apply.
 - 1. Section 15010 – “BASIC MECHANICAL REQUIREMENTS”
 - 2. Section 15100 – “VALVES”
 - 3. Section 15800 – “AIR DISTRIBUTION”
 - 4. Section 15990 – “TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS”

1.03 QUALITY ASSURANCE

- A. If equipment manufactured by manufacturer other than that scheduled is utilized, then the Mechanical Contractor shall be responsible for coordinating with the General Contractor and all affected Subcontractors to ensure proper provisions for installation of the furnished unit. This coordination shall include, but not be limited to, the following:
 - 1. Structural supports for units.
 - 2. Piping size and connection/header locations.
 - 3. Electrical power requirements and wire/conduit and overcurrent protection sizes.
 - 4. The Mechanical Contractor shall be responsible for all costs incurred by the General Contractor, Subcontractors, and Consultants to modify the building provisions to accept the furnished units.

1.04 REFERENCES

- A. AMCA 99 – Standard Handbook
- B. AMCA 210 – Laboratory Methods of Testing Fans for Rating Purposes
- C. AMCA 300 – Test Code for Sound Rating Air Moving Devices
- D. AMCA 301 – Method of Publishing Sound Ratings for Air Moving Devices
- E. AMCA 500 – Test Methods for Louvers, Dampers, and Shutters
- F. ANSI/AFBMA 9 – Load Ratings and Fatigue Life for Ball Bearings
- G. ANSI/UL 900 – Test Performance of Air Filter Units

- H. ARI 410 – Forced-Circulation Air Cooling and Air Heating Coils
- I. ARI 430 – Standard for Application of Central-Station Air Handling Units
- J. ARI 260 - Sound Rating of Ducted Air Moving and Conditioning Equipment
- K. NFPA 90A – Installation of Air Conditioning and Ventilation Systems
- L. SMACNA – Low Pressure Duct Construction Standards
- M. AMCA 611-95 – Methods of Testing Airflow Measurement Stations for Rating
- N. ASHRAE 52.1/52.2 – Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size
- O. ASHRAE 62 – Ventilation for Acceptable Indoor Air Quality
- P. ASHRAE 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings

1.05 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 15010.
- B. Shop drawings shall indicate assembly, unit dimensions, weight loading, required clearances, construction details, and field connection details.
- C. Product data shall indicate dimensions, weights, capacities, ratings, fan performance, motor electrical characteristics, gauges, and finishes of materials.
- D. Provide fan curves with specified operating point clearly plotted.
- E. Submit product data of filter media, filter performance data, filter assembly, and filter frames.
- F. Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.
- G. Submit manufacturer's installation instructions under provisions of Section 15010.

1.06 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 15010.
- B. Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.07 RATINGS AND CERTIFICATIONS

- A. Conform to AMCA 210 for fan performance ratings.
- B. Conform to E.T.L. or U.L. standards.
- C. Conform to ARI 410 for capacities, pressure drops, and selection procedures of air coils.
- D. Conform to ARI 430 for all fabrication procedures of air handling units.

- E. Utilize only ANSI/UL 900 listed Class I or Class II filter media, approved by local authorities.
- F. Utilize only ISO9001, 9000, or 9002 certified facilities in the manufacturing of the air-handling unit.
- G. Electric control wiring shall be in accordance NEC codes & ETL requirements.
- H. Motors shall satisfy the Federally mandated Energy Policy Act (EPACT).

1.08 DELIVERY, STORAGE AND HANDLING

- A. All handling and storage procedures shall be per manufacturer's recommendations.
- B. Unpainted units shall be shrink-wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Alternatively, units may be completely covered by tarps while in transit or shipped in an enclosed truck. Units not factory shrink-wrapped shall be re-covered by the contractor at the job-site while awaiting installation. Protection of the complete unit for avoidance of general rusting must be handled as best suits the circumstances. Store in a place protected from construction traffic and handle carefully to avoid damage to components, enclosures, and finish.
- C. All openings shall be protected against damage from shipping.
- D. Safety warning labels shall be clearly marked in 3-language format.
- E. Filters will ship loose from factory with unit as scheduled.
- F. All loose-shipped items need to be packed, protected and secured with the air units.
- G. Pipe chases will ship attached to the unit as indicated on the drawings unless the total unit width including the pipe chase exceeds 102", in which case the pipe chase will ship loose.
- H. Factory Packaged Controls (FPC) will be factory-mounted as selected. Motor control devices will be factory-mounted as selected and indicated on the drawings. Electronic equipment cannot be stored in wet or damp areas even though they are sealed and secured.
- I. Motors should be protected and inspected in accordance with the manufacturers' specific instructions regarding periods of long storage.

1.09 WARRANTY

- A. The manufacturer's standard warranty shall be for a period of twelve months from the date of shipment. The warranty shall include parts and labor during this period. A factory-trained and factory-employed technician shall be available within 50 miles of the job site to respond to a service call. The warranty shall not include parts associated with routine maintenance, such as belts, air filters, etc. Warranty is not extended to any

alteration, modifications or external component attached to “original” equipment “as-built” and shipped from manufacturing facilities.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.
- B. Manufacturer’s “start-up” requirements must be complied with to ensure safe and correct operation.

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Trane
- B. York
- C. Carrier
- D. Aeon
- E. Lennox

2.02 GENERAL DESCRIPTION

- A. Factory-manufactured air-handling units designed to the performance levels specified with a combination of air-handling components in unitized housings to form complete, integrated machines as indicated on the drawings.
- B. Fabricate air-handling units suitable for the scheduled capacities.
- C. Factory-test and balance fan design and drives to limit vibration at operating speeds.
- D. Base performance on sea level conditions.
- E. All internal components specified in the air-handling unit schedule shall be factory-furnished and installed. Unit(s) shall be completely factory assembled.

2.03 UNIT CASING

- A. The unit casing shall be heavy gauge galvanized steel. The casing shall be fully insulated. All insulation edges shall be either captured or sealed.

2.04 FANS

- A. Fans shall be selected to provide the airflow and pressure specified.
- B. Fan segments shall be equipped with double width double inlet (DWDI) housed fans. Double width double inlet (DWDI) fans, having airfoil or forward curved blades.
- C. Fans shall be belt driven where specified.

- D. The fan assembly shall be factory-mounted in spring vibration isolators.

2.05 COILS

- A. DX evaporator coils shall be completely factory-assembled, including the expansion valve and drain pan. Units ten tons and over shall have dual refrigerant circuits. Coils shall meet or exceed the scheduled capacity.
- B. Hot water heating coils shall be shipped completely factory-assembled within a heavy gauge sheet metal casing. Coils shall be application specific and matched to the applicable air-handling unit. Hot water coils shall have performance certified in accordance with ARI Standard 410 for coil capacity and pressure drop. Coils shall meet or exceed the scheduled capacity.

2.06 FILTERS

- A. Units shall have a factory or field installed filter rack for two-inch throw away filters.
- B. Spare sets of media shall be provided as indicated in the basic mechanical requirements.

PART 3: EXECUTION

3.01 INSTALLATION

- A. General: Installing contractor shall install air-handling unit(s), including components and controls required for operation, in accordance with air-handling unit manufacturer's written instructions and recommendations.
 - 1. Air-handling unit(s) shall be stored only in a clean, dry place, protected from weather and construction traffic.
 - 2. Air-handling unit(s) shall be handled such that damage to components, enclosure, and finish is avoided.
 - 3. Install in conformance with ARI 435.
 - 4. Isolate fan segments with flexible duct connections.

END OF SECTION 15724

DIVISION 15 – MECHANICAL

SECTION 15732 – VARIABLE REFRIGERANT FLOW SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The following shall apply to this Section:
 - 1. Drawings.
 - 2. General Provisions of the Contract.
 - 3. Solicitation Documents.
 - 4. General Conditions.
 - 5. Supplementary Conditions.
 - 6. Division 1.

1.02 WORK INCLUDES

- A. A variable capacity, heat recovery air conditioning variable refrigerant flow type split systems.

1.03 RELATED WORK

- A. Division 1 - General Conditions.
- B. Section 15010 - "BASIC MECHANICAL REQUIREMENTS".
- C. Section 15190 - "MECHANICAL IDENTIFICATION".

1.04 SUBMITTALS

- A. Submit the following in accordance to Section 15010 - "BASIC MECHANICAL REQUIREMENTS":
 - 1. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, dimensions, required clearances, weights, furnished specialties and accessories; and installation and start-up instructions.
 - 2. Shop Drawings:
 - a. Submit shop drawings detailing the manufacturer's electrical requirements for power supply wiring for rooftop units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

3. Operation and Maintenance Data: Submit maintenance data and parts list for each unit, including “trouble-shooting” maintenance guide, servicing guide and preventative maintenance schedule and procedures. Include this data in maintenance manual in accordance with requirements of Division 1.

1.05 QUALITY ASSURANCE

- A. Manufacturer’s Qualifications: Firms regularly engaged in manufacture of units, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Handle units and components carefully to prevent damage. Replace damaged units or components with new.
- B. Store units and components in clean dry place, off the ground, and protect from weather, water, and physical damage.
- C. Rig units to comply with manufacturer’s rigging and installation instructions for unloading units, and moving them to final location.

1.07 SPECIAL WARRANTY

- A. Warranty on manufacturer parts and labor shall have a period of (1) year from date of substantial completion.
- B. Warranty on Compressor: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, compressors with inadequate and defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer’s instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement is limited to component replacement only, and does not include labor for removal and reinstallation.

1. Warranty Period: 10 years from date of substantial completion.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The VRF system shall be able to provide heat during both the Defrost Cycle and the Oil Return Cycle. If the VRF system does shut down during any of these cycles then the system will be provided with back-up electric heat in all evaporator fan units.

2.02 INDOOR UNITS

- A. Ducted indoor units shall be a built-in ceiling concealed fan coil unit, equipped with an electronic expansion valve, direct-drive DC (ECM) type fan with auto CFM adjustment at commissioning.

- B. Outside air processing units shall be a built-in ceiling concealed fan coil unit, equipped with an electronic expansion valve. The unit shall be capable of introducing 100% outside air controlled to a fixed discharge air temperature.
 - 1. Non-discharge air controlled fan coils are not acceptable.
 - 2. Units that require recirculation of air to meet specified CFM are not acceptable.

2.03 OUTDOOR UNITS

- A. The heat recovery systems shall continue to provide heat to the indoor units in heating operation while in the defrost mode.
 - 1. Reverse cycle (cooling mode) defrost during heating operation shall not be permitted due to the potential reduction in space temperature unless supplemental heat is provided to make up for the heat loss.
- B. Outdoor units shall be mounted at least 12" above roof to insure water properly drains away from the units.
- C. Outdoor units shall include hail guards to protect the coils from damage.

2.04 BRANCH SELECTOR BOXES

- A. Branch selector boxes shall be furnished with 3 electronic expansion valves per port to control the direction of refrigerant flow.
 - 1. The use of solenoid valves for changeover and pressure equalization shall not be acceptable due to refrigerant noise and changeover delays due to pressure equalization.
 - 2. If common/shared valves are used, additional boxes must be provided to insure each branch has dedicated valves and no single point-of-failure exists.
 - 3. The unit shall not require provisions for condensate removal.

2.05 CONTROLS

- A. Centralized system shall be provided capable of setting and monitoring variable refrigerant flow systems.
- B. The Mechanical Contractor shall furnish and install all control devices to interface the VRF equipment shown on the plans and specifications.

2.06 PERFORMANCE

- A. Refer to the HVAC Equipment Schedule.

2.07 MANUFACTURERS

A. Variable Refrigerant Flow Systems

1. Daikin
2. Mitsubishi
3. Carrier/Toshiba
4. LG

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's installation instructions.
- B. Complete structural, mechanical and electrical connections in accordance with manufacturer's installation instructions.
- C. The Bidding Mechanical Contractor shall have completed 8 hour minimum of Factory Certified Installation Training Program 15 days prior to the start date of construction. Certification shall be submitted to the engineer of record prior to the start of work.

3.02 DEMONSTRATION AND INSTRUCTION

- A. Start-up Services:
 1. Provide the services of a factory-authorized service representative to start-up VRF system, in accordance with manufacturer's written start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
 2. Replace filters as required so all units have a clean set of filters at substantial completion of the project. In addition, furnish a spare set of filters for all units.
- B. Operating and Maintenance Training:
 1. Provide services of manufacturer's service representative to instruct Owners' representative in operation and maintenance of variable refrigerant flow system. Training shall include start-up and shut-down, servicing and preventative maintenance schedule and procedures, and troubleshooting procedures plus procedures for obtaining repair parts and technical assistance. Review operating and maintenance data contained on the Operating and Maintenance Manuals specified in Division 1. Provide sign-in sheet for training session in Operating and Maintenance Manual, including date, instructor, personnel present, and material discussed.

END OF SECTION 15732

DIVISION 15 – MECHANICAL
SECTION 15800 - AIR DISTRIBUTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The following shall apply to this Section:
1. Drawings.
 2. General Provisions of the Contract.
 3. Solicitation Documents.
 4. General Conditions.
 5. Supplementary Conditions.
 6. Division 1.

1.02 WORK INCLUDES

- A. Provide all ductwork with extractors, dampers, turning vanes, hangers, access doors, etc., as indicated on the drawings, as specified and as required to complete this portion of the work in conjunction with the air distribution system.
- B. Provide factory fabricated units, exhaust fans, wall louvers, access doors, fire dampers, security grilles, grilles, registers, diffusers, etc., as specified and as shown on the drawings.
- C. Provide control dampers, fire dampers, and balancing dampers as shown on drawings or as required for proper duct system operation.

1.03 SUBMITTALS

- A. Submit shop drawings in accordance with Section 15010 - "BASIC MECHANICAL REQUIREMENTS" for the following equipment:
1. Registers, grilles and diffusers.
 2. Fire dampers.
 3. Exhaust fans.
 4. Duct liner.
 5. Sealing materials.
 6. Fire stopping materials.

1.04 QUALITY ASSURANCE

- A. Codes and Standards: Duct lining materials, separately and in combination shall be UL listed and shall have maximum fire hazard classifications of flame spread 25 and smoke development 50.
- B. Units shall be factory assembled and tested. Fan ratings to be based on current AMCA Standards.
- C. Roof exhaust fans shall bear AMCA seal.
- D. Fire dampers shall conform to requirements of National Fire Protection Association and the state and local fire marshal.
- E. NFPA Compliance: Comply with the following:
 - 1. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," except as indicated otherwise.

PART 2 - PRODUCTS

2.01 DUCTWORK

- A. Construction: Ductwork, unless otherwise shown, shall be galvanized steel sheets (F.S. QQ-S-775 Type I, Class e) or aluminum alloy 3003 (F.S. QQ-A-250/2c Temper H-14). Ductwork (unless noted otherwise on drawings) shall be constructed in accordance with SMACNA low pressure duct construction standards for 1" w.c. pressure. For convenience, they may be constructed per the following table:

DIMENSION	GAUGE	REINFORCING	MAX SPACING
0" - 12"	26	None	
13" - 26"	26	1" standing "S"	5'0"
27" - 42"	24	1" standing "S"	4'0"
43" - 60"	22	1" x 1" x 3/16" angle	2'6"

Install reinforcing on four sides of duct where depth exceeds 16"; install on two sides only where duct depth is 16" or less.

- B. Ductwork to be Painted: Where ducts will be exposed and painted, use "Paint-Grip" galvanized steel (this includes spiral duct). Duct inside clear dimensions, unless otherwise approved by the Engineer, shall conform accurately to the sizes indicated on the drawings and shall be straight, with joints neatly finished. Ducts shall be securely anchored to the building in an approved manner and shall be installed so as to be completely free from vibration under all conditions of operation. Turning vanes shall be installed in all elbows, in both supply and return ducts. Sheet metal ducts shall be properly braced and reinforced. All rectangular duct with dimensions over 12" shall be cross-braced to prevent "oil-canning."

- C. Exposed Rectangular Ductwork: The rectangular ducts shall be assembled with transverse joints made with the "Ductmate" system or an approved equal. The Ductmate joints shall be assembled with corners, cleats and gasket tape per the manufacturer's instructions. Duct metal gauges may be reduced per the Ductmate recommendations.
- D. Concealed Rectangular Ductwork: **All duct joints and seams shall be sealed with a water-based brush on type duct sealer equivalent to "United McGill Duct Sealer".** The sealant shall be applied per the manufacturer's instructions. No leakage shall be detectable when the duct is pressurized to 1" water column. Unsealed duct joints will not be accepted.
- E. Round Ductwork: Round low-pressure ductwork in concealed locations shall be galvanized steel "Snaplock" pipe. Tape all transverse joints. Spiral duct shall be used where indicated on drawings. Where indicated on drawings, round ductwork and all below-grade ductwork shall be spiral galvanized round duct, "United" or approved equal. Spiral duct shall conform to SMACNA duct construction standards Section III. Spiral seams shall be lock-formed or continuous-welded. Elbows referred to as "radiused" may be gored elbows, 5 sections minimum. Duct sizes may be increased 1" as required to allow "nesting" for economical shipment.
- F. Flexible connectors at connections to equipment shall be fabricated of "Elgen Silent-Duct" neoprene commercial grade strip, 9" wide with 3" flexible section, or equal. Place as indicated on drawings, or as required. Use care to avoid violating fire integrity of ducts.

2.02 FLEX DUCT

- A. Flexible air duct shall be insulated fabric acoustical flexible air duct. The ductwork shall be UL listed, Class 1 Air Duct and comply with NFPA 90A and 90B. Core material shall be an acoustical transparent CPE fabric supported by helically wound galvanized steel mechanical locked construction. Wire helix type supported core not acceptable. The fabric shall be mechanically fastened to the steel helix without the use of adhesive. The duct shall be rated for minimum 4000 feet per minute velocity and positive pressure of 6 inches W.G. and negative pressure of 4 inches W.G. Factory insulation shall be flexible fiberglass insulation with an R value of at least 6.0 at a mean temperature of 75 degrees F. (R4.2 not acceptable). Insulation shall be covered with a reinforced aluminum pigmented vapor barrier jacket having a permeance of not greater than 0.05 perms when tested in accordance with ASTM E 96, procedure A. Flexible duct routing shall not exceed 8'-0" in length.
- B. Flexible ductwork shall be Flexmaster USA Type 8M. **For alternate flexible duct manufacturer, a sample is required and shall be submitted to the engineer for approval.**

2.03 EXHAUST DUCTS

- A. Exhaust ducts shall be round or rectangular galvanized steel as shown on the plans. Flexible duct is not permitted. Do not insulate exhaust duct work unless called for on the drawings and as specified below.

2.04 DUCT LINER

- A. Specified on plans

2.05 DUCT WRAP

- A. Specified on plans

2.06 FLEXIBLE CONNECTIONS

- A. Where sheet metal connections are made to fan or where ducts of dissimilar metal are connected, a noncombustible flexible connection of approved noncombustible material approximately 6" in width, conforming to ASTM Specification D1571-67, shall be installed.

2.07 INSPECTION AND ACCESS DOORS

- A. Duct access doors shall be 12" x 12" unless otherwise indicated. Where size of duct will not accommodate this size, the doors shall be 12"W X (smallest duct dimension minus 2"). All access doors shall be rigid and shall be provided with airtight neoprene gaskets. Doors shall be provided with a galvanized piano hinge and two camlock type brass fasteners. Man-size access doors shall be provided with door handles operable from both sides. Doors in insulated ducts shall be of the insulated type.
- B. Access doors for access to dampers or equipment behind gyp. board ceilings and walls shall be as specified in the architectural specifications.

2.08 HANGERS AND SUPPORTS FOR DUCTS

- A. Install rigid round, rectangular, and flat oval metal duct with support systems indicated in SMACNA "HVAC Duct Construction Standards," Tables 4-1 through 4-3 and Figures 4-1 through 4-8.
- B. Support horizontal ducts within 2' of each elbow and within 4' of each branch intersection.
- C. Support vertical ducts at a maximum interval of 16' and at each floor.
- D. Upper attachments to structures shall have an allowable load not exceeding $\frac{1}{4}$ of the failure (proof test) load but are not limited to the specific methods indicated.

2.09 REGISTERS AND GRILLES

- A. Registers and grilles shall be of the size indicated on the drawings. Registers and grilles shall have vanes slanted to prevent direct sight into grille.
- B. Anything visible through grille in customer contact and office areas shall be painted flat black.
- C. Provide anti-smudge rings on all ceiling diffuser located in gypsum board and lay-in ceilings. Where ceiling height permits.

2.10 TAKEOFF FITTINGS

- A. Branch duct takeoff fittings shall be minimum 26 gauge galvanized steel with flange connector and adhesive neoprene gasket. Flange shall be pre-drilled for securing to duct with screws. Branch duct takeoff fittings for supply and exhaust diffusers and registers shall include an integral manual volume damper with locking quadrant clearly indicate damper position. Damper is not required on return air branches.
- B. “Spin-in” fittings or job-fabricated units are not acceptable.
- C. Takeoff fittings shall be Buckley model ATM and ATMD or equal. Where duct height requires a rectangular to round takeoff, utilize a Buckley model 3300 and 3300D or equal.

2.11 FIRE DAMPERS

- A. Fire dampers shall have the following features:
 - 1. UL #555 listed and labeled to close, if activated, even if air distribution system is in operation.
 - 2. One piece steel frame.
 - 3. Steel blades with interlocking joints.
 - 4. Stainless steel negator closure spring if required for horizontal mounting.
 - 5. 160°F. U.L. listed fusible links and blade locks.
 - 6. Type “B” construction (recessed curtain).

2.12 FANS

- A. Roof Mounted Fans:
 - 1. Housing: The housing and base shall be constructed of 16 gauge aluminum. The fan base shall have continuously welded corners and shall overlap and protect the curb. Each fan housing shall have a permanently attached engraved aluminum nameplate indicating the fan manufacturer and model number.
 - 2. Fan Motors & Drives: Motors shall be the heavy duty type with permanently lubricated sealed ball bearings. Disconnect switches shall be factory mounted inside the fan housing and out of the airstream. Fan bearings shall be the heavy duty regreasable ball type in a cast iron housing. The minimum L50 bearing life shall be 200,000 hours. The drive assembly shall be mounted to a 14 gauge steel channel isolated with rubber-in-shear vibration isolators. Where belt drives are scheduled, they shall be adjustable.
 - 3. Fan Wheels: Direct or belt driven, as scheduled, of the centrifugal type and backwardly inclined. The fan wheel shall be constructed of aluminum and balanced in accordance with AMCA Standard 204-96.

4. Curbs: Aluminum (0.08") or galvanized steel (18 gauge) construction, continuously welded corners, 12" minimum curb height, 1-1/2" 3lb acoustical insulation. Provide 1/4" sponge rubber pad on top of curb for vibration isolation.
 5. Backdraft Dampers: Each roof mounted fan except grease exhaust fans shall be provided with an aluminum backdraft damper w/sealed blades. Dampers shall be automatic or motorized as indicated on plans.
 6. Grease Exhaust Fan Accessories: Vented curb extension, hinged base, grease trough.
- B. Ceiling and In-Line Fans:
1. Construction: The fans shall be all metal construction. The housing shall be constructed of 20 gauge galvanized steel and acoustically insulated. The blower assembly shall be mounted to 14 gauge steel channel isolated with rubber-in-shear vibration isolators. The assembly shall be removable. The fan wheel shall be constructed of galvanized steel and balanced in accordance with AMCA Standard 204-96. The motor shall be the open drip proof type with permanently lubricated sealed bearings and built in thermal overload protection.
 2. Accessories: Ceiling mounted exhaust fans shall be provided with an architectural style aluminum grill with a polished aluminum finish. A solid state variable speed controller shall be provided for all units with a single phase motor. The controller shall be mounted on or adjacent to the fan housing.

2.13 ACCEPTABLE MANUFACTURERS

- A. Grilles and Registers
1. Kreuger.
 2. Anemostat.
 3. Price.
 4. Titus.
 5. Carnes.
 6. Tuttle and Bailey.
 7. Nailor.
- B. Louvers and Dampers
1. Carnes.
 2. Greenheck.
 3. Ruskin.
 4. Nailor.
 5. Cesco.
 6. Louvers & Dampers Co.
- C. Flexible Ductwork
1. Flexmaster USA.

D. Duct Lining

1. Owens-Corning "Aeroflex Plus Type 300".
2. Certain-Teed "Ultralite Duct Liner".
3. Johns-Manville "Microlite Duct Liner".

E. Duct Wrap Insulation

1. Owens Corning All Service Duct Wrap.
2. Certain-Teed Standard Duct Wrap.

F. Fire Dampers

1. Air Balance.
2. Cesco.
3. Greenheck.
4. Nailor.
5. Louvers & Dampers Co.
6. Ruskin.
7. Vent Products.

G. Fans

1. Cook.
2. Greenheck.
3. Acme.
4. Twin City Fan & Blower.

PART 3 - EXECUTION

3.01 DUCTWORK

- A. Duct System Pressure Class: Construct and install each duct system for the specific duct pressure classification indicated.
- B. Ducts shall be of the internal dimensions shown on the Drawings. In no case shall the Contractor change the indicated size of the ductwork without approval of the Engineer. Wherever necessary to change the shape of the duct, it shall be done gradually and the full cross-sectional area shall be maintained.
- C. Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight (5% leakage for systems rated 3" and under; 1% for systems rated over 3") and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. All joints shall be sealed with duct sealant. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor.

- D. Ducts 24" or greater in width or height shall be stiffened with galvanized structural angle reinforcing, not to exceed 4' on centers and on all four surfaces, to prevent sagging or buckling and to provide a rigid installation and freedom from vibration and noise. Where angle cleats are made of same gauge metal as ducts (or heavier) the angle cleats will serve as reinforcing members on two surfaces of the ducts at joints in the ducts. Additional reinforcing angles shall be provided adjacent to branch duct connections which are of less width or depth than the surface of the main duct at point of connection, and at all other locations as necessary to make the duct work free from noise and vibration when fans are operating.
- E. This Contractor shall carefully check the arrangement of ducts and dimensions for all working spaces at the building so that there will not be interference with the running of ducts.
- F. Where ducts pass through walls and ceilings (exposed and concealed), this Contractor shall provide bent angle collar (as required to cover annular space) having flanges at corners lapped and riveted and the other leg of angle cut short and bent around corner of duct. Collars shall serve to confine sound barrier packing and shall fit tight around ducts. Where more than one duct passes through the same opening the collars shall form a complete seal of the spaces between and around all such ducts. This shall apply to concealed ductwork as well as exposed ductwork. The space between the duct and wall shall be packed with fiberglass duct-seal to provide an effective sound and dust barrier. Where the bent angle collar in any wall opening must support masonry in the wall above the opening, the top member of the bent angle collar shall be reinforced with rolled section steel angles suitable for the weight to be carried as approved by the Engineer and placed so as to be concealed in the wall in all locations where exposed in finished rooms.

3.02 FLEXIBLE CONNECTIONS

- A. Flexible connections shall be securely fastened by zinc-coated iron clinch-type draw bands, for round ducts. For rectangular ducts, flexible connections locked to metal collars shall be installed using normal duct construction methods.

3.03 INSPECTION AND ACCESS DOORS

- A. Access doors in ductwork shall be provided at all fire dampers, motorized dampers, and where indicated on the drawings. Unless otherwise indicated, doors shall swing so that fan pressure or suction holds the door closed. Access doors in ductwork with duct liner or insulation shall be insulated.

3.04 HANGING OF DUCTS

- A. Horizontal ducts shall be supported with angle and rod or strap iron trapeze hangers. Strap iron hangers shall be placed around sides and bottom of ducts with sheet metal screws in sides and bottom. Trapeze hangers shall be securely fastened to ducts and to the construction above. Horizontal duct supports shall be spaced not to exceed 8' apart and not less than one trapeze support per section of duct.
- B. Special hanging systems, where indicated, will be installed in lieu of duct supports specified above.
- C. No equipment or ductwork shall be hung from roof deck.

3.05 TAKEOFF FITTINGS

- A. Install takeoff fittings with dampers in each supply air branch takeoff. Mark damper open and closed positions on side of duct with black paint.
- B. Fittings shall be secured in duct with screws. Operators shall be outside the duct system. All holes shall be carefully covered and sealed.

3.06 FIRE DAMPERS

- A. Fire dampers shall be installed as required by NFPA 90A, and as indicated on the drawings. Fire dampers must be installed in 10 gauge sleeve above ceiling terminal air devices or in masonry wall. Steel retaining angles, 10 gauge, shall be bolted or welded to sleeve on both sides of wall, with duct connected to sleeve on both sides with slip connector held with not less than one No. 8 sheet metal screw on each vertical side of duct.

3.07 INSTALLATION OF EQUIPMENT

- A. Install all fans, fire dampers, registers, grilles, etc., per manufacturer's recommendation and instructions.
- B. Care shall be taken with installation of roof exhaust fans and roof vents to prevent damage. Any fan or vent dented or damaged in any other way during construction shall be repaired or replaced.

3.08 ACOUSTICAL DUCT LINING - INSTALLATION

- A. **Acoustical duct lining shall be installed at locations as indicated on plans and as specified in Part 2 of this specifications section.**
- B. Duct liner shall be installed as called for in latest edition of manufacturer's installation manual and/or as called for or shown in the SMACNA HVAC Duct Construction Manual - 1995.
- C. Adhere liner with coated side toward air stream to all interior sides of duct with 100% coverage of fire-resistant insulation bonding adhesive. Adhesive shall completely cover sheet metal at each end of each section of ductwork. Provide Z bar liner retainer on leading edge of liner.
- D. When duct width exceeds 12" or height exceeds 24" further secure the liner to these surfaces with mechanical fasteners at 16" o.c.
- E. Velocities - 1500 to 4000 FPM: Install as above but additionally paint all joints of liner and butter the edges of liner where sections of ductwork will be joined with fire-resistant mastic.
- F. Note: All duct sizes shown are inside of linings. Increase sheet metal sizes as required.

3.09 DUCT WRAP - INSTALLATION

- A. Duct wrap shall be installed at locations as indicated on plans.**
- B. Duct wrap shall be installed as called for in latest edition of manufacturer's installation manual and/or as called for or shown in the SMACNA HVAC Duct Construction Manual - 1995.

3.10 EXHAUST DUCTS

- A. Exhaust ducts shall not be insulated or lined unless specifically noted otherwise.

3.11 ADJUSTING AND CLEANING

- A. Adjust volume control devices as required by the testing and balancing procedures to achieve required air flow. Refer to Section 15990 - "TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS" for requirements and procedures for adjusting and balancing air systems.

END OF SECTION 15800

DIVISION 15 – MECHANICAL

SECTION 15900 – HVAC CONTROLS-ELECTRIC

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The following shall apply to this Section:
 - 1. Drawings.
 - 2. General Provisions of the Contract.
 - 3. Solicitation Documents.
 - 4. General Conditions.
 - 5. Supplementary Conditions.
 - 6. Division 1.

1.02 WORK INCLUDES

- A. **It is the contractor's responsibility to achieve the sequence of operations.** The contractor shall provide all devices and wiring necessary to automatically control each HVAC system in accordance with the sequence of operations. Control system devices consist of all thermostats, transmitters, controllers, flow switches, flow meters, humidistats, aquastats, motion detectors, carbon monoxide detectors, duct smoke detectors, automatic dampers, damper operators, switches, relays, contacts, transformers, control panels, timers, valve actuators and any other necessary equipment along with a complete system of electrical wiring. All wiring and conduit shall comply with requirements of Division 16.

1.03 RELATED WORK

- A. Section 15050 - "MATERIALS AND METHODS".

1.04 SUBMITTALS

- A. Prior to any fabrication, ordering, or installation work, complete shop drawings for the control system shall be made. The submittal shall be in accordance with Section 15010 - "BASIC MECHANICAL REQUIREMENTS" and shall include the following:
 - 1. Control wiring diagrams.
 - 2. Complete manufacturer's data sheet on each control device to be used.
 - 3. Actual sample of each thermostat, room sensor, and control device to be installed in the occupied spaces. Covers, guards, etc. shall be included (These can subsequently be used on the project).
- B. Actual sample submittals shall be brought or sent to the Engineer's office directly. Other submittals shall be made in the normal manner via the general contractor and architect.

1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."

1.06 SYSTEM DESCRIPTION

- A. The system shall be electric as indicated in the control diagram. Exact duplication of the arrangements shown in the diagram is not required. System design is the responsibility of the contractor and he shall arrange the system to accomplish the objectives of control which are indicated by the diagrams and the sequence of operation herein.

1.07 ELECTRIC WIRING

- A. Control wiring, regardless of voltage, is the responsibility of the contractor, including all conduit and outlet boxes for controls. All line voltage and low voltage control wiring shall be installed in accordance with the requirements of the Electrical Specifications. No control wiring shall be installed inside ductwork.
- B. Control wiring which operates at more than 24 volts nominal shall be copper wire installed in EMT conduit. Low voltage control wiring in accessible locations above ceilings may be jacketed plenum cable. No wire smaller than 18 gauge shall be used. Such wiring shall be neatly strapped in place with plastic wire ties. Attach to electrical conduits, top chords of bar joists, or top rows of joist bridging. Do not attach to or lay on ceilings or bottom chords of bar joists. Low voltage wiring where exposed to view shall be installed in EMT conduit.
- C. Outlet boxes or other recessed enclosures for control wiring shall be installed as indicated and the contractor shall assure that the proper boxes are available in time to avoid delaying the masonry work or other trades.
- D. Line voltage wiring which provides power to the main motor of any piece of HVAC equipment, including manual switch wiring, is considered power wiring and is specified under the electrical work. Circuits to motorized dampers are control wiring.
- E. Control diagrams are the responsibility of the contractor. At the completion of the job, all diagrams shall be provided to the Owner along with the equipment operating and maintenance instructions. See Section 15010 - "BASIC MECHANICAL REQUIREMENTS."
- F. Where control wiring must be routed in masonry walls (such as to thermostats) it shall be installed in conduit. Assure that conduit and boxes are placed in time to avoid delaying masonry work.

PART 2 - PRODUCTS

2.01 CONTROL DEVICES

- A. All control system devices require the Engineer's approval of submittals.
- B. Provide clear tamper resistant covers for all thermostats, humidistats and CO2 sensors.

2.02 ACCEPTABLE MANUFACTURERS

- A. All control devices shall be commercial grade devices manufactured by a nationally recognized company regularly engaged in the production of such devices.

PART 3 - EXECUTION

3.01 CONTROL DEVICES

- A. All thermostats, room sensors, override buttons and other control devices which are adjustable by the occupants of the building, shall be mounted so as to meet ADA (Americans with Disabilities Act) accessibility requirements. Mount devices 48" A.F.F. to the bottom of the device unless a conflict occurs. Where the 48" location is obstructed by a light switch, counter, or other item, the height may be increased to 54", but only in locations where the control can be operated by a "side reach" from a wheelchair. If this adjustment will not resolve the conflict, report it to the engineer for resolution.
- B. Where such devices cannot be mounted directly on the unit, transformers, control modules and motor interface devices shall be mounted on a plywood base adjacent to HVAC unit.
- C. Wire, test and calibrate any controls shipped loose with HVAC equipment.

3.02 CONTROL HARDWARE INSTALLATION

- A. The complete control system shall be setup and started in operation by its installers.
- B. After approximately 6 months use of the building, the controls subcontractor shall visit the building and check all functions of the controls, making any adjustments which may be made necessary by the change in seasons, and reviewing its operation with the Owner's representative.

3.03 TRAINING

- A. The contractor shall conduct a training session for the Owner's operating and maintenance personnel to familiarize them with the control system. This session shall be held after the system is fully operational.

3.04 SEQUENCE OF OPERATION

- A. See plans.

3.05 EQUIPMENT LABELING

- A. Labels shall be installed wherever necessary to clarify functions of components and facilitate adjustment and servicing. Labels shall be required on, but not limited to the following:
1. Control panels.
 2. Automatic damper motors.
 3. Freeze protection stats.
 4. Air-handling units and their starters.
 5. Remote temperature sensors

3.06 FINAL ADJUSTMENT OF CONTROLS

- A. After completion of the installation, adjust all thermostats, control valves, motors and other equipment provided under this contract and place them in complete operating condition subject to approval of Engineer.

END OF SECTION 15900

DIVISION 15 – MECHANICAL

SECTION 15990- TESTING, ADJUSTING, & BALANCING OF HVAC SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The following shall apply to this Section:
 - 1. Drawings.
 - 2. General Provisions of the Contract.
 - 3. Solicitation Documents.
 - 4. General Conditions.
 - 5. Supplementary Conditions.
 - 6. Division 1.

1.02 WORK INCLUDES

- A. The HVAC systems shall be tested and balanced by an independent agency.

PART 2 - PRODUCTS - NOT APPLICABLE

PART 3 - EXECUTION

3.01 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS (NEBB OR AABC CERTIFIED)

- A. This Agency shall be certified by the National Environmental Balancing Bureau (NEBB) or by the American Air Balance Council (AABC). Five (5) copies of the final balancing report shall be submitted on applicable NEBB Reporting Forms for review. Each individual final reporting form submitted shall bear the name of the person who recorded the data and the seal of the supervisor of the performing firm. Identification of all types of instruments used and their last dates of calibration shall be submitted with the final report.
- B. HVAC systems will be tested and balanced by an independent agency retained by the Contractor.
- C. The independent air/hydronic testing and balancing agency (TAB) shall perform the balancing and testing of the HVAC in accordance with the procedures of AABC or NEBB to analyze, balance, adjust and test air and water moving equipment, air and water distribution system including kitchen exhaust hood system.
- D. Flow rates shall be balanced to within 10% of the design flow rates.
- E. The Contractor shall put all heating, ventilating and air conditioning systems and equipment into operation and shall continue the operation of same during each working

day of testing and balance and shall place the automatic temperature control system in satisfactory operation before the TAB agency shall begin work.

- F. Prior to the final acceptance of the HVAC system by the Engineer, the Contractor shall allow the TAB agency to schedule this work in cooperation with other trades involved and comply with the completion date of the project.
- G. The Contractor shall make available to the TAB agency a complete copy of shop drawing submittal data on mechanical equipment including performance curves (fans and pumps, chillers, air distribution devices, etc.) necessary to test and balance the HVAC system.
- H. The Contractor shall schedule the following necessary personnel:
 - 1. Automatic Temperature Control Manufacturer's Service Representative to set adjustments of automatic operated damper and devices to operate as specified, and/or noted, including setting of all controls for proper calibrations.
 - 2. Mechanics - To operate, adjust, replace or repair the HVAC equipment that is found requiring any change/replacement in the pulleys, belts, dampers, valves, etc., of Contractor's furnished and installed equipment.
 - 3. Electrician - To assist in any problems resulting from any of the power or control wiring installation, including replacement of starters, and heater elements.
 - 4. The Contractor shall make any changes in pulleys, belts and dampers or the addition of dampers as required for correct balance of the system as recommended by TAB agency, at no cost to Owner.
- I. The Contractor shall make all necessary corrections within 48 hours upon notification of TAB agency of the deficiencies requiring adjustment, (piece-meal correction is not acceptable) and within 10 working days for items that require replacement or installation.
- J. The Contractor shall leave all strainers clean and all air filters replaced prior to the start of testing and balancing activity.
- K. If the Contractor had scheduled the TAB agency to perform the work and the HVAC systems are not ready to be tested and balanced, any additional cost required to extend the TAB work shall be at the Contractor's expense.

END OF SECTION 15990

DIVISION 16 – ELECTRICAL

SECTION 16010 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings.
- B. General Provisions of the Contract.
- C. Solicitation Documents.
- D. General Conditions.
- E. Supplementary Conditions.
- F. Division 1.

1.02 WORK INCLUDES

- A. The work to be performed under this Division shall include all labor, materials, equipment, transportation, construction plant, and facilities necessary to provide a complete and satisfactory system ready to use. The Contractor shall examine all Drawings and all Sections of the Specifications and shall be responsible for ascertaining to what extent other Drawings and Sections affect the work herein specified.
- B. All rough-in and final connections to the kitchen equipment shall include, but not limited to, solenoid valves, condensing units, evaporators, defrost heaters, door heaters, threshold heaters and all interconnecting wiring between evaporators and condensing units. Install all starters and other electrical equipment furnished by others and provide the necessary interconnect wiring. Tighten all loose connections on equipment regardless of who furnished equipment. Coordinate the work with the kitchen equipment supplier.

1.03 CODES, REGULATIONS, AND STANDARDS

- A. All work must be performed in accordance with the requirements of local, county, state and national codes and regulations including the requirements of the locally adopted edition of the following codes:
 - 1. 2006 International Building Codes.
 - 2. 2005 National Electrical Code.
 - 3. Occupational Safety and Health Act of 1970.
 - 4. Life Safety Code, N.F.P.A. No. 101.

1.04 SUBMITTALS

- A. See Division 1 and this section for requirements for shop drawings and product data.
- B. As soon as possible and within thirty (30) days after the award of the contract and before beginning the fabrication of any material or the installation of any equipment, a complete schedule of the materials and equipment proposed for installation shall be submitted to the Engineer for approval. This schedule shall include manufacturers' names, catalog

data, diagrams, drawings and other descriptive data as required or requested by the Engineer.

- C. All items of materials and equipment used for the project shall be submitted.
- D. Submittals shall be assembled in an orderly manner and shall include a title page with space for the Engineer's approval stamp and remarks. It shall also contain a concise listing of all items being submitted. Submit five (5) copies as follows: Architect (for records); Engineer (for records); Owner (for records); and two (2) copies for Contractor's use.
- E. Asbestos Free Material/Product: Prior to approval of the material/product to be used, the manufacturer/supplier shall furnish the Engineer with written certification that the material/product contains no asbestos. This certificate is mandatory before approval will be issued. Submittals furnished without the asbestos-free certification will be returned to the Contractor with no action taken until such certification is provided.

1.05 SUBSTITUTION OF EQUIPMENT

- A. All proposed substitutions for specified products on this project (except as listed above) require approval in advance of bidding. Approval will not be granted after award of contract. See Substitution Request Form in the bidding documents at the beginning of these specifications for the appropriate approval form. If no form is found, submit by mail, or hand-carried on contractor's or supplier's letterhead. **DO NOT FAX.** Substitutions must be submitted for review five (5) working days prior to the bid date to be considered.
- B. It is incumbent on the Contractor to submit technical data that will fully establish the equality of the proposed substitute equipment with that listed and evidence to substantiate the availability of the required repair and maintenance service. Each request for substitution shall be accompanied by the following information for each piece of equipment:
 - 1. Statement indicating that this substituted equipment will not increase the contract cost nor extend the completion date.
 - 2. Manufacturer's name and model number.
 - 3. Catalog cuts, diagrams and other data published by the manufacturer with the particular model identified and the pertinent design data for that model highlighted or underlined for easy reference.
 - 4. Each request for substitution shall also include the following information relating to service maintenance and repair:
 - a. Name, address and telephone number of nearest factory authorized technical representative.

- b. Name, address and telephone number of firm(s) qualified to perform preventive maintenance, minor or major repairs in the locale of the project.
 - c. Name, address and telephone number of firm(s) from whom spare parts and major components are available.
 - d. Building name and address, and the name, address and telephone number of its owner's representative where equipment of the same manufacturer as that requested for substitution has been installed and in operation for two or more years. Two or more such installations shall be listed and the location should be in the vicinity of the proposed project.
- C. In the event of Engineer's approval of a substitution of equipment, the requesting entity will be notified by telephonic message or FAX by the Engineer (or authorized representative), and/or by the issuance of an amendment to the contract documents incorporating the equipment by name and model number.

1.06 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with the NEC (NFPA-70), Latest Edition.

1.07 DEFINITIONS

- A. FURNISH: The term furnish means supply and deliver to the Project Site, ready for unloading, unpacking, assembly, installation and similar operations.
- B. INSTALL: The term install describes operations at the Project Site including the actual unloading, unpacking, assembly, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations.
- C. PROVIDE: The term provide means to furnish and install, complete and ready for intended use.

1.08 RECORD DOCUMENTS

- A. Prepare record documents in accordance with the requirements in Division 1. In addition to the requirements specified in Division 1, indicate installed conditions for:
 - 1. Major raceway systems, size and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.
 - 2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 - 3. Approved substitutions, Contract Modifications, and actual equipment and materials installed.

1.09 MAINTENANCE MANUALS

- A. Prepare maintenance manuals in accordance with Division 1. In addition to the requirements specified in Division 1, include the following information for equipment items:
 - 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 - 2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
 - 3. Maintenance procedures for routine preventative maintenance and trouble-shooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 - 4. Servicing instructions and lubrication charts and schedules.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

1.11 GUARANTEES AND WARRANTIES

- A. Submit to the Owner, two copies of all warranties and guarantees specified in the General Conditions, Supplementary Conditions, the individual sections of the specifications, or as provided by the various subcontractors and material suppliers. All such documents shall show the name and location of the project and the name of the purchaser.
- B. The Contractor shall provide to the Owner a non-prorated guarantee of all materials and workmanship for a period of not less than one year from the date of the Owner's final certificate.
- C. The Contractor shall be responsible for enforcing all special or extended guarantees required in individual sections of the specifications that might be provided by various subcontractors or material suppliers.
- D. Acceptance of the work under this Division shall be subject to the conditions that all installed systems, equipment, apparatus, and appliances included in the work shall operate and perform as designed, including code clearances, and as selected with respect to efficiency, capacity and quietness and shall operate and perform without producing objectionable noise within occupied areas of the building.
- E. Acceptance of the work shall also be subject to the conditions that any time within one year after date of final payment, any defective part of the work resulting from the supply

of faulty workmanship or material shall be immediately amended, repaired or replaced as a part of the contract work without cost to the Owner.

- F. This guarantee shall be extended to include the capacity and integrated performance of the component parts of the various systems in strict accordance with the true intent and purpose of the specification. The contractor shall conduct such tests as herein before specified or as may be required by the Engineer to demonstrate the capacity and performance ability of the various systems to maintain specified conditions.
- G. Exclusions: lamps furnished by the Contractor shall be guaranteed for their rated life, not to exceed one year from the date of final acceptance. Lamps failing to meet the rated life shall be replaced by the Contractor. Replacement lamps shall be furnished to the Owner and installation of the replacement lamps shall be by the Owner.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION

3.01 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in Divisions 2 through 16 for rough-in requirements.

3.02 ELECTRICAL INSTALLATIONS

- A. Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
 - 1. Coordinate electrical systems, equipment, and materials installation with other building components.
 - 2. Verify all dimensions by field measurements.
 - 3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
 - 4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
 - 5. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.
 - 6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

7. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
 8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer.
 9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
 10. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
 11. Install access panel or doors where units are concealed behind finished surfaces.
 12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
 13. Prior to energizing, verify that all equipment is suitable for the voltage being applied.
- B. The permanent light fixtures shall not be used for temporary lighting. They may be used for lighting the work space only after they are permanently installed, wired and the building is receiving the final finishes.

3.03 CUTTING AND PATCHING

- A. Perform cutting and patching in accordance with Division 1. In addition to the requirements specified in Division 1, the following requirements apply:
1. Perform cutting, fitting, and patching of electrical equipment and materials required to:
 - a. Uncover work to provide for installation of ill-timed work.
 - b. Remove and replace defective work.
 - c. Remove and replace work not conforming to requirements of the Contract Documents.
 - d. Remove samples of installed work as specified for testing.

- e. Upon written instructions from the Engineer, uncover and restore work to provide for Engineer observation of concealed work.
- 2. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
- 3. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
- 4. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

END OF SECTION 16010

DIVISION 16 – ELECTRICAL

SECTION 16110 - RACEWAYS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings.
- B. General Provisions of the Contract.
- C. Solicitation Documents.
- D. General Conditions.
- E. Supplementary Conditions.
- F. Division 1.
- G. Section 16010 – “Basic Electrical Requirements”.

1.02 WORK INCLUDES

- A. Raceways for all conductors, including, but not limited to, that required for service, feeders, branch circuit power, lighting and HVAC system control wiring.
- B. Identification of all raceways.

1.03 SUBMITTALS

- A. Submit shop drawings in accordance with Section 16010 - “BASIC ELECTRICAL REQUIREMENTS.”

1.04 QUALITY ASSURANCE

- A. All materials shall be new without blemish or defect, in accord with standards specified and UL listed or labeled.

1.05 SYSTEM DESCRIPTION

- A. Raceways Include:
 - 1. Rigid Metal conduit and fittings.
 - 2. Intermediate metal conduit and fittings.
 - 3. Flexible metallic conduit and fittings.
 - 4. Liquidtight flexible conduit and fittings.
 - 5. Electrical metallic tubing and fittings.
 - 6. Rigid non-metallic conduit and fittings.

7. Liquidtight flexible metallic tubing and fittings.

1.06 REFERENCES

- A. Specified references, or cited portions thereof, current at date of bidding documents unless otherwise specified, govern the work.
- B. American National Standards Institute (ANSI):
 1. C80.1 - Rigid Steel Conduit, Zinc coated
 2. C80.3 - Electrical Metallic Tubing, Zinc coated
 3. C80.4 - Fittings for Rigid Metal Conduit and Electrical Metallic Tubing
- C. American National Standards Institute/National Electrical Manufacturers Association (ANSI/ NEMA): FB 1 - Fittings and Supports for Conduit.
- D. American National Standards Institute/National Electrical Manufacturers Association (ANSI/ NEMA): ANSI C1/NFPA 70 - National Electrical Code, Latest Edition.
- E. Federal Specifications (FS):
 1. FS-WW-C-563 - Electrical Metallic Tubing (EMT)
 2. FS-WW-C-566 - Flexible Metal Conduit
 3. FS-WW-C-581 - Galvanized Rigid Conduit (GRS)
- F. National Electrical Manufacturers Association (NEMA):
 1. NEMA TC-3 - PVC Fittings for use with Rigid PVC Conduit and Tubing.
- G. Manufacturers' Catalogs: Specified manufacturers' catalogs are incorporated by reference to same force and effect as if repeated herein in full.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Materials shall be suitably packaged by manufacturers to prevent damage during shipment. Damaged materials will not be acceptable for use.
- B. Store materials on site in clean, dry storage area or, if outside, elevated above grade and covered.

PART 2 - PRODUCTS

2.01 RACEWAYS

A. Conduit:

1. Steel Rigid Metal: Comply with ANSI C80.1, FS-WW-C-581 and UL-6.
2. Intermediate Metal: Comply with ANSI C80.1, FS-WW-C-581 and UL-6.
3. Steel Flexible Metal: Comply with FS-WW-C-566 and UL-1.
4. Steel Liquidtight Flexible: Comply with FS-WW-C-566 and UL-1.
5. Rigid Nonmetallic: Comply with NEMA TC-2, PVC, Schedule 40.

B. Tubing:

1. Steel Electrical Metallic (EMT): Comply with ANSI C80.3, FS-WW-C-563 and UL 797.

2.02 FITTINGS

A. Rigid and IMC Conduit fittings and conduit bodies:

1. Comply with ANSI C80.4, ANSI/NEMA FB 1, threaded type.
2. Locknuts; steel or malleable iron.
3. Bushings; insulating or insulated throat type.
4. Couplings; threaded or gland compression malleable iron type. Set screw or indenter type not acceptable.
5. UL listed hazardous location fittings (with sealing compound).

B. Electrical Metallic Tubing fittings and conduit bodies:

1. Couplings and Connectors; steel compression type or zinc die cast set screw type. Comply with ANSI/NEMA FB 1.

C. Flexible conduit fittings and conduit bodies:

1. Connectors; malleable iron, threadless, squeeze clamp type for nonjacketed conduit.
2. Connectors; steel or malleable iron compression type with insulated throat and "O" ring assembly for liquidtight conduit.
3. Comply with ANSI/NEMA FB 1.

D. Nonmetallic conduit fittings and conduit bodies:

1. Comply with NEMA TC 3.

2.03 CONDUIT SEALING

A. Fire Seal: Seal penetrations of fire-rated walls, floors or ceilings by raceways for compliance with NEC 300-21. Fill void around raceway. Use heavy wall steel pipe sleeves, anchored to building construction and finished plumb with wall, ceiling or floor lines.

B. Thermal Seal:

1. Seal penetrations of thermally insulated equipment (such as walk-in coolers or freezers) or rooms to prevent heat transfer. Exterior of raceway with fiberglass. Interior of raceway at entry to equipment or room with explosion-proof seal fittings filled with U.L. listed sealing compounds.

C. Water Seal:

1. Seal penetrations of perimeter walls or floors below grade to prevent entry of water. Use materials compatible with wall or floor construction and reviewed by Engineer's Representative. Use pre-manufactured fittings.
2. Seal penetrations of roof with flashings compatible with roof design and reviewed by Roofing System Manufacturer and Engineer's Representative.

2.04 RACEWAY SUPPORTING DEVICES

A. Suspended conduits less than 1 inch.

1. For exposed construction, provide strap type hangers supported from beam clamps or threaded rods.
2. For conduits suspended above ceilings, anchor to building structural steel. When span exceeds NEC limits, provide channel steel between framing members. Tie wiring of conduit to air ducts, or other piping not permitted. Plumber's perforated strap not permitted.

B. Suspended Conduit 1" or larger.

1. Provide threaded rod with "U" type hangers for single conduit.
2. Provide trapeze hanger assemblies with Unistrut P-1000, Husky HP-200 or Kindorf B-901 and threaded rod for two or more conduits. Anchor conduits to hanger assembly with split pipe clamps.
3. Anchor threaded rod to inserts in concrete or beam clamp on steel structure.

C. Surface Mounted Conduit:

1. Provide one-hole galvanized steel straps for conduits one inch or less manufactured by Appleton, Steel City or RACO. Provide clampbacks on exterior walls below grade or in wet areas.
2. For conduit larger than one inch and all exterior surfaces, use malleable iron pipe straps.
3. For multiple conduits, provide channel anchored to wall with conduit attached to channel with split pipe clamps.

D. Surface Metallic Raceways

1. Provide two-hole straps matching raceway.

E. Anchoring:

1. Hollow Masonry: Toggle bolts or spider type expansion anchors.
2. Solid Masonry: Lead expansion anchors or preset anchors.
3. Concrete: Self-drilling anchor or powder driven studs.
4. Metal: Machine screws, bolts or welded studs.
5. Wood: Wood screws.

2.05 ACCEPTABLE MANUFACTURERS

A. Raceways

1. Allied Tube and Conduit.
2. Anaconda.
3. B-line.
4. Carlon.
5. Certain-Teed Corp.
6. Electri-Flex.
7. ETP.
8. International Metal Hose.
9. Jones & Laughlin Steel.
10. Republic Steel.
11. Robintech.
12. Steelduct Conduit Products.
13. Square D.
14. Triangle.
15. Walker.
16. Wheatland Tube.
17. Wiremold.
18. Youngstown Steel.

B. Fittings

1. Carlon.
2. Crouse-Hinds.
3. Killark.
4. O.Z./Gedney.
5. RACO.
6. Steel City.

C. Conduit Sealing

1. Chase Technology-CTC, PR-855.
2. Dow Corning - Silicone RTV foam 3-6548.
3. Nelson - Flameseal.
4. T & B - Flamesafe.
5. 3M - Fire Barrier.

D. Conduit Supporting Devices

1. Crouse-Hinds.
2. Midwest Electric.
3. Minerallac.
4. T & B.

PART 3 - EXECUTION

3.01 INTERFERENCES

- A. Coordinate work with other trades so that interference between piping, equipment, structural and electrical work will be avoided.
- B. When interference develops, Engineer's Representative will decide which equipment will be relocated; regardless of which apparatus was installed first.

3.02 CONDUIT SIZING, ARRANGEMENT, AND SUPPORT

- A. In general, conduit shall be concealed within walls, ceilings, and floors. Conduit in spaces such as electrical/mechanical equipment rooms may be exposed.
- B. Size conduit for conductor type installed; 3/4" minimum size unless noted otherwise.
- C. Arrange conduit to maintain headroom and present a neat appearance.
- D. Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.

- E. Maintain minimum 6" clearance between conduit and uninsulated piping. Maintain 12" clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.
- F. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized straps, lay-in adjustable hangers, clevis hangers, or bolted split stamped galvanized hangers.
- G. Group conduit in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps. Provide space for 25% additional conduit.
- H. Do not fasten conduit with wire or perforated pipe straps. Remove all wire used for temporary conduit support during construction, before conductors are pulled.
- I. Do not support any conduits, boxes, or any other electrical work directly from underside of roof deck without written consent of the engineer.
- J. Do not support any conduit from the ceiling grid or the ceiling grid support wires.

3.03 CONDUIT INSTALLATION

- A. All conduits in finished spaces shall be concealed unless otherwise noted.
- B. Cut conduit square using a saw or pipe cutter; de-burr cut ends.
- C. Bring conduit to the shoulder of fittings and couplings and fasten securely.
- D. Use conduit hubs or sealing locknuts for fastening conduit to cast boxes, and for fastening conduit to sheet metal boxes in damp or wet locations.
- E. Install no more than the equivalent of four 90° bends between boxes. (Two 90° bends for telephone conduits, data conduits, and sound system conduit).
- F. Use conduit bodies to make sharp changes in direction, as around beams.
- G. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2" size.
- H. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.
- I. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.
- J. Provide #12 AWG insulated conductor or nylon pull string in empty conduit, except sleeves and nipples.
- K. Provide UL listed expansion-deflection joints where conduit crosses building expansion or seismic joints.

- L. Where conduit penetrates fire-rated walls and floors, provide mechanical fire-stop fittings with UL listed fire rating equal to wall or floor rating, or, at contractor's option, seal opening around conduit in accord with paragraph 2.03.
- M. Route conduit through roof openings for piping and ductwork where possible. Provide flashing making waterproof joints where conduits pass through roof or roofing membrane.
- N. Maximum Size Conduit within floor slabs: $\frac{3}{4}$ ". Do not route conduits to cross each other in slabs. Run larger conduits below floor slabs or above ceilings.
- O. Thermally seal conduit where conduits leave heated area and enter unheated area. See 2.03.
- P. Wipe plastic conduit clean and dry before joining. Apply full even coat of cement to entire area that will be inserted into fitting. Let joint cure for 20 minutes minimum.

3.04 CONDUIT INSTALLATION SCHEDULE

- A. Underground Installations: Rigid steel conduit. Plastic-coated rigid steel conduit. Schedule 40 PVC conduit.
- B. Installations In or Under Concrete Slab: Schedule 40 PVC conduit.
- C. In Slab above Grade: Schedule 40 PVC conduits.
- D. Exposed Outdoor Locations: Rigid steel conduit. Intermediate metal conduit.
- E. Interior Locations Above Floor Slabs: Rigid steel conduit. Intermediate metal conduit. Electrical metallic tubing.
- F. Where nonmetallic conduits is used in or below slab or underground, continue the conduit runs above slab or grade using IMC or rigid steel conduit.
- G. Provide a green insulated equipment grounding conductor in all feeder and branch circuit raceways. Size conductor according to NEC Article 250.
- H. Connections to lighting fixtures: Flexible Metallic Conduit, UL listed Fixture Whip or Type MC Cable. Provide green insulated equipment grounding conductor. Length not to exceed 6'.
- I. Connections to food service equipment, equipment in exterior locations or equipment in wet locations: Liquidtight flexible conduit. Provide green insulated equipment grounding conductor. Length not to exceed 4'.
- J. Connection to motors, compressors or equipment with motors: Flexible Metallic Conduit. Provide green insulated equipment grounding conductor. Length not to exceed 4'.

END OF SECTION 16110

DIVISION 16 – ELECTRICAL
SECTION 16120 - WIRES & CABLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings
- B. General Provisions of the Contract
- C. Solicitation Documents
- D. General Conditions
- E. Supplementary Conditions
- F. Division 1
- G. Section 16010 – “Basic Electrical Requirements”

1.02 WORK INCLUDES

- A. Wiring and cables including, but not limited to, feeders, branch circuit power, lighting and control.
- B. Electrical connections to all equipment unless noted otherwise.

1.03 SUBMITTALS

- A. Submit shop drawings in accordance with Section 16010 - “BASIC ELECTRICAL REQUIREMENTS.”

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Wire, cable and installation thereof shall be in accord with the National Electrical Code, Latest Edition.
 - 2. All materials shall be new, without blemish or defect, in accord with standards specified and UL listed or labeled.
 - 3. Test power and signal wire and cable according to Section 16950 - “TESTING”.

1.05 REFERENCES

- A. Specified references, or cited portions thereof, current at date of bidding documents unless otherwise specified, govern the work.
- B. National Electrical Manufacturers Association (NEMA):
 - 1. WC 3 - Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

- 2. WC 5 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- 3. WC 7 - Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- C. National Fire Protection Association (NFPA): NFPA 70 - National Electrical Code, Latest Edition.
- D. Underwriters' Laboratories, Inc. (UL): Listed and labeled materials.
- E. Manufacturers' Catalogs: Specified manufacturers' catalogs are incorporated by reference to same force and effect as if repeated herein in full.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Materials shall be suitably packaged by manufacturer to prevent damage during shipment. Damaged materials will not be acceptable for use.
- B. Store materials on site in clean, dry storage area.
- C. Handle all materials carefully to preclude damage. Material with damaged insulation shall not be acceptable for use.

PART 2 - PRODUCTS

2.01 BUILDING WIRE

- A. Thermoplastic insulated building wire: NEMA WC 5, UL-83 ICEA S-61-402 or S-66-524.
- B. Feeders and branch circuits: Copper, stranded conductor, 600 volt insulation THHN/THWN. (Exception: Wire sizes #10 AWG and smaller shall be solid.)
- C. Aluminum conductors are not allowed.
- D. Control circuits: Copper, solid or stranded conductor, 600 volt insulation, THHN/THWN.
- E. Provide 1" wide taped, colored bands at panelboards, cabinets, and boxes for sizes larger than #8 AWG. Identify both phase and circuit numbers at these locations.

2.02 JOINTS & SPLICES

- A. Make terminations, taps and splices with an indent type pressure connector with insulating cover for #8 AWG and smaller.
- B. Instead of indent type connectors, insulated spring compression connectors may be used for #10 AWG and smaller.

- C. Use mechanical compression or bolted type connector for #6 AWG or larger. Cover connector with insulating tape or heat shrinkable insulation equivalent to 150% conductor insulation.

2.03 TYPE MC CABLE

- A. Type MC Cable shall meet the following:
 - 1. UL 1569 Standard for Metal-Clad Cables.
 - 2. UL Standard 83 for Thermoplastic-Insulated Wires and Cables or UL Standard 44 for Thermoset-Insulated Wires and Cables.
 - 3. UL Standard 1479 Standard for Fire Tests of Through-Penetration Firestops.
 - 4. UL Classified 1, 2, and 3 Hour Through-Penetration Firestop Systems.
 - 5. All Type MC cable shall comply with National Electrical Code.
 - 6. Rated for air-handling space installations.
- B. MC Cable Fittings: Type MC Cable connectors shall comply with UL 514B Standard for Conduit, Tubing, and Cable Fittings.
- C. Conductors:
 - 1. Conductors: Soft-drawn solid copper conductors shall be permitted for #14, #12, and #10 AWG conductor sizes.
 - 2. Insulation: The conductors shall be constructed with THHN insulation rated for 90°C dry and rated for 600 volts.
 - 3. An equipment ground wire shall be included with all Type MC Cable.

2.04 ACCEPTABLE MANUFACTURERS

- A. Building Wire
 - 1. Anaconda Wire & Cable Co.
 - 2. Crescent.
 - 3. General Cable Corp.
 - 4. General Electric Co.
 - 5. Okonite.
 - 6. Phelps Dodge Cable & Wire Co.
 - 7. Pirelli.
 - 8. Sigma Corra-Clad (MC Cable).
 - 9. Triangle.

- B. Joints and Splices - Indent Type Pressure Connector for #8 AWG and Smaller
 - 1. Buchanan.
 - 2. Burndy.
 - 3. Ideal.
 - 4. Thomas & Betts.

- C. Joints and Splices - Insulated Spring Compression Connectors for #10 AWG and Smaller
 - 1. Buchanan, Bcap.
 - 2. Ideal, Wing nut.
 - 3. ITT Holub, Free Spring.
 - 4. T & B, Piggy.
 - 5. 3M, Scotchlok.

- D. Joints and Splices - Mechanical Compression or Bolted Type Connector for #6 AWG or Larger
 - 1. AMP, Inc.
 - 2. Anderson.
 - 3. Blackburn.
 - 4. Burndy Corp.
 - 5. General Electric Co.
 - 6. Ideal Industries.
 - 7. ITT Weaver.
 - 8. O.Z./Gedney Co.
 - 9. T & B.
 - 10. 3M Co.

- E. Type MC Cable
 - 1. Allied Tube and Conduit.
 - 2. Southwire.
 - 3. The Okonite Company.
 - 4. General Cable.

PART 3 - EXECUTION

3.01 BASIC WIRING

- A. All wiring with a circuit voltage in excess of 24 volts, all exposed wiring, and all fire alarm system wiring shall be installed in a raceway.

- B. Use no wire smaller than #12 AWG for power and lighting circuits (unless scheduled otherwise on construction documents), and no smaller than #14 AWG for control wiring for fused control circuits.

- C. Multi-wire branch circuits will only be permitted for general use receptacle circuits and individual branch circuits. All other circuits shall have individual neutrals (where a neutral is required).
- D. Splice only in accessible junction or outlet boxes. Do not splice in panelboard cabinets and gutters.
- E. Neatly train and lace wiring inside boxes, equipment and panelboards.
- F. Make conductor lengths for parallel circuits equal.

3.02 TYPE MC CABLE

- A. Type MC Cable is an acceptable wiring method for connections to recessed lighting fixtures and/or equipment at a maximum length of 72" dedicated to each connection.
- B. Neat and Workmanlike Installation: Type MC Cable shall be installed parallel or perpendicular to walls and building structure. No diagonal runs shall be permitted.
- C. Install per the manufacturer's installation instructions.
- D. Secure and support at intervals not exceeding six feet unless otherwise permitted in the National Electrical Code.
- E. Bends in Type MC Cable shall be made so that the cable will not be damaged. The radius of the curve of the inner edge of any bend should not be less than seven times the cable diameter.
- F. Type MC Cable will not be permitted to be installed in exposed locations.

3.03 WIRING 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. Install wire in raceway after interior of building has been physically protected from weather, all plumbing, heating and ventilating work likely to injure conductors completed, conduit system is complete and interior of raceway cleaned.

3.04 OPEN WIRING

- A. Open wiring shall be routed in a neat and orderly manner. Wiring shall be routed parallel or perpendicular to structural lines and be supported at intervals necessary to avoid sagging or strain.
- B. Where a cable tray system is not specified, wiring shall be supported by the use of individual cable support "rings", "hooks" or other methods approved by the engineer.

3.05 CONNECTIONS AND TERMINATIONS

- A. Identify each conductor in panelboards, junction or pull boxes, or troughs with a permanent pressure sensitive label with suitable numbers or letters for easy recognition. Identify control wiring at each end and in junction boxes with numeric wire number corresponding to control wiring diagram. See Section 16195 - "ELECTRICAL IDENTIFICATION", for identification requirements.
- B. Thoroughly clean wire before installing lugs and connectors.
- C. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
- D. Terminate spare conductors with electrical tape and roll up in box.

3.06 FIELD QUALITY CONTROL

- A. Inspect wiring for physical damage and proper connection.
- B. Torque test conductor terminations to manufacturer's recommended values.
- C. Perform continuity test on all power and branch circuit conductors. Verify proper phasing.

END OF SECTION 16120

DIVISION 16 – ELECTRICAL

SECTION 16130 - BOXES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings
- B. General Provisions of the Contract
- C. Solicitation Documents
- D. General Conditions
- E. Supplementary Conditions
- F. Division 1
- G. Section 16010 – “Basic Electrical Requirements”

1.02 WORK INCLUDES

- A. Provide all boxes for the work.
- B. Provide coordination of boxes requiring access with General work.
- C. General Construction Trades provide access panels for boxes hidden by building construction.

1.03 SUBMITTALS

- A. Submit shop drawings in accordance with Section 16010 - “BASIC ELECTRICAL REQUIREMENTS.”

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements
 - 1. Comply with NFPA. National Electrical Code, Latest Edition.
 - 2. Provide materials listed/labeled by UL.

1.05 SYSTEM DESCRIPTION

- A. Boxes include:
 - 1. Wall and ceiling outlet boxes.
 - 2. Floor Boxes.
 - 3. Pull and junction boxes.
 - 4. HVAC control device boxes.

1.06 REFERENCES

- A. Specified references, or cited portions thereof, current at date of bidding documents unless otherwise specified, govern the work.
- B. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA OS 1-Sheet Steel Outlet Boxes, Device Boxes, Covers and Box Supports).
- C. National Electrical Manufacturers Association (NEMA): NEMA 250 - Enclosures for Electrical Equipment.
- D. National Fire Protection Association (NFPA): NFPA 70 - National Electrical Code, Latest Edition.
- E. Manufacturers' Catalogs: Specified manufacturers' catalogs are incorporated by reference to same force and effect as if repeated herein in full.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Materials shall be suitably packaged by manufacturer to prevent damage during shipment. Damaged materials not acceptable for use.
- B. Store materials on site in clean, dry storage area.
- C. Handle all materials carefully to preclude damage.

PART 2 - PRODUCTS

2.01 BOXES

- A. Pull Boxes and Junction Boxes:
 - 1. Comply with NEC - 370, UL 50 and ANSI/NEMA OS 1; galvanized steel.
 - 2. Flush mounted boxes: Overlapping cover with flush head retaining screws, prime-coated.
 - 3. Surface mounted boxes: Screw-on or hinged cover. Provide silicon bronze standard retaining screws.
 - 4. Boxes in finished areas: Constructed of 14 gauge steel minimum, galvanized or prime coated.
 - 5. Boxes greater than 144 square inches: Shall be constructed of 1½" x 1½" x ¼" galvanized angle covered with 10 gauge galvanized sheet steel riveted or bolted with hinged cover of 11 gauge galvanized steel.
 - 6. Boxes larger than 12" in any dimension: hinged enclosure.

7. Exterior Below Grade: Non-metallic, sand-gravel polymer base fiberglass reinforced.

B. Outlet Boxes:

1. Hot dipped galvanized, 1.25 oz. per sq. ft., sherardized or cadmium plated. Conform to UL 514.
2. Interior boxes: Sheet steel with conduit knockouts, attached lugs for locating. ANSI/NEMA OS 1.
3. Exterior boxes or exposed interior in wet/damp locations: Cast aluminum, deep type, corrosion proof fasteners, watertight, gasketed, threaded hubs.
4. For suspended or surface mounted fixtures:
 - a. 4" octagonal or square according to devices used. Minimum 1½" deep. Furnished with fixture studs. Installed with ¾" minimum depth plaster rings on suspended ceilings. 4" octagonal or square for all exposed conduit work with fixture extension pan or deep fixture canopy to enclose the box.
 - b. Fixtures listed for thru-way wiring may be used as such without an outlet box.
5. For recessed fixtures:
 - a. 4" octagonal or square. Minimum 1½" deep. Complete with blank cover.
 - b. Fixtures listed for thru-way wiring may be used as such without an outlet box.
6. Switch and Receptacle Boxes:
 - a. Wall: 4" square for up to two devices. Single gang with 18 cubic inch minimum capacity for one device. Solid gang boxes for two devices. Complete with 1" minimum depth tile ring where used in exposed tile, paneled walls. Complete with 1" minimum depth plaster ring where used in plastered walls. Install with ½" raised galvanized device covers where used for exposed conduit work. Provide concrete-tight masonry boxes in poured concrete or CMU walls.

C. Conduit Bodies:

1. Galvanized cast metal of type, shape and size to fit location.
2. Constructed with threaded conduit ends, removable cover, corrosion resistant screws.

D. Floor Boxes

1. Single Service Floor Boxes.

- a. Deep, cast iron with leveling legs meeting U.L. 714 and Fed. Spec. W-C-583b.
- b. Rectangular, multi-gang compartmental type, semi-adjustable, cast iron, deep.
- c. Brass flanges and covers.
 - 1) 1½" x 1½" duplex threaded cover for duplex power receptacles.
 - 2) 2_ " x ¾" combination threaded cover for telephone outlets and other signal outlets. Provide 2_ " threaded brass split nozzle for cable protection.

2. Multi-service Floor Boxes:

- a. Floor boxes shall be multiple services and shall be activated with services recessed.
- b. Floor box unit shall be constructed of a cast-iron base, a steel cover-plate, and steel wiring compartment cover to allow wiring feed-thru from one compartment to another.
 - 1) Cast-iron base shall be .188" min.
 - 2) Cover-plate shall be galvanized steel (14 ga.).
 - 3) Steel receptacle brackets shall be .062" min.
- c. Box construction shall be as required by UL 514A.
- d. Entire cover-plate shall be removable for unrestricted access to all connector locknuts inside base.
- e. Unit shall contain 4 wiring compartments (enclosed and/or non-enclosed).
- f. Total box volume shall be 215 cu. in. and shall be broken down as follows:
 - 1) 2 compartments - 27 cu. in. each.
 - 2) 2 compartments - 36 cu. in. each.
- g. Size and quantity of threaded conduit openings shall be as follows:

- 1) 2 - 27 cu. in. compartments - one $\frac{3}{4}$ ".
- 2) 2 - 36 cu. in. compartments - two $1\frac{1}{4}$ " and one $\frac{3}{4}$ ".
- h. Hand access area shall be no less than 38 sq. in.
- i. Unit shall provide for minimum of 1_" pre-pour adjustment and $\frac{3}{4}$ " post-pour adjustment.
- j. Floor box unit shall be capable of being activated in either the flush or recessed mode.
- k. Recessed activations shall provide no less than 2 wire/cable egress points. These shall include wire management blocks to adequately control wire/cables.
- l. Activation units shall be as selected by the Engineer.

2.02 ACCEPTABLE MANUFACTURERS

- A. Appleton Electric Co.
- B. Crouse-Hinds Co.
- C. General Electric Co.
- D. Hoffman Co.
- E. Hubbell.
- F. Killark Electric Mfg. Co.
- G. O.Z./Gedney Co.
- H. Pyle-National.
- I. RACO.
- J. Square D.
- K. Steel City.
- L. Thomas & Betts Co.
- M. Walker.
- N. Quazite.

PART 3 - EXECUTION

3.01 COORDINATION

- A. Provide boxes as shown and for splices, taps, wire pulling, equipment connections and code compliance.
- B. Locations shown are approximate unless dimensioned. Verify location of boxes and outlets prior to rough-in.
- C. Locate boxes to allow access. When inaccessible, provide access doors.
- D. Locate boxes to maintain headroom and present a neat appearance.

3.02 INSTALLATION

- A. Provide knockout closures to cap unused knockout holes where blanks have been removed.
- B. Support all boxes independently of conduit except for cast boxes connected to two rigid conduits both supported within 12" of box.
- C. Floor Boxes:
 - 1. Confirm exact placement with related work before installing. Set level and flush with finish floor. Securely anchor box to avoid movement during concrete pour.
 - 2. Securely anchor to floor box.
- D. Outlet Boxes:
 - 1. Flush mount outlet boxes in areas other than mechanical rooms, electrical rooms, and above removable ceilings.
 - 2. Do not install boxes back-to-back in same wall. Provide at least 6" separation where possible.
 - 3. Masonry Walls:
 - a. Adjust position of outlets in finished masonry walls to suit masonry course lines.
 - b. Coordinate cutting of walls to achieve neat openings for boxes.
 - c. Locate boxes in walls so that only corner need be cut from masonry units.
 - d. Use only concrete tight masonry boxes in all masonry walls.
 - 4. Use multiple gang boxes where more than one device is mounted together. Do not use sectional boxes. Provide barriers to separate different voltage systems.
 - 5. For boxes mounted in exterior walls, make sure insulation is behind outlet boxes. Do not damage insulation.
 - 6. For outlets mounted above counters, benches, or backsplashes, coordinate location and mounting heights with units. Where boxes are mounted on sidewalls at counters and lavatories, hold boxes to front of counter or lavatory for handicapped accessibility.
 - 7. Adjust outlet mounting height to agree with specified location for equipment served.
 - 8. Position outlets to locate luminaires as shown on reflected ceiling drawings.

9. Position outlets and junction boxes in inaccessible ceilings areas within 6" of luminaire; accessible through luminaire ceiling opening.
 10. Provide recessed boxes in finished areas; secure to interior wall and partition studs, allow for surface finish thickness. Use stamped steel stud hangers in hollow stud wall, and adjustable steel channel fasteners for flush ceiling boxes.
 11. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
 12. Provide cast boxes for exterior locations and wet locations.
- E. Pull and Junction Boxes:
1. Locate above accessible ceilings or in unfinished areas.
 2. Support independent of conduit.
- F. HVAC Control Device Boxes:
1. Coordinate quantity, location and size required with HVAC/temperature controls contractor.
- G. Provide covers for all boxes.

END OF SECTION 16130

DIVISION 16 – ELECTRICAL
SECTION 16150 - WIRING DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings
- B. General Provisions of the Contract
- C. Solicitation Documents
- D. General Conditions
- E. Supplementary Conditions
- F. Division 1
- G. Section 16010 – “Basic Electrical Requirements”
- H. Section 16120 – “Wires and Cables”
- I. Section 16130 – “Boxes”

1.02 WORK INCLUDES

- A. Provide:
 - 1. Switches
 - 2. Receptacles
 - 3. Device plates
 - 4. Occupancy sensors switches

1.03 SUBMITTALS

- A. Submit shop drawings in accordance with Section 16010 - “BASIC ELECTRICAL REQUIREMENTS.”

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements: All materials: U.L. listed or labeled.

1.05 REFERENCES

- A. Specified references, or cited portions thereof, current at date of bidding documents unless otherwise specified, govern the work.
- B. National Electrical Manufacturers Association (NEMA):
 - 1. WD-1 - General Purpose Wiring Devices.
 - 2. WD-5 - Specific Purpose Wiring Devices.

- C. National Fire Protection Association (NFPA): NFPA 70 - National Electrical Code (NEC), Latest Edition.
- D. Underwriters' Laboratories, Inc. (UL): All materials UL listed and labeled.
- E. Federal Specification WC596F (Receptacles) and WS896E (Switches).
- F. Manufacturers' Catalogs: Specified manufacturers' catalogs are incorporated by reference to same force and effect as if repeated herein in full.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Materials shall be suitably packaged by manufacturer to prevent damage during shipment. Damaged materials will not be acceptable for use.
- B. Store materials on site in clean, dry storage area.
- C. Handle all materials carefully to preclude damage during installation.

PART 2 - PRODUCTS

2.01 WALL SWITCHES

- A. Manual Switches: Specification Grade, 20-Amp, 120-277-Volt, quiet type, back and side wired, toggle handle. Hubbell #CSB_20 series or equal. Gray color.

2.02 RECEPTACLES

- A. NEMA 5-20 Duplex Receptacles: Heavy Duty Specification Grade, 20-Amp, 125-Volt, finger groove nylon faced, back and side wired. Hubbell #CR5362_ series or equal. Color as scheduled.
- B. NEMA 5-20 Duplex Ground Fault Circuit Interrupter (GFCI) Receptacles: Extra Heavy Duty Industrial Grade, 20-Amp, 125-Volt, flush polyester faced, back and side wired. Hubbell #GFR5362SG_ series or equal. Color as scheduled.
- C. Special purpose devices shall be of amperage rating and configuration for equipment served.

2.03 DEVICE PLATES

- A. Materials:
 - 1. Finished Spaces: .04" thick, type 302, satin finished stainless steel.
 - 2. Weatherproof; Cast metal, gasketed. Provide spring-loaded gasketed door for receptacles.

- 3. Surface Devices in Unfinished Areas: Galvanized steel.
- B. Use plates manufactured by device manufacturer.

2.04 OCCUPANCY SENSOR SWITCHES

- A. Passive Infrared Switches: 120-277-Volt, 1,000 sq. ft. coverage. Hubbell #AP2000_1N series or equal. Gray color.

2.05 ACCEPTABLE MANUFACTURERS

- A. Hubbell
- B. Legrand
- C. Leviton

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install wall switches with OFF position down.
- B. Install convenience receptacles with grounding pole on top when mounted vertically or with grounding pole on left when mounted horizontally.
- C. Install plates on all switch, and receptacle outlets. Install blank plates on all unused boxes.
- D. Install devices and plates flush and level.
- E. Seal all connections on GFCI with seal coat compound and wrap with two layers tape.

END OF SECTION 16150

DIVISION 16 – ELECTRICAL

SECTION 16195 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings
- B. General Provisions of the Contract
- C. Solicitation Documents
- D. General Conditions
- E. Supplementary Conditions
- F. Division 1
- G. Section 16010 – “Basic Electrical Requirements”

1.02 WORK INCLUDES

- A. Provide identification of manual and automatic operable equipment:
 - 1. Safety Switches.
 - 2. Starters.
 - 3. Contactors, relays and time switches.
 - 4. Panelboards & Switchboards.
 - 5. Control panels, relay panels, and special junction boxes.
 - 6. Manual starters and interval timers.
- B. Provide identification of all passive equipment:
 - 1. Terminal Cabinets.
- C. Provide identification of conduit system including boxes.
- D. Provide identification of wiring system.

1.03 QUALITY ASSURANCE

- A. Comply with:
 - 1. ANSI A13.1, Identification of Piping Systems.
 - 2. National Electric Code (NEC), Latest Edition.
 - 3. Local Rules & Regulations.

1.04 REFERENCES

- A. Specified references, or cited portions thereof, current at date of bidding documents unless otherwise specified, govern the work.
- B. American National Standards Institute (ANSI): ANSI A13.1 - Identification of Piping Systems.
- C. National Fire Protection Association (NFPA): NFPA 70 - National Electrical Code (NEC), Latest Edition.
- D. Underwriters' Laboratories, Inc. (UL): All products UL listed and labeled.
- E. Manufacturers' Catalogs: Specification manufacturers' catalogs are incorporated by reference to same force and effect as if repeated herein in full.

1.05 SUBMITTALS

- A. Submit shop drawings in accordance with Section 16010 - "BASIC ELECTRICAL REQUIREMENTS." Provide schedule of proposed identification plate wording for Engineer review.

PART 2 - PRODUCTS

2.01 EQUIPMENT IDENTIFICATION PLATES

- A. Provide plates for all equipment consisting of machine engraved laminated plastic. Plate field shall be black with white core.
 - 1. Size of plate shall be commensurate with lettering thereon.
 - 2. Lettering for major items of equipment, such as a disconnect or panelboard, shall be ½" in height. Lettering for smaller items, such as light or timer switches shall be ¼" in height.
 - 3. Wording on plate shall contain the following information as appropriate and approved by the Engineer.
 - a. Equipment served, such as AHU-1.
 - b. Voltage.
 - c. Originating or controlled circuit number, such as AL 1, 3, & 5.
 - d. Maximum fuse size (if applicable).

2.02 CONDUIT SYSTEM IDENTIFICATION

- A. Identify all fire alarm system components, except those concealed in walls.
 - 1. Conduit: 2" wide red tape or paint strip 50' on center.
 - 2. Boxes: Paint cover red with stenciled words "FIRE ALARM".

2.03 WIRING SYSTEM IDENTIFICATION

- A. Wire Insulation Color: See Section 16120 - "WIRES AND CABLES".
- B. Code all wire and cable larger than color coded sizes available from manufacturer by application of electrical plastic tape in colors specified. Apply tape in uniform manner circling wire or cable. Apply tape in all boxes and cabinets. Half-lap tape for length of cable as required by Local Authorities or NEC. Tape shall be 3M, Plymouth or Permacel.
- C. Maintain consistent coding throughout installation to ensure proper phase identification.
- D. Control wiring may use numbered or lettered marker tape. Record wiring so marked on project record documents. Marker tape shall be 3M Scotch Code, Panduit Insta-Code, T & B E-Z Coder, Stranco Tuff-Code, Bradypack or Electrovert.

2.04 MISCELLANEOUS IDENTIFICATION

- A. Complete all panel directories completely typewritten. Each circuit shall be identified by location and type of load. Example: Lighting - Office.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Affix Equipment Identification Plates to equipment with stainless steel self tapping screws. Do not use adhesive.

END OF SECTION 16195

DIVISION 16 – ELECTRICAL

SECTION 16400 - ELECTRICAL EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings
- B. General Provisions of the Contract
- C. Solicitation Documents
- D. General Conditions
- E. Supplementary Conditions
- F. Division 1
- G. Section 16010 – “Basic Electrical Requirements”

1.02 WORK INCLUDES

- A. Provide:
 - 1. Panelboards
 - 2. Safety Switches
 - 3. Contactors
 - 4. Fuses

1.03 SUBMITTALS

- A. Submit shop drawings, product data, and installation drawings in accordance with Section 16010 - “BASIC ELECTRICAL REQUIREMENTS”.
- B. See Division 1 Complete for requirements for record of “as-built” drawings and specifications for all components.
- C. Panelboard submittals shall include overall dimensions, wiring gutter dimensions, location of the main, branches, and neutral.

1.04 QUALITY ASSURANCE

- A. Regulatory requirements:
 - 1. Panelboards:
 - a. UL Standard 67.
 - b. NEMA Standards PBI-1977.

- c. Fed. Spec. W-P-115A Type 1, Class 1.
- 2. Safety Switches:
 - a. UL Std. 98.
 - b. NEMA Std. KS1-1975.
- 3. Contactors:
 - a. UL Std. 508.
 - b. NEMA Std. 1CSZ-Z11B.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver equipment in time to maintain approved construction schedule.
- B. Store in safe, dry location. Protect from dust, moisture, weather and extreme temperatures.
- C. Follow manufacturer's recommendation for transportation, handling and storage.

PART 2 - PRODUCTS

2.01 PANELBOARDS - LIGHTING AND APPLIANCE

- A. Circuit breaker panelboards shall meet Federal Spec W-P-115A for Type 1 panels. Panelboard bussing may be tinned-aluminum. Circuit breakers shall be quick-make, quick-break, thermal-magnetic, trip indicating, and have common trip on all multi-pole circuit breakers. Trip indication shall be shown by the breaker handle taking a neutral position between ON and OFF when the breaker is tripped. The ampacity of the circuit breaker shall be stamped in a location visible without removing the front of the panelboard. The minimum circuit breaker interrupting capacity shall be as indicated on plans. Circuit breakers shall be plug on type. All circuit breakers on lighting panels shall be UL labeled "SWD" and "HACR". All circuit breakers serving HID loads shall be so rated. Panelboards shall be equal to the style/type shown on schedules.
- B. All terminals shall be UL listed as suitable for the type of conductor specified.
- C. Main lugs shall be bolt type.
- D. Panelboard bus assemblies shall be enclosed in galvanized or rust-resisting steel cabinets. Fronts shall include doors and cylinder tumbler type locks with catches and spring loaded door pulls. All doors shall be keyed alike. Door hinges shall be concealed when panel doors are closed. Fronts shall not be removable with doors locked. A circuit directory frame and card with clear plastic cover shall be locked on the inside of the front. Door and front shall be of code gauge steel with rust inhibiting primer and gray baked enamel finish.

- E. Panelboards shall be provided with the total branch mounting space shown in the schedule.
- F. Panelboards shall have solid neutral and equipment grounding bus. Panels designated for electronic equipment (Cpx) shall have 200% neutral bus.

2.02 PANELBOARDS - POWER DISTRIBUTION CIRCUIT BREAKER (INTERIOR)

- A. Shall be rated 600 volts AC or 250 volts DC maximum. Continuous main current ratings as indicated on associated schedules, not to exceed 1200 amperes maximum. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67.
- B. Provide UL Listed Short Circuit Current Ratings (SCCR) as indicated on the associated schedules, not to exceed the lowest interrupting capacity rating of any circuit breaker installed with a maximum of 200,000 RMS symmetrical amperes. Main lug and main breaker panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Articles 230-F and G.
- C. The bussing shall be fully rated with sequentially phased branch distribution. Panelboard bussing rated 100 - 600 amperes shall be plated aluminum. Bussing rated 800 amperes and above shall be plated copper.
- D. Interior trim shall be of dead-front construction to shield user from all energized parts. Main breakers up to 800 amperes shall be vertically mounted. Main breaker and main lug interiors shall be field convertible for top or bottom incoming feed.
- E. Equipment ground bar shall be bonded. Ground bar shall be aluminum. Solid neutral shall be equipped with a full capacity grounding strap for service entrance applications. Gutter mounted neutral will not be acceptable.
- F. Metal nameplates shall contain system information, catalog number or factory order number. Nameplate shall be secured to the dead-front with rivets or screws. Sticker or foil nameplates are not permitted. Interior wiring diagram, neutral wiring diagram, UL listed label and Short Circuit Current Rating shall be displayed on the interior. Leveling provisions shall be provided for flush mounted applications.
- G. The branch mounting space shown in the panelboard schedules provides provisions for future breakers. Provide provisions equal to the space allowed for the specified panelboards.

2.03 SAFETY SWITCHES

- A. All safety switches shall be the fusible type, horsepower rated, NEMA type, general duty unless otherwise noted on drawings.
- B. Enclosures shall be code gauge steel with rust inhibiting primer and gray baked enamel finish. Install safety switches with NEMA 1 enclosures in dry locations and NEMA 3R enclosures in wet locations.

- C. Switches shall have quick-make, quick-break operating handle and mechanism which shall be an integral part of the enclosure. Switches shall be lockable in both positions and shall have an interlock to prevent opening switch door with handle in the OFF position. This feature shall have a defeater mechanism.
- D. Switch blades shall be visible in OFF position with door open. Switches shall be dead front type with arc suppressors. Lugs shall be UL listed for copper or aluminum. All current carrying parts shall be plated.
- E. Switches shall have a solid neutral unless otherwise noted.
- F. Switches shall have factory installed kits to prevent the use of other than UL class R fuses.

2.04 LIGHTING CONTACTORS

- A. Contactors shall be electrically held and shall switch the load at the voltage required and shall have the quantity of poles required.
- B. The contactor shall be continuously rated per pole for all types of ballast and tungsten lighting and resistance loads, and shall not be de-rated for use on high-inrush loads.
- C. The contactor shall have double-break, silver-cadmium-oxide power contacts. Auxiliary arcing contacts are not acceptable. All power contacts shall be convertible from N.O. to N.C. or vice-versa. All contacts shall have clearly visible N.O. and N.C. contact-status indicators.
- D. The contactor shall be industrial-duty rated for applications to 600 volts maximum.
- E. The contactor shall have NEMA type enclosure as required by installation.

2.05 FUSES

- A. Circuits 601 to 6000 amperes shall be protected by current limiting time-delay fuses. Fuses shall hold 500% of rated current for a minimum of 4 seconds, clear 20 times rated current in .01 seconds or less and be listed by Underwriters' Laboratories, Inc., with an interrupting rating of 200,000 amperes RMS symmetrical. The fuses shall be UL Class L.
- B. Circuits 0 to 600 amperes shall be protected by current limiting dual-element fuses. All dual-element fuses shall have separate overload and short-circuit elements. Fuse shall incorporate a spring activated thermal overload element having a 284°F. melting point alloy and shall be independent of the short-circuit clearing chamber. The fuse shall hold 500% of rated current for a minimum of 10 seconds (30A, 250V Class RK1 case size shall be a minimum of 8 seconds at 500% of rated current) and be listed by Underwriters' Laboratories, Inc., with an interrupting rating of 200,000 amperes RMS symmetrical.
- C. Motor circuits - All individual motor circuits with full load ampere ratings (FLA) of 480 amperes or less shall be protected by dual-element fuses. The fuses shall be UL Class RK1, or J, dual-element time-delay.

- D. The ampere rating of fuses shall be as required by the load served. Field verify by inspecting the nameplate of the equipment being protected.

2.06 ACCEPTABLE MANUFACTURERS

- A. Electrical Equipment
 - 1. Eaton/Cutler-Hammer
 - 2. GE
 - 3. Siemens
 - 4. Square D
- B. Fuses
 - 1. Bussman
 - 2. Mersen

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Prior to energization, confirm that equipment is suitable for voltage to be applied.
- B. Comply with equipment manufacturer's written installation instructions for all equipment.
- C. Install equipment with minimum of 3'-6" working clearance measured from front of enclosure.
- D. Set equipment true and plumb using a carpenter's level.
- E. Support panels adequately in the same manner as described for outlet boxes for different types of construction.
- F. Wiring within equipment cabinets shall be done in a neat and workmanlike manner with branch circuit conductors run along the outside edges of the wiring gutters and then horizontally into the terminals.
- G. For flush mounted panelboards, stub a minimum of three empty ¾" diameter conduits into the ceiling cavity space for future use.
- H. Install safety switches which serve as equipment disconnecting means so that equipment maintenance can be performed within sight of the disconnect, if possible.
- I. When safety switches are mounted directly to equipment in wet locations, the installation shall be watertight. Install sealing locknuts with rubber O-rings for equipment with knockouts.

- J. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std. 486A.
- K. Adjust operating mechanisms for free mechanical movement.
- L. Touch-up scratched or marred surfaces to match original finishes.
- M. Prior to energization of circuitry, check all accessible connections to manufacturer's tightening torque specifications.
- N. Prior to energization of equipment, check with ground resistance tester phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled.
- O. Prior to energization, check equipment for electrical continuity to circuits, and for short-circuits.
- P. Subsequent to wire and cable hook-ups, energize equipment and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.
- Q. Provide engraved plastic nameplates for each switch in main panel, for each panelboard and for each safety switch. Indicate type of load and maximum fuse size. Provide schedule of nameplates with submittals.
- R. Fuses shall not be installed until equipment is ready to be energized.

END OF SECTION 16400

DIVISION 16 – ELECTRICAL
SECTION 16450 - GROUNDING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings
- B. General Provisions of the Contract
- C. Solicitation Documents
- D. General Conditions
- E. Supplementary Conditions
- F. Division 1
- G. Section 16010 – “Basic Electrical Requirements”
- H. Section 16110 - “Raceways”
- I. Section 16120 - “Wires and Cables”

1.02 WORK INCLUDES

- A. Provide system grounding for service to this addition.
- B. Provide equipment grounding.

1.03 SUBMITTALS

- A. Test data. Comply with Division 16 Section 16010 - “SUBMITTALS”.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with National Electrical Code, Latest Edition.
 - 2. Comply with Public Authorities having jurisdiction.

1.05 SYSTEM DESCRIPTION

- A. Ground electrical service neutral at service entrance equipment to the electrode system.
- B. Ground raceways and electrical equipment.
- C. Bond together system neutrals, service entrance enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors and plumbing systems.

1.06 REFERENCES

- A. Specified references, or cited portions thereof, current at date of bidding documents unless otherwise specified, govern the work.
- B. National Fire Protection Association (NFPA): NFPA 70 National Electrical Code (NEC), Latest Edition.
- C. Underwriters' Laboratories, Inc. (UL): All products UL listed and labeled.
- D. Manufacturers' Catalogs: Specification manufacturers' catalogs are incorporated by reference to same force and effect as if repeated herein in full.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Reference 16120 "Wires and Cables"

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Provide a system ground and equipment grounding provisions as shown on plans and as specified in this section. Comply with NEC Article 250.
- B. Equipment grounding provisions shall consist of the following:
 - 1. Exposed, noncurrent-carrying metal parts of fixed equipment likely to become energized, including the following, shall be grounded (bonded):
 - a. Electrical distribution and control equipment enclosures, frames, cabinets, and cutout boxes.
 - b. Metal raceways and boxes.
 - c. Wiring devices.
 - d. Motor frames and enclosures.
 - 2. Cord and plug connected equipment, except for double insulated appliances and other exceptions allowed by the National Electrical Code, shall be grounded.
- C. Equipment grounding conductors shall comply with the following requirements:
 - 1. An equipment grounding conductor shall be installed in all branch circuit and feed raceways.

2. Ground wires shall be run inside the same raceways as the circuit conductors and shall have green insulation of the same type as the circuit conductors. Ground wires shall be bonded to all boxes and equipment enclosures through which they pass and at each end of metal raceways by means of grounding bushings.

3.02 FIELD QUALITY CONTROL

- A. Measure ground resistance from system neutral connection at service entrance to convenient ground reference point using suitable ground testing equipment. Resistance shall not exceed 10 ohms. When resistance exceeds 10 ohms, drive and bond an additional ground rod, one rod length away. Ground resistance test shall be made a minimum of 48 hours after rainfall.

END OF SECTION 16450

DIVISION 16 – ELECTRICAL

SECTION 16500 - LIGHTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings
- B. General Provisions of the Contract
- C. Solicitation Documents
- D. General Conditions
- E. Supplementary Conditions
- F. Division 1
- G. Section 16010 – “Basic Electrical Requirements”

1.02 WORK INCLUDES

- A. Provide lighting fixtures
- B. Provide lamps
- C. Provide required fixture supports

1.03 SUBMITTALS

- A. Submit shop drawings in accordance with Section 16010 - “BASIC ELECTRICAL REQUIREMENTS.”

1.04 QUALITY ASSURANCE

- A. Regulatory requirements.
 - 1. NEMA Std. Pub. Nos. SH5 and TT1 for pole construction, materials, and hardware.
 - 2. Building lighting fixtures:
 - a. Applicable sections of NEC, Latest Edition.
 - b. ANSI 132.1
 - c. UL 57, 676, 1570, 1571, and 1572.
 - d. Fluorescent ballasts shall be CBM labeled.
 - e. NEMA Std. Pub. Nos. FA1. LE1 and LE2.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver equipment in time to maintain approved construction schedule.
- B. Store in safe, dry location. Protect from dust, moisture, weather and extreme temperatures.
- C. Follow manufacturer's recommendation for transportation, handling and storage.
- D. Do not use for temporary lighting. Refer to Section 16010.

PART 2 - PRODUCTS

2.01 FIXTURES

- A. Specified on plans.
- B. All exit lights and emergency lights, located in gyms or other activity areas, shall be provided with wire guards.

2.02 BALLASTS

- A. All ballasts shall be rated for the circuit voltage shown on plans.
- B. All fluorescent ballasts shall be electronic.
- C. Ballasts for exterior lighting fixtures shall be suitable for use at temperatures -20°F. and above.
- D. Unless otherwise noted, fluorescent ballasts shall be solid state electronic type for use with T8 (Octron or equal) fluorescent lamps. Electronic ballasts shall have a total harmonic distortion of 20% or less.

2.03 LAMPS

- A. Provide lamps for all light fixtures as scheduled on drawings.
- B. Lamps shall be approved by the fixture manufacturer.

2.04 ACCEPTABLE MANUFACTURERS

- A. Electronic ballasts
 - 1. Advance.
 - 2. Lutron.
 - 3. Motorola.
 - 4. Triad.
 - 5. Valmont.

- B. Lamps
 - 1. General Electric.
 - 2. Sylvania.
 - 3. Venture

PART 3 - EXECUTION

3.01 LIGHTING FIXTURES

- A. Provide all plaster frames, angles, channel, hangers and supports required to support lighting fixtures. Fixtures shall be supported independently of ceiling.
- B. Exit signs in suspended ceiling areas shall be located in the center of the ceiling tile and oriented so as to provide maximum visibility to escape paths.
- C. Remove all dirt, paint, and foreign matter from fixture lenses and frames between substantial completion and final acceptance of the building.

END OF SECTION 16500

DIVISION 16 – ELECTRICAL

SECTION 16721 - FIRE ALARM SYSTEM

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings.
- B. General Provisions of the Contract.
- C. Solicitation Documents.
- D. General Conditions.
- E. Supplementary Conditions.
- F. Division 1.
- G. Section 16010 – “Basic Electrical Requirements”.
- H. Section 16110 – “Raceways”.
- I. Section 16120 – “Wires and Cables”.
- J. Section 16130 – “Boxes”.
- K. Section 16195 – “Electrical Identification”.

1.02 WORK INCLUDES

- A. Provide a complete, code-compliant, fire alarm system as generally indicated on plans and herein specified, by:
 - 1. Reviewing the system components indicated on plans with a NICET Level III (minimum) Fire Alarm Technician, and adding or subtracting components as required. **Any addition or subtraction of components, and associated installation work, shall be included in the Contractor’s Bid.**
 - 2. Providing all system components, conduit, and cable for the complete operating system.

1.03 SUBMITTALS

- A. Submit shop drawings in accordance with Section 16010 - “BASIC ELECTRICAL REQUIREMENTS.” Shop drawings shall include but not be limited to the following:
 - 1. Wiring schematic for project building showing equipment/device locations and wiring connection diagrams for entire system, including riser diagrams.
 - 2. A complete point to point wiring diagram of all devices including terminal connections to individual modules in the Control Panel.
 - 3. Clear description and complete data for each device being furnished.
 - 4. NEMA, F.M., UL listings.
 - 5. Rough-in boxes.

1.04 QUALITY ASSURANCE

- A. Source quality control:
 - 1. Ensure all equipment is new and of current design and manufacture.
 - 2. All control equipment to be solid state.
 - 3. All equipment shall meet ADA requirements.
 - 4. NFPA-72A.
 - 5. System manufacturer shall be an ISO 9001 certified company
- B. All equipment shall be installed by workmen with a minimum of 4 years experience in the installation of similar equipment. The installing company shall employ NICET (minimum Level II Fire Alarm Technology) technicians on site to guide the installation and final checkout.
- C. System shall be fully operational, tested, and a manufacturer's written certification issued before building is occupied.

1.05 SYSTEM DESCRIPTION

- A. The system shall be a microprocessor controlled, intelligent reporting fire alarm system complete with all equipment required for a fully functional and operational system. It shall include but not limited to the Fire Alarm Control Panel, alarm initiating devices, alarm notification appliances, remote annunciators, auxiliary control devices, and wiring as shown on the drawings and specified herein.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver equipment in time to maintain approved construction schedule.
- B. Store in safe, dry location. Protect from dust, moisture, weather and extreme temperatures.
- C. Follow manufacturer's recommendation for transportation, handling and storage.

1.07 MAINTENANCE AND SERVICE

- A. Except as required by warranty provision, no maintenance or service is included in this Contract.

PART 2 - PRODUCTS

2.01 SYSTEM OPERATION

- A. Actuation of any alarm initiating device shall cause the following to occur:
 - 1. Continuously sound all alarm devices until fire alarm system is cleared or silenced.
 - 2. All controlled air handling equipment shall shut down.
 - 3. Flash an alarm lamp in the control panel.
 - 4. Alarm devices may be silenced by an "Alarm Acknowledged" or "Reset" pushbutton on control panel; however, a subsequent alarm shall cause the alarm devices to resound.
 - 5. Register the location of the alarm on zone annunciators and remote annunciator where indicated.
 - 6. All doors held open shall be released.
 - 7. If shown on drawings, activation of the heat detectors in the elevator equipment room or elevator shaft shall operate the elevator shunt trip circuit breaker or the equivalent.
 - 8. If shown on drawings, activation of any smoke detectors located in the elevator machine room, hoist way or lobby shall provide for a signal (contact closure) for elevator capture. Coordinate with elevator supplier.
 - 9. Transmit alarm or trouble condition to the Owner's selected central station via commercial telephone lines.
- B. Power failures, opens, grounds, or malfunction of system components shall cause a trouble signal to be registered at the control panel, at the zone annunciators.
- C. System shall operate on 120 VAC power and automatically transfer to standby batteries upon loss of power. Batteries shall have the capability of operating the system in a standby mode with normal power disconnected for at least 60 hours and still be capable of operating the system in an alarm condition for 15 minutes.

2.02 FIRE ALARM CONTROL PANEL

- A. Fire alarm control panel shall be equipped as follows:
 - 1. Semi-flush mounting cabinet complete with an outer door frame assembly which is equipped with a locking door panel.

2. Alarm control with an acknowledge switch for trouble and alarm, trouble LED, earth ground LED, LED test switch, trouble signal silence switch and alarm reset switch.
3. Internal system test switch which will cause all devices to alarm but not signal the remote station.
4. Battery/Charger Monitor containing an LED and circuit to monitor the battery for low voltage, battery disconnected or charger failure.
5. Fuse and reset switch.
6. Digital communicator for proprietary station notification.
7. Class B signal circuits as required by load.
8. Transformer mounted within the control panel cabinet.
9. Power supply as required by alarm device load.
10. Auxiliary relays. Two sets of 4PDT 10 amp contacts.
11. Rechargeable lead calcium batteries.
12. Battery charger. Automatic dual rate with a volt/ammeter to monitor the battery condition and a "Charger Failure" LED.
13. Fan shutdown controls. Only where indicated on drawings.
14. Selectable strobe synchronization.
15. Printer/PC interface.
16. Integral 80-character LCD display with backlighting.

2.03 ALARM DEVICES

- A. Unless otherwise noted on plans, alarm devices shall be audible/visible type. Audible alarm shall be a 24 volt DC parallel connected horns with minimum output of 87 dB at 10 feet. Visible alarms shall be a 100 candela, 24 volt DC lamp with self-contained flasher. Lamp shall be covered by a Lexan lens with "FIRE" factory imprinted. Audible and visible alarm shall be mounted in a common enclosure. 85 dB, Piezo "mini-horns" may be used where shown. Mini-horns are not allowed except where shown on plans. Alarm devices are not required to be addressable.
- B. Where shown on plans, provide visible alarm devices only.
- C. All signal devices shall meet Americans with Disabilities Act requirements.

- D. All signal devices installed in gymnasiums, multipurpose rooms or other areas subject to abuse, shall be equipped with a wire guard.

2.04 ADDRESSABLE MANUAL PULL STATIONS

- A. Single action, non-breakglass type initiating station with pull-down lever, flush mounting. Station housing shall be constructed of high impact Lexan, red in color with white lettering.

2.05 ADDRESSABLE SMOKE DETECTORS (ALL TYPES MAY NOT BE REQUIRED)

- A. All detectors shall be ionization type. Sensitivity of the detectors shall be field adjustable and a check of sensitivity shall be possible while the detector is installed and operating. Detectors shall have flashing light to indicate normal operation. Provide detectors with normally open auxiliary contacts for annunciator circuit.
- B. Duct smoke detectors shall have sampling tube and contacts for interlocking air handling equipment fan(s).
- C. The detector shall be UL Listed for compatibility with the fire alarm control panel and shall obtain its operating power from the alarm initiating circuit.
- D. Removal of the detector head shall interrupt the supervisory circuit and activate a trouble signal at the control panel. It shall be possible to alarm the duct detector by using the remote stations.
- E. Detector shall be furnished with a remote test switch equipped with alarm and power pilot lights.
- F. Ceiling detectors shall be listed to UL Standard 268 and shall be documented compatible with the control equipment to which they are connected. The detectors shall contain a locking screw to discourage unauthorized removal of the head from the base.
- G. The detectors shall have 30-mesh insect screens, and have completely closed backs to restrict entry of dust and air turbulence. Electronics of the unit shall be completely shielded to protect against false alarms from EMI and RFI. The detector head shall be easily disassembled to facilitate cleaning.
- H. The detectors shall contain a red LED that shall pulse to indicate power on and shall glow continuously to indicate alarm. The detector shall contain a functional test switch (magnetically operated) that, when operated, will test the electronics of the unit and put it into alarm.

2.06 REMOTE ANNUNCIATOR

- A. Remote annunciator shall be LCD type that mimics all display information from the FACP and shall provide as a minimum the following.
 - 1. Control switches for System Acknowledge, Signal Silence, Drill and Reset.

2. Key switch to enable/disable the control switches and mechanically locks the annunciator enclosure.
3. System status LEDs for AC power, Alarm, Trouble Supervisory and Alarm Silence.
4. Local Sounder.

2.07 CABLE

- A. Alarm and initiating circuit wiring and annunciator wiring shall be of type recommended by equipment manufacturer. Cable shall be UL listed for use with local protective signaling systems.

2.08 MAGNETIC DOOR HOLDERS

- A. Magnetic door holders shall be the semi-flush, wall mounted type. Provide 25 lbs. (minimum) of holding force.

2.09 ADDRESSABLE HEAT DETECTORS

- A. Heat detectors shall be the fixed temperature type with 135EF. temperature rating, and two sets of contacts.
 1. Heat detectors in hazardous locations shall be explosion proof. Others shall be the "low profile" type, white in color.

2.10 ACCEPTABLE MANUFACTURERS

- A. Edwards
- B. Faraday
- C. Gamewell
- D. Notifier
- E. Pyrotronics
- F. Siemens
- G. Simplex

PART 3 - EXECUTION

3.01 INSTALLATION

- A. All wiring shall comply with NEC, Latest Edition, Section 760-3 and NFPA Pamphlet 72A, Class B.
- B. Comply with equipment manufacturer's wiring instructions.
- C. All wiring shall be continuous from terminal to terminal or from terminal to device pigtail lead. Wiring shall be color coded and color coding scheme shall be used consistently.

- D. All fire alarm system wiring shall be in conduit.
- E. Device boxes shall be flush mounted unless noted otherwise.

3.02 INSTRUCT OWNER'S PERSONNEL

- A. Provide one 3 hour seminar for instruction of 4 personnel in the operation of the system. Seminar shall be conducted by manufacturer's representative.

3.03 CERTIFICATION

- A. System shall be thoroughly tested by the manufacturer's representative. Testing shall be performed in the presence of the local Fire Department Representative. Contractor shall notify Engineer prior to testing. Contractor shall issue a written certification statement that all equipment has been installed in accordance with plans and specifications and also manufacturer's wiring diagrams, instructions, and directions. Certification shall state that the system is in complete proper operating order.

END OF SECTION 16721