SECTION 15005

GENERAL PROVISIONS RELATED TO PLUMBING WORK

PART 1 GENERAL

1.01 SCOPE

A. The plumbing work will include the furnishing of all plant, labor, materials, accessories, and equipment required to install a complete and fully operational plumbing system as shown, specified and/or reasonably implied for a complete project.

B. The project includes all plumbing work indicated, specified and reasonably implied for the construction of the building, such as:

1. Provision of complete new interior domestic water system to within 5 ft. outside the building or as otherwise shown on drawings.

2. Provision of complete new soil, waste and vent system to within 5 ft. outside the building or as otherwise shown on drawings.

3. Provision of plumbing fixtures and equipment.

4. Site utilities are provided under the General Contract.

C. Refer to Division 1, Division 2, and General Conditions for Project Requirements.

1.02 DETAIL SPECIFICATION SECTIONS

A. The following specification sections cover the various work items, materials and equipment as may be applicable to the Plumbing Contract.

1. Section Title
   a. 15100 Electrical Requirements for Plumbing Equipment
   b. 15135 Gages and Meters
   c. 15140 Plumbing Supports and Anchors
   d. 15190 Plumbing Identification
   e. 15260 Plumbing Pipe Insulation
   f. 15410 Plumbing Pipe
   g. 15430 Plumbing Specialties
   h. 15440 Plumbing Fixtures
   i. 15450 Plumbing Equipment
   j. 15460 Tests and Cleaning

1.03 COORDINATION OF WORK

A. The General Contractor shall be responsible for coordination between various Subcontractors. Whenever interference might occur between the Plumbing Work and the work of other trades, the Plumbing Contractor shall consult with the General Contractor before installing any of the work in question. When it appears that a departure from the Plans is necessary due to actual field conditions or other causes, detailed drawings shall be prepared for submittal to the Architect for approval. The Architect shall make final decision as to any conditions which require changing the work.

1.04 FEES, PERMITS AND INSPECTIONS

A. Plumbing Contractor shall obtain permits and arrange all inspections necessary for the installation of his work, paying all fees in connection therewith, and furnishing the Architect with certificates of inspection from all authorities having jurisdiction.

B. Inspections and tests shall be made upon formal notice to the Architect and the Owner from the Contractor sufficiently in advance to allow a representative of the Architect and the Owner to be present for each test.

C. No piping or other construction shall be covered up or concealed until it has been inspected or approved. The Contractor shall furnish all material, labor, fuel, equipment and apparatus, and bear all expenses of such tests as are hereinafter specified for the work.

1.05 CODES AND STANDARDS

A. The applicable provisions of the following codes and standards, each of the latest issues, and all addenda thereto shall form a part of these specifications.

1. North Carolina Building Codes (which includes the National Electrical Code).
2. North Carolina Boiler Inspection Law, Rules, and Regulations, latest issue.
3. National Fire Protection Association Standards No's. 13 & 54.
4. Underwriters' Laboratories, ASTM, ASME, NEMA, ANSI, and other Standards as specifically referred to in these specifications.
5. County of Martin and local utility standards.

1.06 TEMPORARY UTILITY SERVICES

A. Temporary utilities shall be provided in accordance with General Conditions.

1.07 POST INSPECTIONS

A. Two post construction inspections shall be held by the Architect/Engineer with the Contractors and Owner to assure that the building is continuing to operate in accordance with the plans and specifications and that no unusual problems are occurring in the building systems. The first post construction inspection will be held approximately six months after substantial completion. This inspection will address Plumbing, HVAC and Electrical work. The second post construction inspection shall be held prior to expiration of the 1 year warranty period.

B. It shall address General Construction as well as Plumbing, HVAC and Electrical work. All problems discovered during these inspections that relate to defective materials or defective workmanship shall be corrected by the responsible Contractor at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 EQUIPMENT AND MATERIALS

A. Equipment and materials entering into the permanent work shall be new and shall bear the manufacturer's name or trade name. All water consuming devices shall be the water saving type. In every case where a standard has been established by the Underwriters' Laboratories for a particular material, such material shall bear UL label. Equipment and material of the same general type shall be of the same make throughout the work to provide uniform appearance, operation and maintenance.

1. Piping, fittings and valves in connection with semi-permanent plumbing fixtures and temporary water outlets shall be as specified for similar items in the permanent work under Section titled "Plumbing Pipe" when fixtures are set in the permanent structure. Should the Contractor elect to construct a temporary structure to contain toilets for the use of workmen, the piping, valves and fittings may be of materials of the Contractor's selection provided they are completely removed from the project when no longer in use.

2. Plumbing fixtures for use in semi-permanent toilets may be approved second-hand items which will meet the requirements of the North Carolina State Plumbing Code. Such fixtures shall be completely removed from the project when no longer in use.

2.02 DIMENSIONS

A. The Plumbing Contractor shall be responsible for insuring that items of equipment furnished fit the space available. He shall make necessary field measurements to ascertain space requirements, including those of connections, and shall furnish and install such sizes and shapes of equipment that the final installation shall suit the true intent and meaning of the drawings and specifications.

2.03 MANUFACTURER'S DIRECTIONS

A. Manufacturer's directions shall be followed completely in the delivery, storage, protection, and installation of all equipment and materials. The Contractor shall promptly notify the Architect in writing of any conflict between the requirements of the Contract Documents and the manufacturer's directions, and shall obtain the Architect's written instructions before proceeding with the work. Should the Contractor perform any work that does not comply with the manufacturer's directions or such written instructions from the Architect, he shall bear all costs arising in correcting the deficiencies.

2.04 EQUIPMENT ACCESSORIES

A. The Plumbing Contractor shall provide all equipment, accessories, connections and incidental items necessary to fully complete the work, ready for use, occupancy and operation by the Owner.

2.05 SUBCONTRACTORS AND MATERIALS LIST

A. The Plumbing Contractor shall, within the requirements of the General Conditions, submit to the Architect, in triplicate, a complete list of Sub-Contractors and materials he proposes to use in the work. Materials list shall include manufacturer's name of specific items of material proposed.

2.06 SHOP DRAWINGS AND CATALOG DATA

A. The Plumbing Contractor shall submit shop drawings and catalog cuts of all pieces of equipment to the Architect for approval. The Plumbing Contractor shall submit the number of copies as required by the General Conditions. Approval of the Architect of shop drawings for any materials, apparatus, devices, and layouts shall not relieve this Contractor from the responsibility of furnishing same of proper dimensions, size, quantity, quality, and all performance characteristics to efficiently

perform the requirements and intent of the Contract Documents. Such approval shall not relieve this Contractor from responsibility for errors of any sort on the shop drawings. If the shop drawings deviate from the Contract Documents, this Contractor shall advise the Architect of the deviations in writing accompanying the shop drawings, including the reason for deviations.

B. Any items found on the job either installed or not installed which do not meet the above criteria shall be replaced by the Contractor at the discretion of the Engineer and the Owner. Review and stamp all shop drawings submittals before submitting them to the Engineer for approval. Any submittals not stamped and signed by the Contractor prior to submittal to the Engineer will be returned to the Contractor for his stamp and resubmittal. A copy of the approved shop drawings shall be maintained on the project site at all times.

2.07 SUBSTITUTIONS

A. Engineer will consider requests for Substitutions in accordance with Division 1 of this specification.

B. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

D. A request constitutes a representation that the Contractor:

1. Has investigated proposed product and determined that it meets or exceeds that quality level of the specified product.

2. Will provide the same warranty for the Substitution as for the specified product.

3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.

4. Waives claims for additional costs or time extension which may subsequently become apparent.

E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals without separate written request, or when acceptance will require revision to the Contract Documents.

F. Substitutions Submittal Procedure:

1. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.

2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence.

3. The Engineer will notify Contractor, in writing, of decision to accept or reject the request.

PART 3 EXECUTION

3.01 SUPERVISION

A. The Contractor shall have a thoroughly competent superintendent in charge of the construction work at all times. The superintendent shall have extensive experience in the work to be performed.

3.02 MATERIALS AND WORKMANSHIP

A. All materials and workmanship shall comply with all applicable codes, specifications, state and local ordinances, industry standards and utility company regulations.

3.03 LOCATION OF PIPES, FIXTURES, EQUIPMENT AND APPURTENANCES

A. Location of pipes, fixtures, equipment and appurtenances shall be adjusted to accommodate the work to interferences anticipated and encountered.

B. Install all equipment to provide minimum clearances per manufacturer's instructions around each piece of equipment.

C. The Contractor shall furnish and install as shown on the drawings, or as necessary to complete the working systems in accordance with the intent of the drawings and specifications, complete systems of piping, all valves as indicated or as necessary to completely control the entire apparatus and all appurtenances. The piping drawings are diagrammatic and indicate the general location and connections. The piping may have to be offset, lowered or raised as required or as directed at the site. This does not relieve the Contractor from providing the necessary valves, fittings, and accessories to meet the conditions and the responsibility for the proper erection of systems of piping in every respect suitable for the work as described in the specification and approved by the Architect.

3.04 BUILDING AND FINISHES

A. Building and finishes shall be protected. The Contractor will be held responsible for damage incurred, and shall repair all damage done.

3.05 INSTALLATION OF SEMI-PERMANENT TOILET FACILITIES

A. Piping, valves, fittings and appurtenances shall be in accordance with Sections titled "Plumbing Pipe".

B. Plumbing fixtures shall be installed in accordance with Section titled "Plumbing Fixtures".

3.06 SUPPORTS

A. The Contractor shall support plumb, rigid and true to line all work and equipment installed under this Contract. The Contractor shall thoroughly study all general, structural, heating, cooling and ventilating, and electrical drawings, shop drawings and catalog data to determine how equipment, accessories, piping, fixtures, and related items are to be supported, mounted, or suspended. He shall provide all

bolts, inserts, pipe stands, brackets, structural supports and accessories for proper support whether or not shown on the drawings.

3.07 RECORD DRAWINGS

A. Record Drawings shall be provided in accordance with Division 1.

B. Record Drawings: Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings. Mark the set in red to show the actual installation where the installation varies substantially from the work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

1. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the work.

2. Mark new information that is important to the Owner, but was not shown on Contract Drawings or Shop Drawings.

3. Note related Change Order numbers where applicable.

4. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.

5. Upon completion of mark-up, submit complete set of record documents to Designer for the Owner's records.

3.08 TEST REPORTS

A. The Contractor shall provide, in addition to notice to the authorities having jurisdiction, a minimum of 24 hours notice, prior to such testing, to the Engineer and Owner. All systems are required to be tested and shall be documented as follows:

1. Documented in writing listing date, item tested, section tested, witnesses to the test (signed) and specification section which requires testing.

2. Reports to testing shall be provided to the Architect within seven (7) days of completion of each test.

3. All backflow preventers shall be tested, with copies of test reports to be included in O & M manuals.

3.09 PAINTING

A. All field painting of plumbing work, with exception of touch-up paint on factory finished equipment, shall be in accordance with the "Painting" section of these specifications. Any equipment which has its factory paint coat scratched or otherwise damaged shall be retouched with paint to match the finish coat, and shall be repainted if necessary.

3.10 FIRESTOPPING

A. Firestopping shall be installed by Plumbing Contractor under provisions of Section 07270 and as detailed on drawings.

B. The Plumbing Contractor shall be responsible for firestopping all partitions, walls and floor penetration resulting from his work. Penetrations shall be firestopped to meet or exceed rating of wall or floor systems as required by code.

3.11 FREEZE PROTECTION

A. Provide capability to drain systems, or provide electric heat, as freeze protection on all water lines subject to freezing conditions.

3.12 DEMONSTRATION OF PROPER INSTALLATION BY PLUMBING CONTRACTOR

A. Upon substantial completion and before Owner acceptance, rod and clean out each sanitary and storm system.

B. The Plumbing Contractor shall demonstrate at final inspection that all floor drains work and adequately drain the area they serve.

END OF SECTION

SECTION 15072

VIBRATION ISOLATION

PART 1 GENERAL

1.01 SCOPE

A. Inertia bases

B. Vibration Isolation

1.02 REFERENCES

A. Section 03100 - Cast-in-Place Concrete

B. Section 15500 – Basic HVAC Requirements

C. Section 15072 - Supports and Anchors

1.03 PERFORMANCE REQUIREMENTS

A. Provide vibration isolation on motor driven equipment over 0.5 HP, and isolation for connected piping and ductwork.

B. Provide minimum static deflection of isolators for equipment as indicated.

1. Under 20 HP

a. 400 - 600 rpm: 1 inch

b. 600 - 800 rpm: 0.5 inch

c. 800 - 900 rpm: 0.2 inch

d. 1100 - 1500 rpm: 0.14 inch

e. Over 1500 rpm: 0.1 inch

2. Over 20 HP

a. 400 - 600 rpm: 2 inch

b. 600 - 800 rpm: 1 inch

c. 800 - 900 rpm: 0.5 inch

d. 1100 - 1500 rpm: 0.2 inch

e. Over 1500 rpm: 0.15 inch

3. Normal

a. 400 - 600 rpm: 3.5 inch

b. 600 - 800 rpm: 2 inch

c. 800 - 900 rpm: 1 inch

d. 1100 - 1500 rpm: 0.5 inch

e. Over 1500 rpm: 0.2 inch

4. Critical

a. 600 - 800 rpm: 3.5 inch

b. 800 - 900 rpm: 2 inch

c. 1100 - 1500 rpm: 1 inch

d. Over 1500 rpm: 0.5 inch

C. Use concrete inertia bases for fans having static pressure in excess of 3.5 inch WC or motors in excess of 40 HP, and on base mounted pumps over 10 HP.

1.04 SUBMITTALS

A. Submit under provisions of Division 1 and Section 15500

B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each.

C. Product Data: Provide schedule of vibration isolator type with location and load on each.

D. Manufacturer's Installation Instructions: Indicate special procedures and setting dimensions.

E. Manufacturer's Certificate: Certify that isolators are properly installed and adjusted to meet or exceed specified requirements.

1.05 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1 and Section 15500

B. Record actual locations of hangers including attachment points

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Mason Industries, Inc.

B. Kinetics Industries, Inc.

C. Vibration Mountings & Controls, Inc.

D. Substitutions: Under provisions of Section 15500

2.02 VIBRATION ISOLATORS

A. Open Spring Isolators:

1. Spring Isolators:

a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.

b. Code: Color code springs for load carrying capacity.

2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.

3. Spring Mounts: Provide with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromed plated hardware.

4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.

B. Restrained Spring Isolators:

1. Spring Isolators:

a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.

b. Code: Color code springs for load carrying capacity.

2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.

3. Spring Mounts: Provide with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromed plated hardware.

Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.

4. Restraint: Provide heavy mounting frame and limit stops.

C. Closed Spring Isolators:

1. Spring Isolators:

a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.

b. Code: Color code springs for load carrying capacity.

2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.

3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.

4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance.

D. Restrained Closed Spring Isolators:

1. Spring Isolators:

a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.

b. Code: Color code springs for load carrying capacity.

2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.

3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.

4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance and limit stops.

E. Spring Hanger:

1. Spring Isolators:

a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.

b. Code: Color code springs for load carrying capacity.

2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.

3. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators or rubber hanger with threaded insert.

4. Misalignment: Capable of 20 degree hanger rod misalignment.

F. Neoprene Pad Isolators:

1. Rubber or neoprene waffle pads

a. 30 durometer.

b. Minimum 1/2 inch thick.

c. Maximum loading 40 psi.

d. Height of ribs shall not exceed 0.7 times width.

2. Configuration: 1/2 inch thick waffle pads bonded each side of 1/4 inch thick steel plate.

G. Rubber Mount or Hanger: Molded rubber designed for 0.5 inches deflection with threaded insert.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instruction.

B. Install isolation as indicated on the plans and for motor driven equipment without factory-installed vibration isolation.

C. Inertia Bases:

1. Provide inertia bases under all base mounted pumps.

2. Set concrete inertia bases for 2 inch clearance between housekeeping pad and base.

3. Adjust equipment level.

D. Install spring hangers without binding.

E. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

F. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

G. Provide pairs of horizontal limit springs on fans with more than 6.0 inches static pressure, and on hanger supported, horizontal mounted axial fans.

H. Support piping connections with spring hangers as follows:

1. Up to 4 Inch Diameter: First three points of support from isolated equipment.

2. 5 to 8 Inch Diameter: First four points of support from isolated equipment.

3. 10 Inch Diameter and Over: First six points of support from isolated equipment.

4. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.

I. Connect flexible conduit and electrical wiring to isolated equipment with flexible hanging loop.

J. All vibration isolators shall be selected to have a minimum static deflection as scheduled below and a reserve load capacity of at least 50% of the design load. All spring isolators shall have a loaded height/diameter ratio of 0.8 or less. All frame and base members shall have a height that is at least 1/10th of the spacing between adjacent isolators. All spring hangers shall function properly with a hanger rod misalignment of up to 15 degrees in any direction.

3.02 MANUFACTURER'S FIELD SERVICES

A. Inspect isolated equipment after installation and submit report indicating compliance with specifications and manufacturer's recommendations. Include static deflections.

END OF SECTION 15072

SECTION 15085

PIPING INSULATION

PART 1 GENERAL

1.01 SCOPE

A. Piping insulation

B. Jackets and accessories

1.02 RELATED SECTIONS

A. Section 15185 – Refrigerant Piping and Specialties

B. Section 15503 – Supports and Anchors

1.03 REFERENCES

A. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate

B. ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus

C. ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.

D. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.

E. ASTM C518 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

F. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

G. ASTM C547 - Mineral Fiber Preformed Pipe Insulation

H. ASTM C552 - Cellular Glass Block and Pipe Thermal Insulation

I. ASTM C921 - Properties of Jacketing Materials for Thermal Insulation

J. ASTM E84 - Surface Burning Characteristics of Building Materials

K. ASTM E96 - Water Vapor Transmission of Materials

L. NFPA 255 - Surface Burning Characteristics of Building Materials

M. UL 723 - Surface Burning Characteristics of Building Materials

1.04 SUBMITTALS

A. Submit under provisions of Division 1 and Section 23 05 00

B. Product Data: Provide product description, list of materials and thickness for each service, and locations

C. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved

1.05 QUALITY ASSURANCE

A. Materials: Flame spread/smoke developed rating of 25/50 or less in accordance with ASTM E84, NFPA 255, and UL 723

1.06 QUALIFICATIONS

A. Applicator: Company specializing in performing the work of this section with minimum five years' experience

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Division 1 and Section 23 05 00.

B. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Store insulation in original wrapping and protect from weather and construction traffic.

D. Protect insulation against dirt, water, chemical, and mechanical damage.

1.08 ENVIRONMENTAL REQUIREMENTS.

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 POLYISOCYNAURATE THERMAL INSULATION MANUFACTURERS:

A. CertainTeed Corporation

B. Knauf Fiber Glass GmbH

C. Owens-Corning Fiberglas

D. Schuller/Manville

E. Substitutions: Under provisions of Section 15500

2.02 INSULATION: ASTM C547; RIGID MOLDED, NONCOMBUSTIBLE.

A. 'K' value: ASTM C335, 0.18 at 75 degrees F.

B. Maximum service temperature: 300 degrees F.

C. Maximum moisture absorption: 2 percent by volume.

D. Water vapor permeance: 3 perm-in or less.

E. Density: 2.0 lb/cu ft density.

2.03 VAPOR BARRIER JACKET

A. ASTM C921, White kraft paper reinforced with glass fiber yarn and bonded to aluminized film.

B. Moisture Vapor Transmission: ASTM E96; 0.02 perm inches.

C. Secure with self sealing longitudinal laps and butt strips.

D. Secure with outward clinch expanding staples and vapor barrier mastic.

2.04 VAPOR BARRIER LAP ADHESIVE

A. Manufacturers:

1. Halstead Industries

2. H. B. Fuller Company

3. 3M

4. Substitutions: Under provisions of Section 15500

B. Compatible with insulation

2.05 FIBROUS GLASS FABRIC

A. Manufacturers:

1. CertainTeed Corp

2. Knauf Fiber Glass GmbH

3. Owens-Corning Fiberglas

4. Schuller/Manville

5. Substitutions: Under provisions of Section 15500

B. Cloth: Untreated; 9 oz. /sq .yd. weight.

C. Blanket: 1.0 lb. /cu. ft. density.

2.06 INDOOR VAPOR BARRIER FINISH

A. Manufacturers:

1. Manville

2. PABCO

3. Fibrex, Inc.

4. Substitutions: Under provisions of Section 15500

B. Vinyl emulsion type acrylic, compatible with insulation, white color.

2.07 OUTDOOR VAPOR BARRIER MASTIC

A. Manufacturers:

1. Manville

2. PABCO

3. Fibrex, Inc.

4. Substitutions: Under provisions of Section 15500

B. Vinyl emulsion type acrylic, compatible with insulation, white color.

2.08 INSULATING CEMENT

A. Manufacturers:

1. Manville

2. PABCO

3. Fibrex, Inc.

4. Substitutions: Under provisions of Section 15500

B. ASTM C449.

2.09 CELLULAR FOAM

A. Manufacturers:

1. K-FLEX USA.

2. Rubatex Corp.

3. Foam Enterprises

4. Substitutions: Under provisions of Section 15500

B. Insulation: ASTM C534; flexible, cellular elastomeric, molded or sheet.

1. 'K' Value: ASTM C177 or C518; 0.27, 0.28 at 75 degrees F.

2. Minimum Service Temperature: -40 degrees F.

3. Maximum Service Temperature: 220 degrees F.

4. Maximum Moisture Absorption: ASTM D1056; 1.0 percent (pipe) by volume, 1.0 percent (sheet) by volume.

5. Moisture Vapor Transmission: ASTM E96; 0.20 perm inches.

6. Maximum Flame Spread: ASTM E84; 25.

7. Maximum Smoke Developed: ASTM E84; 50.

8. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive

1. Air dried, contact adhesive, compatible with insulation.

2.10 JACKETS

A. PVC Plastic

1. Manufacturers:

a. CertainTeed Corporation

b. Knauf Fiberglass GmbH

c. Owens-Corning Fiberglas

d. Schuller/Manville

e. Substitutions: Under provisions of Section 15500

2. Jacket: ASTM C921, One piece molded type fitting covers and sheet material, off white color.

   a. Minimum Service Temperature: -40 degrees F

   b. Maximum Service Temperature: 150 degrees F

   c. Moisture Vapor Transmission: ASTM E96; 0.002 perm inches

   d. Maximum Flame Spread: ASTM E84; 25

   e. Maximum Smoke Developed: ASTM E84; 50

   f. Thickness: 30 mil

   g. Connections: Brush on welding adhesive; pressure sensitive color matching vinyl tape.

   h. Shall be field applied jackets as specified above.

3. Covering Adhesive Mastic

   a. Compatible with insulation

B. Canvas Jacket: UL listed

1. Fabric: ASTM C921, 6 oz. /sq. yd., plain weave cotton treated with dilute fire retardant lagging adhesive.

2. Lagging Adhesive

   a. Compatible with insulation

C. Aluminum Jacket: ASTM B209.

1. Thickness: 0.016 inch sheet.

2. Finish: Smooth.

3. Joining: Longitudinal slip joints and 2 inch laps.

4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.

5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

B. Provide glass fiber insulation on hydronic piping systems in accordance with glass fiber insulation schedule attached at the end of this Section. Cellular foam may be substituted on metal pipe used for condensate drains.

C. On exposed piping, locate insulation and cover seams in least visible locations.

D. For insulated pipes or cold pipes conveying fluids below ambient temperature:

1. Provide vapor barrier jackets, factory applied or field applied.

2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe.

3. Finish with glass cloth and vapor barrier adhesive for field applied jackets.

4. Provide PVC fitting covers on all elbows and tees.

5. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.

6. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies and expansion joints.

E. For insulated pipes conveying fluids above ambient temperature:

1. Provide standard jackets, with or without vapor barrier, factory applied or field applied.

2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.

3. Finish with glass cloth and adhesive for field applied jackets.

4. Provide PVC fitting covers on all elbows and tees.

5. For hot piping conveying fluids 140 degrees F. or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

6. For hot piping conveying fluids over 140 degrees F., insulate flanges and unions at equipment.

F. Inserts and Shields:

1. Application: Piping 1/2 inch diameter or larger.

2. Shields: 18 gauge minimum galvanized steel between pipe hangers or pipe hanger rolls and inserts.

3. Insert Location: Between support shield and piping and under the finish jacket.

4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.

5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

G. Finish insulation at supports, protrusions, and interruptions.

H. For buried piping, provide factory fabricated assembly with inner all-purpose service jacket with self sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

I. For heat traced piping, insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

J. Provide canvas jacketing on all piping exposed on mezzanines, in Mechanical Equipment Rooms and in occupied finished spaces.

3.03 TOLERANCE

A. Substituted insulation materials shall provide thermal resistance within 10 percent at normal conditions, as materials indicated.

3.04 POLYISOCYNAURATE THERMAL INSULATION SCHEDULE

PIPING SYSTEMS	PIPE SIZE (Inch)	THICKNESS (Inch)
COOLING SYSTEMS		
Condensate Drains	1″-4″	1″
Condensate Drains from		

Cooling Coils		

3.05 CELLULAR FOAM INSULATION

PIPING SYSTEMS	PIPE SIZE (Inch)	THICKNESS (Inch)
VARIABLE VOLUME REFRIGERATION SYSTEM		
Hot Gas, Liquid Line and Suction	Up to and including 1-1/4"	1-1/2"

END OF SECTION 15085

SECTION 15100

ELECTRICAL REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections: Separate electrical components and materials required for field installation and electrical connections are specified in Division 16.

1.02 SUMMARY

A. This section specifies the basic requirements for electrical components which may or may not be an integral part of the Plumbing equipment. These components include, but are not limited to motors, motor starters, and disconnect switches.

B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for Plumbing equipment are specified within the individual equipment specification sections, and/or are scheduled on the drawings.

C. All electrical work shall be done by licensed electricians in accordance with the N.C. State Building Code which includes the National Electrical Code, latest edition and the Electrical Division of this specification. Furnish a certificate to the appropriate Electrical Inspector.

D. Work Included:

1. The Plumbing Contractor shall furnish and install all motor starters, disconnect switches, and combination starters for equipment furnished under their contract. All power wiring on the line side shall be provided by the Electrical Contractor up to a termination point consisting of a junction box, trough, starter or disconnect switch. The Electrical Contractor is responsible for the line side termination. Refer to plumbing detail sheets, of the Contract Drawings for division responsibility regarding electrical requirements.

2. Provide all 120 v and 24 v control wiring, in conduit, required to satisfactorily control all equipment included in this section. Furnish and wire all control devices such as transformers, thermostats, switches, relays and any other devices necessary to control the equipment furnished in this section.

1.03 REFERENCES

A. NEMA Standards MG 1.

B. NEMA Standards ICS 2.

C. NEMA Standard 250.

D. NEMA Standard KS 1.

E. National Electrical Code (NFPA 70).

F. N.C. State Building Code.

1.04 SUBMITTALS

A. Provide a separate electrical submittal for all field mounted starters and disconnects not included as integral pieces of Plumbing equipment. Submittal shall conform to requirements of Division 1 and Sections 16441 and 16481.

B. For Plumbing equipment with integral starters and/or disconnects no separate electrical submittal is required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification sections.

C. Before any electrical work is performed submit wiring diagrams and methods of powering and controlling all electrically connected or operating equipment to the Architect for approval. Controls subcontractor shall check and approve all diagrams before submittal to the Engineer. The diagrams shall show points of connection of equipment to system provided by the Electrical Contractor and shall show conduit and wire sizes.

1.05 QUALITY ASSURANCE

A. All electrical equipment and materials shall be UL labeled.

PART 2 PRODUCTS

2.01 MOTORS

A. The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements shall be specified by the Engineer in the individual equipment specifications.

1. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.

2. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range.

3. Temperature Rating: Rated for 40 deg. C. environment with maximum 50 deg. C. temperature rise for continuous duty at full load (Class A Insulation).

4. Starting capability: Frequency of starts as indicated by automatic control system, and not less than 5 evenly time spaced starts per hour for manually controlled motors.

5. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors.

6. Motor construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque.
   a. Frames: NEMA Standard No. 48 or 54; use driven equipment manufacturer's standards to suit specific application.
   b. Bearings:
      1) ball or roller bearings with inner and outer shaft seals;
      2) re-greasable, except permanently sealed where motor is normally inaccessible for regular maintenance;
      3) designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor;
      4) for fractional horsepower (1/20 hp and below), light duty motors, sleeve type bearings are permitted.
   c. Enclosure Type:
      1) open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation;
      2) guarded drip-proof motors where exposed to contact by employees or building occupants;
      3) weather protected Type I for outdoor use, Type II where not housed;
   d. Overload protection: Built-in thermal overload protection and, where indicated, internal sensing device suitable for signaling and stopping motor at starter.
   e. Noise rating: "Quiet" rating on motors located in occupied spaces of building.
   f. Efficiency: All motors shall be "Energy Efficient". Motors shall have a minimum efficiency as scheduled in accordance with IEEE Standard 112, test method B. If efficiency not specified, motors shall have a higher efficiency than "average standard industry motors", in accordance with IEEE Standard 112, test method B.
   g. Nameplate: indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

7. All motors shall be of the quiet operating type, guaranteed to fulfill the specified requirements without producing objectionable sound in occupied areas of the building. All belt connected motors shall have adjustable bases and set screws to maintain proper belt tension. All fan motors shall have adjustable sheaves for speed adjustment, and one belt more than computed.

8. No shaded pole motors will be acceptable on any equipment above 1/20 horsepower.

2.02 DISCONNECT SWITCHES

A. Shall conform to all requirements specified in Section 16441 - "Enclosed Switches".

B. Disconnect switches shall be fused.

C. Nema 4X disconnect switches shall be provided in wet areas, refer to drawings.

2.03 MOTOR STARTERS AND COMBINATION STARTERS

A. Shall conform to all requirements specified in Section 16481 - "Enclosed Motor Controllers".

PART 3 EXECUTION

3.01 CONDUCTOR SIZES SHALL BE AS SPECIFIED IN THE NATIONAL ELECTRICAL CODE.

3.02 Control circuits shall be 120 volts or 24 volts. Electrical Contractor shall provide in-line toggle switch, labeled and identified, at each control panel and starter to disconnect control power. All control power shall be provided from the load side of toggle switches, such that the switches will turn off power to their respective control panel and associated control power.

3.03 Ground all equipment per requirements of the National Electrical Code.

3.04 Equipment overcurrent protection and conductors in the electrical contract shall be sized to accommodate most major brands of Plumbing equipment. If the Plumbing Contractor chooses to use an item of equipment that exceeds the capacity of the electrical overcurrent protection and conductors, or requires multiple circuits, the Plumbing Contractor shall be responsible for any additional cost required to increase the size of the overcurrent protection and conductors or provide the additional circuits and disconnects at no additional cost to the Owner or Electrical Contractor. He shall also coordinate this work with the Electrical Contractor to assure proper electrical service to the equipment.

END OF SECTION

SECTION 15135

GAUGES AND METERS

PART 1 GENERAL

1.01 SCOPE

A. Pressure gauges and pressure gauge taps.

B. Thermometers and thermometer wells.

1.02 RELATED SECTIONS

A. Section 15410 - Plumbing Pipe.

1.03 REFERENCES

A. ASME - B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.

B. ASTM E1 - Specification for ASTM Thermometers.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.01 PRESSURE GAUGES

A. Manufacturers:

1. Palmer Instruments.

2. Weiss Instruments Model UG-2.

3. Ametek, U.S. Gauge Div.

B. Gauge: ASME B40.1, drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.

1. Case: Steel with brass bourdon tube.

2. Size: 3-1/2 inch diameter.

3. Mid-Scale Accuracy: One percent.

4. Scale: Psi 0-100.

2.02 PRESSURE GAUGE TAPPINGS

A. Gauge Cock: Tee or lever handle, brass for maximum 150 psig.

B. Needle Valve: Stainless Steel, 1/4 inch NPT for minimum 150 psig.

C. Siphon: Bronze, 1/4 inch angle or straight pattern.

2.03 STEM TYPE THERMOMETERS

A. Manufacturer:

1. Palmer Instruments.

2. Weiss Instruments Model 3 VBM.

3. Substitutions: Permitted with prior approval.

B. Thermometer: ASTM E1, adjustable angle, round dial-type, with type 304 stainless steel case and positive locking device.

1. Size: 9 inch

2. Window: Clear glass.

3. Stem: ½ inch NPT brass; length as required per pipe diameter.

4. Scale: 0° F. – 200° F.

5. Calibration: Degrees F.

6. Accuracy: 1 percent.

2.04 THERMOMETER SUPPORTS

A. Socket: Brass separate sockets for thermometer stems with or without extensions as required, and with cap and chain.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide instruments with scale ranges selected according to service with largest appropriate scale.

C. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

D. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

E. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

END OF SECTION

SECTION 15140

PLUMBING SUPPORTS AND ANCHORS

PART 1 GENERAL

1.01 SCOPE

A. Pipe and equipment hangers and supports

B. Equipment bases and supports

C. Sleeves and seals

D. Flashing and sealing equipment and pipe stacks

1.02 RELATED SECTIONS

A. 03300 Cast-In Place Concrete: Equipment Bases

B. 09900 Painting

C. 15410 Plumbing Piping

D. 15430 Plumbing Specialties

E. 15440 Plumbing Fixtures

F. 15450 Plumbing Equipment

1.03 REFERENCES

A. ASME B31.1

B. ASME B31.2

C. ASME B31.5

D. ASME B31.9

E. ASTM F708

F. MSS SP58

G. MSS SP69

H. MSS SP89

I. UL 203

1.04 SUBMITTALS

A. Submit under provisions of Division 1

B. Product Data: Provide manufacturer's catalog data including load capacity.

C. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

D. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

1.05 REGULATORY REQUIREMENTS

A. Conform to applicable code for support of specified piping systems.

PART 2 PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

A. Pipe hangers and supports shall be a size to support piping filled with water with a safety factor of 5 based on ultimate tensile strength, without sagging or excessive vibration or movements. Pipe hangers shall be sized to permit insulation to pass through. Use one hanger manufacturer throughout this project. Supports for vertical piping passing through floors shall be heavy steel riser clamps, bolted each side.

B. Manufacturers:

1. Grinnell Corporation
2. Elcen Metal Products
3. Mason Industries, Inc.
4. Vibration Mountings & Controls
5. B-Line Systems, Inc.

C. Piping:

1. Plumbing Piping – DWV.
   a. Conform to ASME B31, 9.
   b. Hangers for pipe sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
2. Hangers for pipe sizes 2 inches and over: Carbon steel, adjustable, clevis.
3. Multiple or trapeze hangers: Steel channels with welded spacers and hanger rods.
4. Wall support for pipe sizes to 3 inches: Cast iron hook.
5. Wall support for pipe sizes 4 inches and over: Welded steel bracket and wrought steel clamp.
6. Vertical support: Steel riser clamp.
7. Floor support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

D. Plumbing Piping - Water:

1. Conform to ASME B31.9.

2. Hangers for pipe sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.

3. Hangers for cold pipe sizes 2 inches and over: Carbon steel, adjustable, clevis.

4. Multiple or trapeze hangers: Steel channels with welded spacers and hanger rods.

5. Wall support for pipe sizes to 3 inches: Cast iron hook.

6. Vertical support: Steel riser clamp.

7. Floor support for cold pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

8. Floor support for hot pipe sizes to 4 inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

9. Copper pipe support: Carbon steel ring, adjustable, copper plated.

2.02 ACCESSORIES

A. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded, with washers on both sides of hangers. Double nut connection.

B. Roof Top Supports: Non-penetrating roof support of 100% UV resistant recycled rubber, or polycarbonate resin pipe supports.

1. B-Line, C Port

2. Miro pillow block pipe supports

3. MAPA

2.03 INSERTS

A. Manufacturers:

1. Hilti Corp.

2. The Rawlplug Co., Inc.

3. Heckman Building Products, Inc.

B. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.04 FLASHING

A. Metal Flashing: 26 gauge galvanized steel

B. Metal Counterflashing: 22 gauge galvanized steel

C. Lead Flashing:

1. Waterproofing: 5 lb/sq ft sheet lead

2. Soundproofing: 1 lb/sq ft sheet lead

D. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing

E. Caps: Steel, 22 gauge minimum; 16 gauge at fire resistant elements

2.05 SLEEVES

A. Sleeves for Pipes through Non-fire Rated Floors: 18 gauge galvanized steel.

B. Sleeves for Pipes through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe, Schedule 40 or 18 gauge of galvanized steel.

C. Sleeves for Pipes through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed. Refer to details on drawings.

D. Firestopping Insulation: In lieu of prefabricated sleeves Contractor may provide penetration seal materials in accordance with printed instructions of the U.L. Fire Resistance Directory and in accordance with manufacturer's instruction, and as required by local code officials.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. All firestopping of Plumbing penetrations shall be provided by the Plumbing Contractor. Install all firestopping penetration seal materials in accordance with printed instructions of the U.L. Fire Resistance Directory and in accordance with manufacturer's instruction, and as required by local code officials.

3.02 INSERTS

A. Provide inserts for placement in concrete formwork.

B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, core drill through concrete slab and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab. Obtain Architect's approval of locations prior to drilling.

3.03 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as scheduled.

B. Hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

C. Place hangers within 12 inches of each horizontal elbow.

D. Use hangers with 1-1/2 inch minimum vertical adjustment.

E. Support vertical piping at every floor.

F. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

G. Support riser piping independently of connected horizontal piping.

H. Provide copper plated hangers and supports for copper piping.

I. Design hangers for pipe movement without disengagement of supported pipe.

J. Prime coat exposed steel hangers and supports. Refer to Section 09900. Hangers and supports located in crawl spaces, pipe shafts and suspended ceiling spaces are not considered exposed.

3.04 FLASHING

A. Provide flexible flashing and metal counterflashing where piping penetrates weather- or water-proofed walls, floors, and roofs.

B. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with commercial grade pre-fabricated flashing collars. For pipes through outside walls, turn flanges back into wall and caulk, metal counterflash, and seal.

C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.

D. Seal shower and mop sink drains watertight to adjacent materials.

E. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.05 SLEEVES

A. Set sleeves in position in formwork. Provide reinforcing around sleeves.

B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

C. Extend sleeves through floors one inch above finished floor level. Caulk sleeves.

D. Where piping penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and caulk air tight. Provide penetration seal materials in accordance with printed instructions of the U.L. Fire Resistance Directory and in accordance with manufacturer's instruction, and as required by local code officials. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

E. Prefabricated fire rated sleeves shall be installed in accordance with manufacturer's instruction. Install stainless steel escutcheons at finished surfaces.

F. Install chrome plated steel escutcheons at finished surfaces.

3.06 EQUIPMENT BASES AND SUPPORTS

A. Pads will be provided by Plumbing Contractor. Housekeeping pads shall be concrete, minimum 4 inches thick with ¾" chamfer edges and extending 6 inches beyond supported equipment on all sides. Plumbing Contractor shall provide all anchoring devices, inserts, etc. as required.

B. Contractor shall paint all equipment pads yellow in accordance with OSHA requirements.

3.07 SCHEDULES

Pipe Size	**Max. Hanger Spacing**	**Hanger Rod Diameter**
Inches	Feet	Inches
1/2 to 1-1/4	6	3/8
1-1/2 to 2	10	3/8
2-1/2 to 3	10	1/2
4 to 6	10	5/8
C.I. Bell and Spigot for No-Hub and at Joints	5	7/8

END OF SECTION

SECTION 15185

REFRIGERANT PIPING AND SPECIALTIES

PART 1 GENERAL

1.01 SCOPE

A. Piping

B. Refrigerant

C. Moisture and liquid indicators

D. Valves

E. Filter-driers

F. Expansion valves

1.02 RELATED SECTIONS

A. Section 15503 – Supports and Anchors

B. Section 15830 – Variable Refrigerant Volume HVAC System

C. Section 15085 - Piping Insulation

1.03 REFERENCES

A. ARI 495 - Refrigerant Liquid Receivers.

B. ARI 710 - Liquid Line Dryers.

C. ARI 730 - Flow-Capacity Rating and Application of Suction-Line Filters and Filter-Driers

D. ARI 750 - Thermostatic Refrigerant Expansion Valves.

E. ARI 760 - Solenoid Valves for Use with Volatile Refrigerants.

F. ASHRAE 15 - Safety Code for Mechanical Refrigeration.

G. ASHRAE 34 - Number Designation of Refrigerants.

H. ASME - Boiler and Pressure Vessel Codes, SEC 9 - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.

I. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

J. ASME B16.26 - Cast Copper Alloy Fittings For Flared Copper Tubes.

K. ASME B31.5 - Refrigeration Piping.

L. ASME B31.9 - Building Services Piping.

M. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

N. ASTM F708 - Design and Installation of Rigid Pipe Hangers.

O. AWS A5.8 - Brazing Filler Metal.

P. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.

Q. MSS SP69 - Pipe Hangers and Supports - Selection and Application.

R. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

S. UL 429 - Electrically Operated Valves.

1.04 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

B. Provide pipe hangers and supports in accordance with ASTM B31.5, MSS SP69 unless indicated otherwise.

C. Liquid Indicators:

1. Use line size liquid indicators in main liquid line leaving condenser.

2. If receiver is provided, install in liquid line leaving receiver.

3. Use line size on leaving side of liquid solenoid valves.

D. Valves:

1. Use service valves on suction and discharge of compressors.

2. Use gauge taps at compressor inlet and outlet.

E. Refrigerant Charging (Packed Angle) Valve: Use in liquid line between receiver shut-off valve and expansion valve.

F. Replaceable Cartridge Filter-Driers:

1. Use vertically in liquid line adjacent to receivers.

2. Use filter-driers for each solenoid valve.

G. Solenoid Valves:

1. Use in liquid line of systems operating with single pump-out or pump-down compressor control.

2. Use in liquid line of single or multiple evaporator systems.

1.05 SUBMITTALS

A. Submit under provisions of Division 1

B. Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions, and sizes.

C. Product Data: Provide general assembly of specialties, including manufacturer's catalog information. Provide manufacturers catalog data including load capacity.

D. Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

E. Test Reports: Indicate results of leak test, acid test.

F. Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.

G. Submit welders certification of compliance with ASME SEC 9.

1.06 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1

B. Record exact locations of equipment and refrigeration accessories on record drawings.

1.07 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 1

B. Maintenance Data: Include instructions for changing cartridges, assembly views, spare parts lists.

1.08 QUALIFICATIONS

A. Installer: Company specializing in performing the work of this section with minimum 5 years documented experience.

1.09 REGULATORY REQUIREMENTS

A. Conform to ASME B31.9 for installation of piping system.

B. Welding Materials and Procedures: Conform to ASME SEC 9 and applicable state labor regulations.

C. Welders Certification: In accordance with ASME SEC 9.

D. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 1 and Section 23 05 00.

B. Deliver and store piping and specialties in shipping containers with labeling in place.

C. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

D. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

1.11 MAINTENANCE MATERIALS

A. Provide maintenance materials under provisions of Division 1 and Section 23 05 00.

B. Provide two filter-dryer cartridges of each type.

PART 2 PRODUCTS

2.01 PIPING

A. Copper Tubing: ASTM B280, Type ACR hard drawn.

1. Fittings: ASME B16.22 wrought copper.

2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.

B. Copper Tubing to 7/8 inch OD: ASTM B88, Type K, annealed.

1. Fittings: ASME B16.26 cast copper.

2. Joints: Flared.

C. Pipe Supports and Anchors:

1. Conform to ASME B31.5, ASTM F708, MSS SP58, MSS SP69, MSS SP89.

2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron or Carbon steel, adjustable swivel, split ring.

3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.

4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

5. Wall Support for Pipe Sizes to 3 Inches Cast iron hook.

6. Vertical Support: Steel riser clamp.

7. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

8. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

9. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

10. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.02 REFRIGERANT

A. Refrigerant: Refer to equipment schedules

2.03 MOISTURE AND LIQUID INDICATORS

A. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum working pressure of 500 psig, and maximum temperature of 200 degrees F.

2.04 VALVES

A. Diaphragm Packless Valves:

1. UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, solder or flared ends, with positive backseating; for maximum working pressure of 500 psig and maximum temperature of 275 degrees F.

B. Packed Angle Valves:

1. Forged brass, forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, solder or flared ends; for maximum working pressure of 500 psig and maximum temperature of 275 degrees F.

C. Ball Valves:

1. Two piece forged brass body with Teflon ball seals and copper tube extensions, brass seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psig and maximum temperature of 300 degrees F.

D. Service Valves:

1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or solder ends, for maximum pressure of 500 psig.

2.05 FILTER-DRIERS

A. Replaceable Cartridge Angle Type:

1. Shell: ARI 710, UL listed, brass, removable cap, for maximum working pressure of 500 psig.

2. Filter Cartridge: Pleated media with integral end rings, stainless steel support.

3. Filter/Dryer Cartridge: Pleated media with solid core sieve with activated alumina.

2.06 SOLENOID VALVES

A. Valve: ARI 760, pilot operated, copper or brass body and internal parts, synthetic seat, stainless steel stem and plunger assembly, with flared, solder, or threaded ends, for maximum working pressure of 500 psig. Stem shall permit manual operation in case of coil failure.

B. Coil Assembly: UL listed, replaceable with molded electromagnetic coil, moisture, and fungus proof, with surge protector and color-coded lead wires, integral junction box with pilot light.

C. Electrical Characteristics: 120 volts, single phase, 60 Hz.

2.07 EXPANSION VALVES

A. Angle or Straight Through Type: ARI 750; design suitable for refrigerant, brass body, internal or external equalizer, bleed hole, mechanical pressure limit (maximum operating pressure MOP feature), adjustable non-adjustable superheat setting, replaceable inlet strainer, with non-replaceable capillary tube and remote sensing bulb.

B. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F superheat. Select to avoid being undersized at full load and excessively oversized at part load.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

A. Install refrigeration specialties in accordance with manufacturer's instructions.

B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.

C. Install piping to conserve building space and not interfere with use of space.

D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Pipe Hangers and Supports:

1. Install in accordance with ASTM B31.5, ASTM F708, and MSS SP89.

2. Support horizontal piping as scheduled.

3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

4. Place hangers within 12 inches of each horizontal elbow.

5. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.

6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

7. Provide copper plated hangers and supports for copper piping.

G. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.

H. Provide clearance for installation of insulation and access to valves and fittings.

I. Provide access to concealed valves and fittings.

J. Flood piping system with nitrogen when brazing.

K. Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.

L. Prepare unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09900.

M. Insulate piping and equipment; refer to Section 15085.

N. Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.

O. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.

P. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.

Q. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.

R. Fully charge completed system with refrigerant after testing.

3.03 FIELD QUALITY CONTROL

A. Test refrigeration system in accordance with ASME B31.5.

B. Pressure test system with dry nitrogen to 200 psig. Test to no leakage.

3.04 SCHEDULES

A. Pipe Hanger Spacing

PIPE SIZE Inches	MAX. HANGER SPACING Feet	HANGER ROD DIAMETER Inches
1/2 to 1-1/4	6.5	3/8
1-1/2 to 2	10	3/8

END OF SECTION 15185

SECTION 15190

PLUMBING IDENTIFICATION

PART 1 GENERAL

1.01 SCOPE

A. Nameplates

B. Tags

C. Pipe Markers

1.02 RELATED SECTIONS

A. Section 09900 - Painting

1.03 REFERENCES

A. ASME A13.1

1.04 SUBMITTALS

A. Submit under provisions of Division 1

B. Submit list of wording, symbols, letter size, and color coding for plumbing identification.

C. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Product Data: Provide manufacturer's catalog literature for each product required.

E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

1.05 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1

PART 2 PRODUCTS

2.01 NAMEPLATES

A. Manufacturers:

1. Seton Name Plate Co.

2. W. H. Brady Co.

3. Preferred Utilities Mfg. Corp.

B. Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.02 TAGS

A. Install label on valve or device body. Indicate type of device and associated service on label. (e.g. "Shutoff Valve – DCW")

B. Provide custom printed Indoor / outdoor vinyl or polypropylene markers for each valve. Utilize portable printer equal to Brady HandiMark Portable Industrial Labeling System.

C. Chart: Provide letter size list of valves and locations in anodized aluminum frame with plexi-glass cover.

2.03 PIPE MARKERS

A. Manufacturers:

1. Seton Name Plate Co.

2. W. H. Brady Co.

3. Carlton Industries. Inc.

B. Color: ASME A131 standards. Refer to schedule at end of this section.

C. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

E. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mils thick, and solid aluminum foil core between 2 layers of plastic tape, manufactured for direct burial service.

2.04 CEILING MARKERS

A. Install label on ceiling grid in proximity to device above ceiling. Indicate type of device and associated service on label. (e.g. "Shutoff Valve – DCW", "Shock Absorber – DCW")

B. Provide custom printed labels, either of vinyl suitable for indoor / outdoor applications or of polypropylene for each device. Utilize portable printer equal to Brady HandiMark Portable Industrial Labeling System.

C. Maximum height of label is one inch. Maximum width of label is one inch. Black lettering on white tape.

D. Provide pipe markers and flow arrows at 10 foot intervals at all turns and at each floor level or all partitions.

PART 3 - EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Section 09900 for stencil painting.

3.02 INSTALLATION

A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Apply stencil painting in accordance with Section 09900.

C. Identify valves in main and branch piping with labels.

D. Identify piping, concealed or exposed, with plastic pipe markers. Identify service, flow direction and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet apart on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

E. Provide ceiling grid labels to locate valves and shock absorbers above T-bar panel ceilings. Locate on grid in proximity to valve.

3.03 SCHEDULES FOR PIPE LABELS

Piping Fluid	Color	Background Letter and Abbreviation	Arrow Color
Domestic Cold Water	Green	CW	White
Domestic Hot Water	Red	HW	White
Tepid Water	Purple	TW	White

3.04 SCHEDULES FOR PIPE

SYSTEM	COLOR
COLD WATER	DARK BLUE
HOT WATER	DARK RED
FIRE PROTECTION	BRIGHT RED

END OF SECTION

SECTION 15410

PLUMBING PIPING

PART 1 GENERAL

1.01 SCOPE

A. Pipe and pipe fittings

B. Valves

C. Sanitary sewer piping system

D. Domestic water piping system

1.02 RELATED SECTIONS

A. Section 02222 - Excavating

B. Section 02223 - Backfilling

C. Section 02225 - Trenching

D. Section 09900 - Painting

E. Section 15121 - Expansion Compensation

F. Section 15140 - Supports and Anchors

G. Section 15190 - Plumbing Identification

H. Section 15260 - Plumbing Piping Insulation

I. Section 15430 – Plumbing Specialties

J. Section 15440 – Plumbing Fixtures

K. Section 15450 – Plumbing Equipment

1.03 REFERENCES

A. ASME B16.3 - Malleable Iron Threaded Fittings

B. ASME B16.4 - Cast Iron Threaded Fittings Class 125 and 250

C. ASME B16.18 - Cast Bronze Solder-Joint Pressure Fittings

D. ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings

E. ASTM A47 - Ferritic Malleable Iron Castings

F. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless

G. ASTM A74 - Cast Iron Soil Pipe and Fitting

H. ASTM A120 - Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized), Welded and Seamless, for Ordinary Uses

I. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

J. ASTM B32 - Solder Metal

K. ASTM B42 - Seamless Copper Pipe

L. ASTM B43 - Seamless Red Brass Pipe

M. ASTM B75 - Seamless Copper Tube

N. ASTM B88 - Seamless Copper Water Tube

O. ASTM B251 - Wrought Seamless Copper and Copper-Alloy Tube

P. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings

Q. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems

R. CISPI 310 - Joints for Hubless Cast Iron Sanitary System

S. AWS A5.8 - Brazing Filler Metal

1.04 SUBMITTALS

A. Submit under provisions of Division 1

B. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories. Provide manufacturer's catalog information. Indicate valve data and ratings

1.05 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1

B. Record actual locations of valves and underground piping

1.06 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 1

B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views

1.07 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.

C. Welder's Certification: In accordance with ASME Sec 9.

1.08 QUALIFICATIONS

A. Installer: Company specializing in performing the work of this section with minimum 10 years' experience.

1.09 REGULATORY REQUIREMENTS

A. Perform Work in accordance with Martin County requirements and N.C. Plumbing code.

B. Conform with Martin County and N.C. Plumbing code for installation of backflow prevention devices.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01600.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system. Rags, wool, cotton waste or similar materials may not be used in plugging.

1.11 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF THE BUILDING

A. Plastic Pipe: ASTM D2665, PVC Schedule 40 material; bell and spigot style solvent sealed joint end.

1. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, clean-outs, reducers, traps and other configurations required.

2. Joints: ASTM D2855 solvent weld with ASTM D2564 solvent cement.

B. Bedding Materials

1. Bedding: As recommended by pipe manufacturer

C. Trenching:

1. See Section 02200

2.02 SANITARY SEWER PIPING, ABOVE GRADE

A. Plastic pipe ASTM D2665, PVC Schedule 40 material, bell and spigot style, solvent sealed joint ends. (Not permitted in kitchen areas).

1. Fittings: Same as 2.01, B.1.

2. Joints: Same as 2.01, B.2.

3. Installed per manufacturer's recommendations.

2.03 WATER PIPING, BURIED - PIPE 3 INCHES AND LESS

A. Copper Tubing: ASTM B88, Type K, annealed.

1. Fittings: ASME B16.18, cast bronze or ASTM B16.22 wrought copper and bronze.

2. Joints: AWS A5.8, BCuP silver braze.

2.04 WATER PIPING, ABOVE GRADE

A. Copper Tubing: ASTM B88, Type L, hard drawn.

1. Fittings: ASME B16.18, cast bronze or ASTM B16.22 wrought copper and bronze.

2. Joints: ASTM B32, solder, Grade 95TA for piping 1 1/4" and smaller; AWS A5.8, BCuP silver braze for piping 1 1/2" and larger.

2.05 FLANGES, UNIONS, AND COUPLINGS

A. Pipe Size 2 Inches and Under:

1. Ferrous pipe: 150 psig malleable iron threaded unions.

2. Copper tube and pipe: 150 psig bronze unions with soldered joints.

B. Pipe Size Over 2 Inches:

1. Ferrous pipe: 150 psig forged steel slip-on flanges; 1/16 inch thick preformed neoprene gaskets.

2. Copper tube and pipe: 150 psig slip-on bronze flanges; 1/16 inch thick preformed neoprene gaskets.

C. Grooved and Shouldered Pipe End Couplings:

1. Housing: Malleable iron clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; steel bolts, nuts, and washers; galvanized for galvanized pipe.

2. Sealing gasket: "C" shape composition sealing gasket.

D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.06 GATE VALVES (BELOW GRADE INSTALLATIONS ONLY)

A. Manufacturers:

1. Hammond
2. Milwaukee
3. Nibco

B. Up to and including 2 Inches: Bronze body, bronze trim, non-rising stem, handwheel, inside screw, single wedge or disc, solder ends 125 WSP-200 WOG rating.

C. Over 2 Inches: Bronze body, bronze trim, rising stem, handwheel, single wedge, solder ends, 125 WSP-200 WOG rating.

D. Install valves in meter box. Box to be flush with finished grade.

2.07 BALL VALVES (INTERIOR ABOVE GROUND INSTALLATION)

A. Manufacturers:

1. Apollo
2. Nibco
3. Hammond

B. Up to and including 2 Inches: Bronze, two piece body, stainless steel ball, teflon seats and stuffing box ring, lever handle, solder ends, Class 150, 200 WOG.

C. Over 2 Inches: Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, flanged Class 150.

2.08 SWING CHECK VALVES

A. Manufacturers:

1. Milwaukee
2. Jenkins
3. Stockham
4. Nibco
5. Hammond

B. Up to and including 2 Inches: Bronze swing disc, threaded ends, Class 125.

C. Over 2 Inches: Iron body, bronze trim, swing disc, renewable disc and seat, flanged ends, Class 125.

2.09 RELIEF VALVES

A. Manufacturers:

1. Watts
2. B & G

B. Bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

2.10 STRAINERS

A. Manufacturers:

1. Watts
2. B&G
3. Wilkins

B. 2 inch and Under: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

C. Size 2-1/2 inch to 4 inch: Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify excavations under provisions of Division 1.

B. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient.

D. Install piping to conserve building space and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Provide clearance for installation of insulation and access to valves and fittings.

H. Provide access where valves and fittings are not exposed.

I. Establish elevations of buried piping outside the building to ensure not less than 2 ft of cover. If job conditions do not permit this depth Contractor shall request approval from Architect for a shallower depth.

J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

K. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting. Refer to Section 09900.

L. Excavate in accordance with Section 02225 for work of this Section.

M. Backfill in accordance with Section 02225 for work of this Section.

N. Install bell and spigot pipe with bell end upstream.

O. Install valves with stems upright or horizontal, not inverted.

P. Provide one plug valve wrench for every ten plug valves sized 2 inches and smaller, minimum of one.

Q. All exposed ceiling and wall pipe penetrations shall be provided with chrome escutcheons.

3.04 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.

C. Install gate or ball valves for shut-off and to isolate equipment, part of systems or vertical risers.

D. Install globe or ball valves for throttling, bypass, or manual flow control services.

E. Provide plug valves in gas systems for shut-off service.

3.05 ERECTION TOLERANCES

A. Establish invert elevations, slopes for drainage to 1/4 inch per foot for pipes less than 4 inches in diameter and 1/8 inch per foot for pipes 4 inches and larger. Maintain gradients.

B. Slope water piping and arrange to drain at low points.

3.06 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Prior to starting work, verify system is complete, flushed and clean.

B. Ensure PH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 parts per million of chlorine.

D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

E. Maintain disinfectant in system for 24 hours.

F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

H. Take samples no sooner than 24 hours after flushing, from 5 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

END OF SECTION

SECTION 15430

PLUMBING SPECIALTIES

PART 1 GENERAL

1.01 SCOPE

A. Hose Bibbs

B. Ice Maker Box

C. Floor Drains

D. Cleanouts

E. Water Hammer Arrestors

F. Backflow Preventers

G. Heat Tracing Cable

1.02 RELATED SECTIONS

A. Section 15410 - Plumbing Piping

B. Section 15440 - Plumbing Fixtures

C. Section 15450 - Plumbing Equipment

1.03 REFERENCES

A. ANSI/ASSE 1011 - Hose Connection Vacuum Breakers

B. ANSI/ASSE 1012 - Backflow Preventers with Immediate Atmospheric Vent

C. ANSI/ASSE 1013 - Backflow Preventers, Reduced Pressure Principle

D. ANSI/ASSE 1019 - Wall Hydrants, Frost Proof Automatic Draining Anti-Backflow Types

E. ANSI A112.21.1 - Floor Drains

F. AWWA C506 - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types

G. PDI WH-201 Water Hammer Arresters

1.04 SUBMITTALS

A. Submit under provisions of Division 1

B. Product Data: Provide component sizes, rough-in requirements, service sizes and finishes

1.05 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1

B. Locate clean outs with two dimensions to permanent structure

1.06 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 1

B. Maintenance Data: Include installation instructions, spare parts lists, and exploded assembly views.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 1.

B. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.01 HOSE BIBBS

A. Manufacturers:

1. Woodford, Model No. B24
2. Mifab, Model No., MHY-95
3. Prier Model No. C355-C156 BX-1

B. Interior: Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome plated where exposed, with removable loose key handle and integral vacuum breaker in conformance with ANSI/ASST 1011.

2.02 ICE MAKER BOX

A. Manufacturers:

1. Guy Gray Model No. M1B1HA or approved equal
2. Metal preformed rough-in box with brass valve and shock arrestor
3. Substitutions permitted with prior approval

2.03 FLOOR DRAINS

A. Manufacturers:

1. Zurn Model No. ZN-415
2. J. R. Smith Model No. 2005
3. Josam Model No. 3000.
4. Wade Model No. W-1100-STD5-1-6.

B. ANSI A112.21.2; lacquered cast iron two piece body with double drainage flange, weep holes, reversible flashing collar, and round adjustable nickel-bronze strainer. Provide 1072 ASSE approved trap guard equal to Sure Seal.

2.04 CLEANOUTS

A. Manufacturers:

1. Zurn.
2. J. R. Smith.
3. Josam.
4. Wade.

B. Interior Finished Floor Areas: Lacquered cast iron, round adjustable with taper thread bronze plug, scoriated nickel bronze cover, Model Z-1400 manufactured by Zurn, Model No. 4023 manufactured by Smith, Model No.5600-22-Y manufactured by Josam, or Model No. W-6000-1 manufactured by Wade.

C. Interior Finished Wall Areas: Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw; Model Z-1468 manufactured by Zurn, Model No. 4472 manufactured by Smith, Model No.58890 manufactured by Josam, or Model No. W-8480R manufactured by Wade.

D. Exterior Surfaced Areas: Round cast brass plug with recessed slot; Model Z-1470-BP manufactured by Zurn, Model No.4470-BP manufactured by Smith, Model No. 584540 manufactured by Josam, or Model No. W-8590 manufactured by Wade. Provide in 24" x 24" x 8" concrete pad.

2.05 WATER HAMMER ARRESTORS

A. Manufacturers:

1. Precision Plumbing Products, Inc.
2. Other acceptable manufacturers offering equivalent products.
   a. J. R. Smith.
   b. Zurn.
   c. Mifab.
   d. Wade

B. ANSI A112.26.1; sized in accordance with PDI WH-201, suitable for operation in temperature range -40 to 450 degrees F. (-73 to 149 degrees C.) and maximum 250 psig working pressure; copper water hammer arrestor, piston type, Model #SC Series.

2.06 BACKFLOW PREVENTERS

A. Manufacturers:

1. Watts.

2. Febco.

3. Conbraco.

4. Wilkins.

B. Reduced Pressure Backflow Preventers: ANSI/ASSE 1013, AWWA C506; bronze body with bronze and plastic internal parts and stainless steel springs; two independently operating, spring loaded check valves, epoxy coated; diaphragm type differential pressure relief valve located between check valves; third check valve which opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

C. Provide RPZ device with manufacturer's air gap drain assembly complete with copper piping piped to exterior of building.

2.07 HEATING CABLE

A. Furnish and Install a UL Listed, CSA Certified and FM Approved system of electric self-regulating heating cable, connection kits and electronic controller for maintaining the hot water as indicated on the drawings. The cable shall utilize a radiation-crosslinked conductive polymer as the heating element, and the cable shall be specifically designed, manufactured and UL Listed, CSA Certified and FM Approved for hot water temperature maintenance.

1. Construction: The self-regulating heating cable shall consist of two (2) 16 AWG (1.2 mm2) nickel-coated copper bus wires embedded in a radiation-crosslinked conductive polymer core. It shall be covered by a radiation-crosslinked, polyolefin, dielectric jacket surrounded by a polymer-coated aluminum wrap, and enclosed in a tinned copper braid of 14 AWG (2.5 mm2) equivalent wire size. The braid shall be covered with a (nominal) 40 mil (1 mm) polyolefin outer jacket, color coded for easy identification.
2. Mechanical: The cable shall have a minimum cut-through resistance of 100 lb (445 N) per the IEEE 515.1 (4.3.3) and CSA 130-03 (6.28) Resistance to Cutting Tests. The cable shall have a minimum impact resistance of l0 ft-lbs per the IEEE 515.1 (4.2.9) and CSA 130-03 (6.2.10.2) Impact Tests. The cable shall have a minimum abrasion resistance of 2500 cycles per the IEEE 515.1 (4.3.4) Abrasion Test. The cable shall withstand a crush resistance of 225 lbs per the IEEE 515.1(4.2.8) Deformation Test, and withstand a crush resistance of 345 lbs (1500 N) per the CSA 130-03 (6.2.7) Crush Resistance Test.
3. Connection Kits: All heating cable connection kits shall be UL Listed, CSA Certified and FM Approved for use as part of the system to maintain hot water temperature. Component enclosures shall be rated NEMA 4X to prevent water ingress and corrosion. Installation shall not require the installing contractor to cut into the heating cable core to expose the bus wires. Connection systems requiring the installing contractor strip the bus wires, or which use crimps or terminal blocks, shall not be acceptable. All connection kits except for the power connection shall be installed under the thermal insulation. The end seal shall use silicone gel.
4. Controller: Installed system shall include at least one agency-approved

electronic controller. The controller shall not be of line sensing over-limit design. The controller shall be capable of setting different pipe temperatures based on ambient and voltage with 24 hour, 7 day/week programmable options. The controller shall have the energy savings feature of lowering pipe temperature during low use periods and the ability to raise the temperature of the pipes for a programmed interval. The controller shall have BMS interface capabilities to set pipe temperatures and provide alarm relays in loss of power, incorrect water heater temperature and communication failure. The controller shall have flexible wiring configurations to operate individually or control up to eight additional controllers.

5. Maintain Temperatures: The system shall maintain temperatures between 105°F (40°C) and 140°F (60°C) at 208 V or single phase, 15 amp service. Temperature shall be maintained by utilizing an electronic controller with straight runs of heating cable on the pipe.
6. Insulation schedule shall be as follows: (This schedule is for heat traced pipe only.)

Insulation Thickness

Copper pipe size (in)	IPS insulation size (in)	Insulation thickness (in)
½	%	1/2
¾	1	1
1	1%	1
1%	1%	1%
11/2	1%	1%
2	2	2
2%	2%	21/2
3	3	3

Note: For pipe 1 1/4 inches and smaller, use insulation that is oversized by 1/4 inch to allow room for installing over the heating cables. For pipes three inches and larger, the thickness of insulation can be equal to the pipe diameter with one heating cable or 1/3 the pipe diameter with two runs of heating cable.

7. Power control (self-regulating index): The slope of the power/temperature shall be such that the power of the heating cable shall increase with decreasing temperature at a rate of at least 0.028 W/ft-°F (0.16W/m-°C) from 50°F (10°C) to 100°F (38°C).
8. Long-term thermal stability (as determined by accelerated testing): The power retention of the heating cable shall be at least 90% after 300 cycles between 50°F (10°C) and 212° (1 00°C).
9. High temperature withstand: The heater shall not decrease in resistance, overheat, or burn when powered at 208 V or 240 V and exposed to 400°F (205°C) in an oven for 30 minutes.
10. Installation and testing shall be per manufacturer.

PART 3 EXECUTION

3.01 PREPARATION

A. Coordinate cutting and forming of roof and floor construction to receive drains to required invert elevations.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

C. Encase exterior cleanouts in concrete flush with finished grade (24" x 24" x 8").

D. Pipe relief from backflow preventer to nearest drain.

END OF SECTION

SECTION 15440

PLUMBING FIXTURES

PART 1 GENERAL

1.01 SCOPE

A. Water closets

B. Lavatories

C. 2-Compartment Lab and Kitchen Sinks

D. Shower (ADA)

E. Emergency Shower/Eyewash Station

F. Electric Water Cooler

G. Mop Receptor

1.02 RELATED SECTIONS

A. Section 06402 - Interior Architectural Woodwork

B. Section 07901 - Joint Sealers: Seal fixtures to walls and floors

C. Section 15141 - Plumbing Supports and Anchors

D. Section 15410 - Plumbing Piping

E. Section 15430 - Plumbing Specialties

1.03 REFERENCES

A. ANSI/ASME A112.6.1 - Supports for Off-the-Floor Plumbing Fixtures for Public Use

B. ASME A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings

C. ANSI/ASME A112.19.1 - Enameled Cast Iron Plumbing Fixtures

D. ANSI/ASME A112.19.2 - Vitreous China Plumbing Fixtures

E. ANSI/ASME A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use)

F. ANSI/ASME A112.19.5 - Trim for Water-Closet Bowls, Tanks, and Urinals (Dimensional Standards)

G. ANSI/ARI 1010 - Drinking-Fountains and Self-Contained Mechanically-Refrigerated Drinking Water Coolers

H. ANSI/ISEA Z358.1 – Emergency Eyewash and Shower Equipment

1.04 SUBMITTALS

A. Submit under provisions of Division 1

B. Product Data: Provide color catalog illustrations of fixtures, sizes, utility sizes, trim and finishes.

1.05 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 1

B. Maintenance Data: Include fixture trim exploded view and replacement parts lists.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 1

B. Accept fixtures on site in factory packaging. Inspect for damage

C. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use

1.07 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated

B. Confirm that millwork is constructed with adequate provision for the installation of countertop lavatories and sinks

PART 2 PRODUCTS

2.01 WATER CLOSET (ADA)

A. Bowl:

1. Manufacturers:
   a. Kohler Model No. K-4350
   b. American Standard Model No. 2234.015
   c. Gerber Model No. Model No. 25-730

2. ANSI/ASME A112.19.2; floor mounted, siphon jet, vitreous china, elongated rim, bolt caps, 1 ½ inch spud, white, 1.6 gallon flush. Rim 17 inches above floor.

B. Flush Valve:

1. Manufacturers:
   a. Sloan Model No. Optima Plus 8111-62
   b. Zurn Model No. ZER-6000-CP-WS1-YB-YC
   c. Delany Model No. PL1402-1.6

2. ASME A112.18.1; exposed "water saving" chrome plated battery powered sensor operated flush valve, I.P.S. screw driver operated combination angle check and stop valve with protective cap, adjustable tailpiece, vacuum

breaker flush connection and spud coupling for top spud, wall and spud flanges, solid ring pipe support, 1.6 gal/flush.

C. Seat:

1. Manufacturers:
   a. Church Model No. 9500 NSSC
   b. Bemis Model No. 1655SSC
   c. Olsonite Model No. 95CCSS
   d. Beneke Model No. 527SS

2. Solid white plastic, open front, extended back, self-sustaining hinge, brass bolts, without cover.

2.02 LAVATORY (ADA)

A. Basin:

1. Manufacturers:
   a. Kohler Model No. K-2849 Hudson
   b. American Standard Model No. 4869.020 Regalyn
   c. TOTO Model No. LT307.4

2. ANSI/ASME A112.19.1; enameled cast iron, wall-hung, 20" x 18", faucet ledge, front overflow, 4 inch centers, 4 inch high back, soap depression, wall hanger, white. Mount 34" inches to rim.

B. Trim:

1. Faucet: ASME A112.18.1; single post, battery powered, sensor operated, electric hand washing faucet with integral above deck temperature mixer, chrome plated finish, solid brass construction, ADA compliant and 0.5 GPM vandal resistant aerator.
   a. Sloan Model No. EAF-150-ISM
   b. Chicago Model No. 116.121.AB.1
   c. Symmons Model No. S-6080

2. Cast brass grid drain (17 gauge) with 6" x 1¼" tailpiece
   a. McGuire Model No. 155A
   b. Kohler Model No. K-7715
   c. Brasscraft Model No. 0701
   d. T&S Model No. B-0899
   e. Zurn Model No. Z-8743

3. Trap: Cast brass 17 gauge swivel joint 1¼" x 1½" trap with clean out plug and nipple and, escutcheon, cast brass slip nuts, polished chrome plated finish.
   a. McGuire Model No. 8902
   b. Kohler Model No. K8999
   c. Brasscraft Model No. 0120
   d. Zurn Model No. Z-8701-9-B

4. Supplies: 1/2" I.P.S. brass chrome plated angle supply with flexible riser, loose key stop and escutcheons.
   a. McGuire Model No. 2165LK
   b. Brasscraft Model No. SR1712AC
   c. T&S Brass Model No. B1305
   d. Zurn Model No. Z-8802-LR-LK

5. White pre-molded antimicrobial vinyl insulation kit on tailpiece, p-trap and supplies.
   a. Truebro Model No. 102K
   b. McGuire Prowrap Model No. PW2000
   c. Zurn Model Z-8946-1
   d. Plumberex Model No. X4333

6. Wall mounted carrier:
   a. Manufacturers:
      1) Zurn Z-1224
      2) Smith 0700
      3) Josam 17100
   b. Top support plate, rectangular steel uprights with welded feet, adjustable support plate and mounting fasteners.

2.03 TWO COMPARTMENT SINK

A. Bowl (Break Room):

1. Manufacturers:
   a. Elkay Model LRAD-3319-5-DS
   b. Just Model No. DL-ADA-1933-A-GR

2. ANSI/ASME A112.19.3; Double compartment, 18 gauge thick Type 302 stainless steel, self-rimming with undercoating, LK-35 basket strainer with chrome brass drain, located in rear center of each bowl, and 5" deep bowl.

B. Bowl (Lab):

Epoxy resin sink molded from thermosetting epoxy resin, molded interior corners to radius, slope sink base to drain outlet, 1-1/2" outlet, with overflow. Color to match adjacent work surfaces.

1. Manufacturers:
   a. Durcon
   b. LOC Scientific
   c. Chem Tops
   d. Kewanee

C. Trim:

1. Faucet: single handle with swing spout, 2.0 GPM aerator, polished chrome finish, hose spray.
   a. Elkay Model No. LK-4102
   b. Chicago Model No. 2200-4CP
   c. T&S Model No. B2731-LH.

2. Strainers: Stainless steel strainer basket with flex stem and rubber stopper, fits 3½" opening, chrome-plated brass, 1-½" off-set tailpiece, one for each compartment.
   a. Elkay Model No. LKAD-35 & LK-53
   b. McGuire Model No. 1151WC & 111C21G17
   c. Just Model No. J-ADA-35
   d. Zurn Model No. Z-8702-9-B

3. Trap: Cast brass 17 gauge swivel joint 1½" x 1½" trap with clean out plug and nipple and escutcheon, cast brass slip nuts, polished chrome plated finish, 1½ chrome plated brass center outlet continuous waste.
   a. McGuire Model No. 8912 & 111C21G17 Cont. Waste.
   b. Kohler Model No. K8999
   c. Brasscraft Model No. 0030
   d. Zurn Model No. Z-8702-9-B & A-8754

4. Supplies: ½" I.P.S. brass chrome plated angle supply with flexible riser, loose key stop with escutcheon.
   a. McGuire Model No. 2167LK
   b. Brasscraft Model No. SR3712AC
   c. T&S Brass Model No. B1305
   d. Zurn Model No. Z-8803-LR-LK

5. White pre-molded antimicrobial vinyl insulation kit on tailpiece, p-trap, continuous waste from second bowl and supplies.
   a. Truebro
   b. McGuire Prowrap
   c. Plumberex

6. Mount in cabinet top as shown and specified under Architectural work.

2.04 SHOWER (ADA)

A. Pressure-balancing shower valve, hand spray with 5 feet of chrome-plated hose with inline vacuum breaker, 24 inch chrome bar with adjustable slide, diverter valve, and fixed shower head.

   1. Manufacturers:
      a. Symmons Model No. 1-117VT-FS-XB24
      b. Delta Model No. 11T5-0-3

B. Drain shall be brass with stainless steel top and to equal Lasco Model No. 03-1223.

C. Shower compartment shall be fiberglass with grab bar, folding seat, curtain, and curtain rod. Unit shall be equal to Clarion Model No. 3837BF24, 38" X 38" x 78".

2.05 EMERGENCY SHOWER (P-12)

A. Barrier free, combination eye/face wash and shower safety station with stainless steel shower head, stainless steel bowl, powder coated cast aluminum flag handle and floor flange, 1 ¼" IPS schedule 40 galvanized pipe and fittings, 1" IPS and ½" IPS U.S. made chrome plated brass stay open ball valves, and polished stainless steel pull rod. Shower unit shall have a 20 gpm flow controlled orifice. Unit shall

have spray heads with integral flip-top dust covers, filters, and 3.0 gpm flow control orifices mounted on a chrome plated brass eyewash assembly. Unit shall include ANSI sign and inspection tag.

B. Fixture shall be equal to Guardian Model No. GBF1909SSH

C. Performance: Unit shall comply with ADA requirements for accessibility by handicapped persons. Unit shall meet or exceed current ANSI Z358.1.

2.06 PLASTIC EMERGENCY SHOWER (P-16)

A. Barrier free, plastic combination eye/face wash and shower safety station with plastic shower head and bowl, 1 ¼" IPS schedule 40 galvanized pipe and fittings, 1" IPS and ½" IPS U.S. made chrome plated brass stay open ball valves, and polished stainless steel pull rod. Shower unit shall have a 20 gpm flow controlled orifice. Unit shall have spray heads with integral flip-top dust covers, filters, and 3.0 gpm flow control orifices mounted on a eyewash assembly. Unit shall include ANSI sign and inspection tag.

B. Fixture shall be equal to ULINE Model No. H5101

C. Safety Shower Water Heater: P-16, Self-contained safety shower water heater 54 Kw, 480 volts @ 65 amps, tank less water heater with temperature controller, solid state relays, ASME rated heat exchanger, NEMA 4X enclosure, with scald protection and adjustable temperature control and freeze protection. Unit shall be suited for outdoor installation.

1. Manufacturers:
   a. Keltech SNA Series
   b. Bradley Corporation
   c. Hubbell Model ETX

D. Performance: Unit shall comply with ADA requirements for accessibility by handicapped persons. Unit shall meet or exceed current ANSI Z358.1.

2.07 ELECTRIC WATER COOLER

A. Fountain:

1. Manufacturers:
   a. Haws Model No. HWUACP8LSS
   b. Elkay Model No. EZTL8-SS
   c. Oasis Model No. P8ACSL-SS

2. ANSI/ARI 1010; two-level wheelchair accessible electric water cooler with stainless steel top, steel body, elevated anti-squirt flexi-guard bubbler with stream guard, automatic stream regulator, mounting bracket, refrigerated with integral air cooled condenser. Unit shall deliver 8.0 GPH of 50 degrees F water at 90 degrees F ambient and 80 degrees F inlet water. Unit shall be equipped with self-closing front and side push bars. Color shall be stainless steel.
   a. Mount lowest unit 34 inches above finished floor. Provide trap, cast brass swivel joint 1-1/4" x 1-1/4" trap with cleanout plug and nipple and

escutcheon - McGuire 8872; Brasscraft 0210; Kohler K8998. Supplies, 3/8" I.P.S. brass chrome plated angle supply with flexible riser, loose key stop and escutcheon - McGuire 165 LK; Brasscraft SR 1512 AC; T&S Brass.

3. Maintenance Data: Include adjustment instructions.

2.08 MOP RECEPTOR

A. Receptor shall be 24" x 24"x 12" type with drop front, molded stone, brass drain, removable stainless steel strainer. Color selection: white.

1. Fiat Model No. MSB2424
2. Florestone Model No. MSR 2424
3. Acorn Model No. TDF-24

B. Trim:

1. (Mop Receptor) ASME A112.18.1 exposed wall type supply with cross handles, spout wall brace, vacuum breaker, hose and spout, strainers, eccentric adjustable inlets, integral screwdriver stops with covering caps and adjustable threaded wall flanges; 3 feet of 1/2 inch diameter plain and reinforced rubber hose, hose clamp, (2) 12 x 24 inch stainless steel wall guards and mop hanger. Mop hanger shall be mounted above basin opposite of faucet.
   a. Faucet
      1) T&S Model No. B-0665-BSTP
      2) Chicago Model No. 8124
      3) Zurn Model No. Z-842M2

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Verify that electric power is available and of the correct characteristics.

3.2 PREPARATION

C. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install each fixture with trap, easily removable for servicing and cleaning.

C. Provide chrome plated rigid supplies to fixtures with loose key stops, reducers and escutcheons.

D. Install components level and plumb.

E. Install and secure fixtures in place with wall supports, wall carriers and bolts.

F. Seal fixtures to wall and floor surfaces with sealant as specified in Section 07901; color to match fixture.

G. Solidly attach water closets to floor with lag screws. Lead flashing is not intended to hold fixture in place.

3.03 INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.04 ADJUSTING

A. Adjust work under provisions of Division 1.

B. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.05 CLEANING

A. Clean work under provisions of Division 1

B. At completion, clean plumbing fixtures and equipment.

3.06 PROTECTION OF FINISHED WORK

A. Protect finished Work under provisions of Division 1

B. Do not permit use of fixtures until final acceptance of building

3.07 FIXTURE HEIGHTS

A. Install fixtures to heights above finished floor as indicated in Architectural specifications and on Engineer/Architectural drawings.

END OF SECTION

SECTION 15450

PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 SCOPE

A. Water Heaters

B. Thermostatic Mixing Valves

C. In-line Circulator Pumps

1.02 RELATED SECTIONS

A. Section 15140 - Supports and Anchors

B. Section 15100 – Electrical Requirements for Plumbing Equipment

1.03 REFERENCES

A. ANSI/ASHRAE 90A - Energy Conservation in New Building Design

B. ASME Section VIIID - Pressure Vessels; Boiler and Pressure Vessel Codes

C. ANSI/NFPA 30 - Flammable and Combustible Liquids Code

D. ANSI/NFPA 70 - National Electrical Code

E. ANSI/UL 1453 - Electric Booster and Commercial Storage Tank Water Heaters

F. ANSI/UL 174 - Household Electric Storage Tank Water Heaters

G. ANSI/NEMA 250 - Enclosure for Electrical Equipment (1000 Volts Maximum)

1.04 SUBMITTALS

A. Submit under provisions of Division 1

B. Product Data:

C. Include dimension drawings of water heaters indicating components and connections to other equipment and piping.

D. Provide electrical characteristics and connection requirements

E. Manufacturer's Installation Instructions.

1.05 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 1

B. Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

1.06 WARRANTY

A. For electric water heater provide 5 year warranty under provisions of Division 1

1.07 QUALITY ASSURANCE

A. Perform Work in accordance with State of N.C. Building Code

B. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:

1. National Sanitation Foundation (NSF)
2. American Society of Mechanical Engineers (ASME)
3. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI)
4. National Electrical Manufacturers' Association (NEMA)
5. Underwriters Laboratories (UL)

1.08 REGULATORY REQUIREMENTS

A. ANSI/NFPA 70, ANSI/UL 174 requirements for water heaters.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 1.

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

PART 2 PRODUCTS

2.01 ELECTRIC WATER HEATER

A. Commercial Manufacturers:

1. A.O. Smith
2. Bradford White
3. Lochinvar

B. Type: Automatic, electric, vertical storage.

C. Performance:

1. Storage: 120 gallons
2. Input: 2 elements @ 6 kw for a 12 kw total (simultaneous operation)
3. Minimum Recovery rate: 135 gph with 100° F temperature rise
4. Maximum working pressure: 150 psig

D. Electrical Characteristics:

1. 480 volts, three phase, 60 Hz

E. Tank: Glass lined welded steel thermally insulated with 2 inch glass fiber, encased in corrosion-resistant steel jacket, baked-on enamel finish.

F. Controls: Automatic water thermostat with temperature range from 120 to 170 degrees F, screw-in nichrome elements

G. Accessories: Brass water connections and dip tube, isolation valves, drain valve, high density magnesium anode, ASME temperature and pressure relief valve and heat trap nipples

2.02 THERMOSTATIC MIXING VALVES

A. Manufacturers:

1. Leonard
2. Lawler
3. Powers

B. Master Mixing Valve Capacity: 1 GPM minimum, and 15 GPM maximum at 20 psi drop, initial setpoint 115°F (adjustable)

C. Emergency Shower Mixing Valve Capacity: 20 GPM minimum bypass, and 43 GPM at 35 psi drop

D. Accessories:

1. Check valves on inlets
2. Volume control shut-off valve on outlet
3. Stem thermometer on outlet
4. Strainer stop checks on inlets
5. Color coded dials
6. Pressure gauges

E. Surface mounted on wall at water heater

2.03 IN-LINE CIRCULATOR PUMPS

A. Manufacturers:

1. Bell & Gossett
2. Grundfos
3. Taco

B. Performance:

1. Flow: 46 gpm at 16 feet of head.

2. Electrical Characteristics:
   a. 1-1/2 hp.
   b. 115 volts, single phase, 60 Hz.

C. Casing: Bronze, rated for 125 psig (860kPa) working pressure.

D. Impeller: Bronze.

E. Shaft: Alloy steel with integral thrust collar and two oil-lubricated bronze sleeve bearings.

F. Seal: Carbon rotating against a stationary ceramic seat.

G. Drive: Flexible coupling

H. Motor: ECM variable speed

PART 3 EXECUTION

3.01 WATER HEATER INSTALLATION

A. Install water heater in accordance with manufacturer's instructions.

B. Coordinate with plumbing piping and electrical work to achieve operating system.

C. Provide label on water heaters to show warranty and substantial completion date

END OF SECTION

SECTION 15460

TESTS AND CLEANING

PART 1 GENERAL

1.01 SCOPE

A. This work consists of providing all plant, labor, materials, apparatus, services, and equipment required to test all plumbing systems, and the cleaning of all equipment and fixtures furnished and/or installed under the Plumbing Specifications.

B. Items of equipment and fixtures installed by others and connected to roughing provided by the Plumbing Contractor shall be the responsibility of the installer. The Plumbing Contractor shall be responsible only to the termination of the roughing.

C. The Plumbing Contractor shall be responsible for the results of testing all work provided by his forces. Equipment and fixtures furnished by others for connection by the Plumbing Contractor shall be tested and approved for operation before connection by the Plumbing Contractor. Rough-in work by the Plumbing Contractor shall be tested and approved before connection to equipment furnished by others. Should internal workings of such items prove faulty the Plumbing Contractor shall notify the Architect.

D. Final cleaning of fixture and equipment shall be the responsibility of the Contractor responsible for the provision of the item.

1.02 GENERAL

A. All work must remain uncovered until required tests have been completed, but in the event the project construction schedule requires it, the Contractor shall make arrangements for prior tests on portions of the work involved. Any damage caused as a result of tests shall be repaired at the expense of the Contractor responsible for the provision of the work under test.

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.

C. The Contractor responsible for the work shall pay all costs and shall furnish all instruments, test equipment and personnel required for the tests. He shall obtain certificates of approval, acceptance and compliance with regulations of agencies and/or authorities having jurisdiction.

D. All tests shall be conducted in the presence of the Architect's representative.

1.03 WORK INCLUDED

A. Pressure testing of water piping systems

B. Pressure testing of drainage and vent systems

C. Placing into proper operation all electric and/or mechanical equipment provided by the Plumbing Contractor and such items as have been installed by him.

D. Cleaning

E. Sterilizing

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 WATER PIPING SYSTEM PRESSURE TEST

A. The following systems shall be hydrostatically tested at a pressure of 1-1/2 times the normal working pressure of 150 psig, whichever is greater.

1. Cold water system

2. Hot water supply system

B. Test pressures shall be maintained without plumbing for a minimum of four (4) hours without loss of pressure other than may be attributable to changes in atmospheric conditions. During the test period, each joint shall be examined for leaks. Sweats or drips will not be accepted.

C. After satisfactory completion of tests and before permanent connection of equipment and fixtures, flush entire pipe systems for a sufficient length of time to free interiors completely of foreign matter.

3.02 SOIL, WASTE, AND VENT DRAINAGE SYSTEMS

A. Water Test: The entire drainage and venting system shall be tested as a single unit or in sections provided that a vertical stack of ten feet (10') above the highest horizontal line of the section is tested integrally with that part or section. Pressure may be maintained by using a pressure pump. A pressure of ten feet (10') head (4.3 pounds) shall be maintained throughout the section being tested for a fifteen (15) minute time period without evidence of leakage at any joint connection.

B. Air Test: If tests are made with air, a pressure of not less than five (5) psig shall be applied with a force pump and maintained at least fifteen (15) minute without leakage. A mercury column gauge shall be used in making the air test.

3.03 STERILIZING

A. The interior piping both hot and cold water shall have been completed and all fixtures set and operating, then the entire system shall be sterilized by thoroughly flushing the system to the satisfaction of the Owner.

3.04 WORK

A. If inspection and tests show defects, such defective work or material shall be replaced and inspection and tests repeated. Repairs to piping shall be made with new material. No caulking of screwed joints or holes will be acceptable.

3.05 CLEANING

A. After satisfactory completion of tests and inspection, all parts of the work shall be thoroughly cleaned. All equipment pipe, valves, and fittings shall be cleaned of grease, metal cuttings, and sludge which may have accumulated by operation of the system for testing.

B. Any stoppage or discoloration or damage to parts of the building, its finish or furnishings, due to the Contractor's failure to properly clean the piping system, shall be repaired by the Contractor without cost to the Owner.

3.06 BALANCING

A. At the completion of the work, flush valves and other parts of the work shall be adjusted for quiet operation. Automatic control device shall be adjusted for proper operation.

B. Hot water return systems shall be balanced to assure that hot water is readily available at all outlets.

3.07 DEMONSTRATION OF OPERATION

A. When the installation is complete and cleaned, and adjustments specified herein have been made, the system shall be operated by the Plumbing Contractor for a period of one (1) week during which time it shall be demonstrated to the Architect as being completed and operating in conformance with the Plans and Specifications. During this week of operation the Contractor shall instruct the Owner's operating personnel in the manner of operation of all systems.

3.08 OWNER'S RIGHT TO TEST SYSTEMS

A. Should, in the opinion of the Architect, and during the guarantee period, reasonable doubt exists as to the proper functioning of any equipment installed under this Contract, the right is reserved for the Owner and Architect to perform any test deemed practical to determine whether such equipment is functioning properly and performing at required capacity. If such tests show proper functioning, the cost of the test will be paid by the Owner. If the test shows improper functioning of any equipment the Plumbing Contractor shall pay the cost of the test and shall also make good any deficiencies shown by the test to the full satisfaction of the Owner and the Architect.

3.09 OPERATING AND MAINTENANCE MANUALS

A. Three (3) complete sets of operating and maintenance manuals shall be submitted to the Owner through the Architect/Engineer two (2) weeks prior to the pre-final inspection date.

B. The O&M manuals shall be installed in a 3-ring heavy back notebook with the name of the building and the words "Operation and Maintenance Manuals" on the cover and spine. The manuals shall contain the following items as a minimum:

1. Index, page numbers and tabs
2. Certificate of substantial completion
3. All warranties
4. List of all subcontractors and suppliers with names, addresses and phone numbers.
5. Complete start-up, operation and shut-down procedures for each piece of equipment, locations of switches, emergency procedures and any other critical items.
6. Lubrication schedules and types of lubricants.
7. Complete set of current shop drawings and equipment description showing all capacities and other operation conditions.
8. Equipment summary showing all capacities and ratings. (HP, KW)
9. All submittal data and shop drawings.
10. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
11. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instruction.
12. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair and reassembly; aligning and adjusting instructions.
13. Wiring and control diagrams
14. Manufacturer's cuts, part numbers, and serial numbers.

3.10 RECORD DRAWINGS

A. Record drawings showing the work as actually installed shall be prepared, signed and dated by the Contractor and turned over to the Architect for approval and submitted to the Owner.

END OF SECTION 15460

SECTION 15500

BASIC HVAC REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Provide and coordinate all plant, labor, materials, apparatus, services, and equipment required for the installation of a fully operational HVAC system as shown on the project drawings and specified in the contract documents.

B. All work shall be planned and coordinated to minimize disturbance of finishes and construction. Contractors shall prepare routing schemes for approval by Architect.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 15.

B. Applicable Codes, Regulations and Specifications:

1. Product Data: Provide manufacturer's catalog data for fastening systems. Latest Edition of the North Carolina State Building Code

2. Applicable National Fire Protection Association (NFPA) Codes

3. Applicable Underwriters Laboratory (UL) Standards, All electrical materials and equipment shall be UL listed and labeled in every case where such listing has been established

4. Latest Edition of the National Electrical Code (NEC, NFPA 70)

5. Latest Edition of the National Electrical Manufacturer's Association (NEMA) Standards

1.03 SUMMARY

A. This Section includes general administrative and procedural requirements for HVAC installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in the general conditions.

1. Submittals

2. Coordination drawings

3. Record documents

4. Maintenance manuals

5. Rough-ins

6. HVAC installations

B. Related Sections

1. Specification Section 15501 "Electrical Requirements for HVAC Equipment", for factory-installed motors, disconnects, motor starters, controllers, accessories and connections.

C. The drawings accompanying this specification are generally diagrammatic and do not show all details required for the complete system. They should however be followed as closely as possible in the general arrangement and location of equipment. Do not scale the drawings. Check all dimensions at the building and investigate all structural and finish conditions. Arrange all work to meet these conditions and provide such offsets, brackets and other necessary accessories as may be required.

D. Immediately upon discovery of any discrepancy in the drawings or the specifications, or points of conflict therein, notify the Engineer who will clarify such discrepancy in writing prior to the progress of the work beyond the point concerned.

E. Do not cover up construction until it has been inspected and approved by the Engineer.

1.04 SUBMITTALS

A. General: Follow the procedures specified in Division 1.

B. Increase, by the quantity listed below, the number of HVAC related shop drawings, product data, and samples submitted, to allow for required distribution plus one copy of each submittal required, which will be retained by the Engineer.

1. Shop Drawings - 1 additional blue - or black-line print

2. Product Data - 1 additional copy of each item

C. Additional copies may be required by individual sections of these specifications. Upon completion of the project, provide the Owner with a complete set of all shop drawings and submittals as outlined in Paragraph VI of this Section.

D. Shop Drawings and Catalog Data: Approval of submittals for any material, apparatus, devices and layouts shall not relieve the Contractor from the responsibility of furnishing same as specified of proper dimensions, size, and quantity. If the submittals deviate from the contract documents in these three areas, advise the Engineer of the deviations in writing accompanying the shop drawings, including the reason for deviations. Any items found on the job either installed or not installed which do not meet the above criteria shall be replaced by the Contractor at the discretion of the Engineer. Review and stamp all shop drawings and submittals before submitting them to the Engineer for approval. Any

submittals not stamped and signed by the Contractor prior to submittal to the Engineer will be returned to the Contractor for his stamp and resubmittal. A copy of all shop drawings and submittals shall be kept at the job site at all times.

E. Required Submittals:

1. Variable Refrigerant Volume (VRV) HVAC Systems
2. Split System Dehumidification units
3. Ventilation Fans
4. Exhaust Fans
5. Electric Infrared Heaters
6. Refrigerant Piping and Accessories
7. Piping Hangers and Supports
8. Ductwork
9. Diffusers, Registers and Grilles
10. Ductwork Hangers and Supports
11. Piping Insulation and Jacketing
12. Mechanical Identification
13. Vibration Isolation
14. Test and Balance Report

1.05 RECORD DOCUMENTS

A. Indicate the following installed conditions:

1. Ductwork mains and branches, size and location, control devices, filters, boxes, and fan coil 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., strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Refer to Division 15 Section "HVAC Identification."
3. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
4. Approved substitutions, Contract Modifications, Alternates and actual equipment and materials installed.

B. During construction operations this Contractor shall faithfully and accurately record all changes from the contract drawings, including dimensions where applicable including invert elevations for all below-grade outside utilities with reference to permanent above-grade objects.

C. At project close-out, this Contractor shall neatly record with red ink all construction changes on an unused set of contract drawing prints supplied by the Engineer. This set of prints shall be submitted to the Engineer for review and approval. Should the Engineer find these record documents to be incomplete they will be returned to the Contractor and corrected accordingly by the Contractor with no additional cost to the Owner.

1.06 OPERATING AND MAINTENANCE MANUALS

A. Four (4) complete sets of operating and maintenance manuals shall be submitted to the Owner through the Architect/Engineer two (2) weeks prior to the pre-final inspection date.

B. The O&M manuals shall be installed in a 3-ring heavy back note book with the name of the building and the words "Operations and Maintenance Manuals" on the cover and spine. The manuals shall contain the following items as a minimum:

1. Index and page numbers

2. Certificate of substantial completion

3. All warranties

4. List of all subcontractors and suppliers with names, addresses and phone numbers

5. Certified testing and balancing report

6. Complete start-up operation, and shut-down procedures for each system including sequence of events, locations of switches, emergency procedures and any other critical items.

7. Lubrication schedules and types of lubricants

8. Complete set of current shop drawings and equipment description showing all capacities and other operation conditions.

9. Equipment summary showing all capacities and ratings. (HP, Tons, KW, Filter size, etc.)

10. All submittal data and shop drawings

11. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts

12. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; summer and winter operating instructions

13. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair and reassembly; aligning and adjusting instructions

14. Wiring and control diagrams.

15. Manufacturer's cuts, part numbers, and serial numbers

16. A print of the main electrical control diagrams on non-fading paper shall be wall mounted under glass in each mechanical room. Show control sequence on the diagrams

1.07 FINAL INSPECTIONS

A. Each project shall have both a pre-final and final inspection made before it is finally accepted by the Owner. A complete thorough training session shall be conducted by this Contractor and all applicable Subcontractors for the Owner's personnel after the pre-final inspection.

B. The pre-final inspection shall be held after all systems are in place and in operation. The HVAC Contractor shall demonstrate to the Engineer and Owner that all systems in the building are properly installed, balanced, and performing as designed and specified. All Contractors and Subcontractors shall attend this inspection including HVAC and air and water balance Subcontractor.

C. The final inspection shall be held with the Owner, Architect/Engineer, all Contractors and Subcontractors to demonstrate to the Owner that all systems in the building are operating as designed and to their satisfaction.

1.08 POST INSPECTIONS

A. Two post construction inspections shall be held by the Architect/Engineer with the Contractors and Owner to assure that the building is continuing to operate in accordance with the plans and specifications and that no unusual problems are occurring in the building systems. The first post construction inspection will be held approximately six months after substantial completion. This inspection will address Plumbing, HVAC and Electrical work. The second post construction inspection shall be held prior to expiration of the 1 year warranty period. It shall address General Construction as well as Plumbing, HVAC and Electrical work. All problems discovered during these inspections that relate to defective materials or defective workmanship shall be corrected by the responsible Contractor at no additional cost to the Owner.

1.09 WARRANTIES

A. All work shall be fully warranted for one year from the date of substantial completion by the Contractor who shall replace any defective materials and repair any defective workmanship. In addition, written warranties shall be provided for the following products and time periods. These warranties shall include any material cost to repair defective materials.

1. 5 Year Warranty

a. HVAC Compressors including Refrigeration

1.10 TEST REPORTS

A. All systems are required to be tested and shall be documented in writing, listing date, item tests, section tested, witnesses to the test (signed), and specification section which requires testing. Reports on testing shall be submitted within seven (7) days of completion of each test. In addition all test reports shall be compiled in a spiral bound 8 1/2" x 11" document and submitted at the same time and in the same quantity as required for Operation and Maintenance manuals.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver the products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification. All equipment and materials shall be fully protected and covered with protective materials to prevent any damage.

1.12 GENERAL PRODUCT INFORMATION

A. Where three or more manufacturers are listed for an item of equipment without an "or approved equivalent" clause, the Contractor may, at his option, provide any one of those specified. Equipment by manufacturers other than those listed will not be considered.

B. Where one or more manufacturers and a substitutions clause are listed for an item of equipment the Contractor may, at his option, provide the specified item or propose a substitute item of equal quality and performance. Submit a request for substitution for any manufacturer not named. Refer to Section II below regarding substitutions. The Engineer shall determine whether a substitute item is equivalent to the product specified and reserves the right to reject that substitute item.

C. All materials and equipment specified and shown on the plans shall be new and free from any defects. Each item of equipment shall bear the manufacturer's name or trade mark.

D. Dimensions: Insure that all items of equipment furnished fit the space available. Make necessary field measurements to ascertain space requirement.

E. Subcontractors and materials list: Provide within 5 days after execution of the contract a complete list of proposed subcontractors and materials including manufacturer's name.

1.13 SUBSTITUTIONS

A. Engineer will consider requests for Substitutions in accordance with Division 1 of this specification.

B. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

D. A request constitutes a representation that the Contractor:

1. Has investigated proposed product and determined that it meets or exceeds that quality level of the specified product.

2. Will provide the same warranty for the Substitution as for the specified product.

3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.

4. Waives claims for additional costs or time extension which may subsequently become apparent.

E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

F. Substitutions Submittal Procedure:

1. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.

2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence.

3. The Engineer will notify Contractor, in writing, of decision to accept or reject request.

1.14 SUPERVISION

A. The Contractor shall have a thoroughly competent foreman in charge of the construction work at all times. The foreman shall have extensive experience in the work to be performed.

1.15 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

1.16 HVAC INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of HVAC systems, materials, and equipment with work of all other Contractors on the project. Comply with the following requirements:

1. Coordinate HVAC 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 HVAC 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 HVAC 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 HVAC 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 level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

9. Install HVAC 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.

10. Duct and pipe penetrations: Duct and pipe penetrations shall be provided by the Mechanical Contractor. Mechanical shop drawings shall be provided to the Architect/Engineer and General Contractor with ALL duct and pipe penetrations sized and located. These shop drawings shall be submitted during early phases of construction so not to delay the General Construction Schedule. Any additional costs, associated with the

construction delays, that result from a failure to coordinate this work will be paid by the Mechanical Contractor.

11. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

12. Properly support all work and equipment installed under this contract. Study all drawings, shop drawings, and catalog data to determine how equipment, accessories, piping, and related items are to be supported, mounted, or suspended. Provide all bolts, inserts, pipe stands, brackets, structural supports, and accessories for proper support of equipment furnished under this contract.

13. Provide suitable vibration isolating bases or suspension systems as indicated and/or required for all rotating, reciprocating, and vibrating equipment. Design all isolation for maximum absorption efficiency so that no transmission of vibration or structurally borne noise shall occur. The selection of isolators for proper loading to obtain the desired efficiency shall be the responsibility of the manufacturer of the isolating units and shall be fully guaranteed by the manufacturer.

14. Fire Barrier Penetrations: Where HVAC work passes through fire rated walls, partitions, ceilings, or floors, the fire rated integrity shall be maintained. Provide penetration seal materials in accordance with printed instructions of the U.L. Fire Resistance Directory and in accordance with manufacturer's instruction.

15. Under no circumstances shall any air handling system be used as a source of temporary heat or cooling until the building has progressed to the point where not dust, or debris are on the premises served by the air handling system. The building at this point should be free of debris, broom cleaned and closed off by the General Contractor to any other portion of the building in which work is in progress.

16. The HVAC Contractor shall contact the Architect/Engineer seven (7) days in advance of using any permanent HVAC system for temporary cooling or heating. 1" wide 30% efficient filters shall be installed in all air handling equipment while supplying temporary heat or cooling. Filters shall be maintained and changed as needed to prevent unloading of dust and dirt into the air distribution system. Filters shall be removed upon completion of the work and new operating filters installed.

17. All field painting of HVAC work, including touch-up paint on factory finished equipment shall be by HVAC Contractor. Any equipment which has its factory paint coat scratched or otherwise damaged shall be retouched with paint to match the finish coat, and shall be repainted if necessary.

PART 2 PRODUCTS – NOT USED

PART 3 INSTALLATION – NOT USED

END OF SECTION 15500

SECTION 15501

ELECTRICAL REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.01 SCOPE

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

B. Related Sections: Separate electrical components and materials required for field installation and electrical connections are specified in Division 16.

1.02 SUMMARY

A. This section specifies the basic requirements for electrical components which may or may not be an integral part of the HVAC equipment. These components include, but are not limited to motors, motor starters and disconnect switches.

B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for HVAC equipment are specified within the individual equipment specification sections, and/or are scheduled on the drawings.

C. All electrical work shall be done by licensed electricians in accordance with the N.C. State Building Code which includes the National Electrical Code, latest edition, and the Electrical Division of this specification. Furnish a certificate to the appropriate Electrical Inspector.

D. Work Included:

1. All power wiring and associated conduit shall be provided to HVAC equipment by the Electrical Contractor. The HVAC Contractor shall furnish all motor starters, disconnect switches and combination starters for HVAC equipment and turn them over to the Electrical Contractor for installation. All final power wiring connections to HVAC equipment shall be made by the HVAC Contractor from slack wire left by the Electrical Contractor. Refer to the Contract Drawings for division responsibility regarding electrical requirements.

2. Provide all control wiring, in conduit, required to satisfactorily control all equipment included in this section. Furnish and wire all control devices such as thermostats, switches, relays and any other devices necessary to control the equipment furnished in this section.

3. HVAC Contractor shall provide power wiring and conduit to all damper and valve actuators.

1.03 REFERENCES

A. NEMA Standards MG 1

B. NEMA Standards ICS 2

C. NEMA Standard 250

D. NEMA Standard KS 1

E. National Electrical Code (NFPA 70)

F. N.C. State Building Code

1.04 SUBMITTALS

A. Provide a separate electrical submittal for all field mounted starters and disconnects not included as integral pieces of HVAC equipment. Submittal shall conform to requirements of Division 1 and Sections 16441 and 16481.

B. For HVAC equipment with integral starters and/or disconnects no separate electrical submittal is required. Submit product data for motors, starters and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification sections.

C. Before any electrical work is performed submit wiring diagrams and methods of powering and controlling all electrically connected or operating equipment to the Architect for approval. Controls Subcontractor shall check and approve all diagrams before submittal to the Engineer. The diagrams shall show points of connection of equipment to system provided by the Electrical Contractor and shall show conduit and wire sizes.

1.05 QUALITY ASSURANCE

A. All electrical equipment and materials shall be UL labeled.

PART 2 PRODUCTS

2.01 MOTORS

A. The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements shall be specified by the Engineer in the individual equipment specifications.

1. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.

2. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range.

3. Temperature Rating: Rated for 40 deg. C. environment with maximum 50 deg. C. temperature rise for continuous duty at full load (Class A Insulation).

4. Starting capability: Frequency of starts as indicated by automatic control system, and not less than 5 evenly time spaced starts per hour for manually controlled motors.

5. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors.

6. Motor construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque.

   a. Frames: NEMA Standard No. 48 or 54; use driven equipment manufacturer's standards to suit specific application.

   b. Bearings:

      1) ball or roller bearings with inner and outer shaft seals;
      2) re-greasable, except permanently sealed where motor is normally inaccessible for regular maintenance;
      3) designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor;
      4) for fractional horsepower (1/20 hp and below) light duty motors, sleeve type bearings are permitted.

   c. Enclosure Type:

      1) open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation;
      2) guarded drip-proof motors where exposed to contact by employees or building occupants;
      3) weather protected Type I for outdoor use, Type II where not housed;

   d. Overload protection: built-in thermal overload protection and, where indicated, internal sensing device suitable for signaling and stopping motor at starter.

   e. Noise rating: "Quiet" rating on motors located in occupied spaces of building.

   f. Efficiency: All motors shall be "Energy Efficient". Motors shall have a minimum efficiency as scheduled in accordance with IEEE Standard 112, test method B. If efficiency not specified, motors shall have a higher efficiency than "average standard industry motors", in accordance with IEEE Standard 112, test method B.

   g. Nameplate: indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

7. All motors shall be of the quiet operating type, guaranteed to fulfill the specified requirements without producing objectionable sound in occupied areas of the building. All belt connected motors shall have adjustable bases and set screws to maintain proper belt tension. All fan motors shall have adjustable sheaves for speed adjustment, and one belt more than computed.

8. No shaded pole motors will be acceptable on any equipment above 1/20 horsepower.

2.02 DISCONNECT SWITCHES

A. Shall conform to all requirements specified in Section 16441 - "Enclosed Switches".

2.03 MOTOR STARTERS AND COMBINATION STARTERS

A. Shall conform to all requirements specified in Section 16481 - "Enclosed Motor Controllers".

2.04 VARIABLE FREQUENCY DRIVES

A. Shall conform to all requirements specified in Section 15542 "Variable Frequency Drives".

PART 3 EXECUTION

A. Conductor sizes shall be as specified in the National Electrical Code.

B. Control circuits shall be 120 volts or 24 volts. Electrical Contractor shall provide in-line toggle switch, labeled and identified, at each control panel and starter, to disconnect control power.

C. Ground all equipment per requirements of the National Electrical Code.

D. Equipment overcurrent protection and conductors in the electrical contract shall be sized to accommodate most major brands of HVAC equipment. If the HVAC Contractor chooses to use an item of equipment that exceeds the capacity of the electrical overcurrent protection and conductors, or requires multiple circuits, the HVAC Contractor shall be responsible for any additional cost required to increase the size of the overcurrent protection and conductors or provide the additional circuits and disconnects, at no additional cost to the Owner or Electrical Contractor. He shall also coordinate this work with the Electrical Contractor to assure proper electrical service to the equipment.

END OF SECTION 15501

SECTION 15503

SUPPORTS AND ANCHORS

PART 1 GENERAL

1.01 SCOPE

A. Pipe and equipment hangers and supports

B. Equipment bases and supports

C. Sleeves and seals

D. Flashing and sealing equipment and pipe stacks

1.02 RELATED SECTIONS

A. Section 03300 - Cast-In-Place Concrete: Equipment bases

B. Section 07270 - Firestopping: Joint seals for piping and duct penetration of fire rated assemblies

1.03 REFERENCES

A. ASME B31.9 - Building Services Piping

B. ASTM F708 - Design and Installation of Rigid Pipe Hangers

C. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer

D. MSS SP69 - Pipe Hangers and Supports - Selection and Application

E. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices

1.04 SUBMITTALS

A. Submit under provisions of Division 1 and Section 15500

B. Product Data: Provide manufacturer's catalog data including load capacity

C. Design Data: Indicate load carrying capacity of trapeze, multiple pipe and riser support hangers

D. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components

1.05 REGULATORY REQUIREMENTS

A. Conform to applicable code for support of specified piping systems

PART 2 PART 2 - PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

A. Manufacturers:

1. Grinnell Corporation

2. Fee & Mason Manufacturing Co.

3. B-Line Systems, Inc.

4. C & S Manufacturing Co.

5. Superstrut/Thomas & Betts

6. Substitutions: Under provisions of Section 15500

2.02 HANGER RODS

A. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded; with washers on both sides of hangers. Double nut connection

2.03 INSERTS, UPPER ATTACHMENTS, AND BEAM CLAMPS

A. Manufacturers:

1. Grinnell Corporation

2. Fee & Mason Manufacturing Co.

3. B-Line Systems, Inc.

4. C & S Manufacturing Co.

5. Superstrut/Thomas & Betts

6. Substitutions: Under provisions of Section 15500

B. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

C. Upper Attachments: Malleable iron or steel, plain finish

D. Beam Clamps: Malleable iron c-clamps with locknuts, adjustable beam clamps in malleable iron or steel, all clamps with plain finish

2.04 FLASHING

A. Metal Flashing: 26 gauge galvanized steel

B. Metal Counterflashing: 22 gauge galvanized steel

C. Lead Flashing:

1. Waterproofing: 5 lb/sq ft sheet lead

2. Soundproofing: 1 lb/sq ft sheet lead

D. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing

E. Caps: Steel, 22 gauge minimum; 16 gauge at fire resistant elements

2.05 EQUIPMENT CURBS

A. Manufacturers:

1. Mason Industries, Inc.

2. Thycurb

3. The Pate Company

4. Substitutions: Under provisions of Section 15500

B. Fabrication: Welded 18 gauge galvanized steel shell and base, 14 inches minimum height, mitered 3 inch cant, variable step to match roof insulation, minimum 1-1/2 inch thick insulation, factory installed wood nailer.

2.06 EQUIPMENT CURBS WITH ACOUSTICAL TREATMENT:

A. Provide with all roof mounted air handling equipment with duct penetrations through roof deck above occupied spaces.

2.07 SLEEVES

A. Sleeves for Pipes through Non-fire Rated Floors: 18 gauge galvanized steel

B. Sleeves for Pipes through Non-fire Rated Walls and Footings, Schedule 40 galvanized steel pipe or 18 gauge galvanized steel

C. Sleeves for Pipes through Fire Rated and Fire Resistive Floors and Walls; Prefabricated fire rated sleeves including seals, UL listed, where indicated

D. Sleeves for Round Ductwork: Galvanized steel.

E. Sleeves for Rectangular Ductwork: Galvanized steel.

F. Firestopping Insulation and sealants: Provide penetration seal materials in accordance with printed instructions of the U.L. Fire Resistance Directory, in accordance with manufacturer's instruction, and as required by local codes and plan details.

G. Sealant for non-fire penetrations: Acrylic caulk.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. All firestopping of HVAC penetrations shall be provided by the HVAC Contractor. Provide penetration seal materials in accordance with printed instructions of the U.L. Fire Resistance Directory and in accordance with manufacturer's instruction, as required by local code officials, and as indicated on plan details.

3.02 INSERTS UPPER ATTACHMENTS, AND BEAM CLAMPS

A. Provide inserts for placement in concrete formwork.

B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams or walls

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface

E. Provide upper attachments and beam clamps to support work from steel beams and bar joists

F. Direct attachment to metal roof decks is prohibited

3.03 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as scheduled.

B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

C. Place hangers within 12 inches of each horizontal elbow.

D. Use hangers with 1-1/2 inch minimum vertical adjustment.

E. Support vertical piping at every floor.

F. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

G. Support riser piping independently of connected horizontal piping.

H. Provide copper plated hangers and supports for copper piping.

I. Design hangers for pipe movement without disengagement of supported pipe.

J. Provide a prime coat and two (2) finish coats of paint on exposed steel hangers and supports. Finish coat shall match paint color of adjacent pipe or

insulation. Hangers and supports located in crawl spaces, pipe shafts and suspended ceiling spaces are not considered exposed.

K. Provide shields and blocking for all piping at hangers and supports in accordance with Section 15507 - Piping Insulation

L. Do not support piping or ductwork from bar joist bridging

3.04 EQUIPMENT BASES AND SUPPORTS

A. All HVAC Equipment sitting on Mechanical Room Floor shall have housekeeping pads provided by Mechanical Contractor. Housekeeping pads shall be concrete, minimum 4 inches thick with 3/4" chamfer edges, and extending 6 inches beyond supported equipment on all sides. The Mechanical Contractor shall provide all anchoring devices, inserts, etc. as required. The Mechanical Contractor shall paint the pads yellow in compliance with OSHA requirements and guidelines.

B. Provide templates, anchor bolts and accessories for mounting and anchoring equipment. Construct supports of steel members. Brace and fasten with flanges bolted to structure.

C. Provide rigid anchors for pipes after vibration isolation components are installed.

3.05 FLASHING (COORDINATE WITH ROOFING REQUIREMENTS)

A. General Contractor shall provide flexible flashing and metal counterflashing where indicated for piping and ductwork penetrating weather or waterproofed walls, floors and roofs.

B. Furnish curbs for mechanical roof mounted equipment a minimum of 14 inches high above roofing surface. Curbs shall be furnished by the Mechanical Contractor and installed by the General Contractor. Curb blocking, flashing and counterflashing shall be provided by the General Contractor. Refer to plan details.

C. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.06 SLEEVES

A. Set sleeves in position in formwork. Provide reinforcing around sleeves.

B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for insulation continuous through the sleeve.

C. Extend sleeves through floors one inch above finished floor level. Caulk sleeves.

D. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and caulk air tight. Provide penetration seal materials in accordance with printed instructions of the U.L. Fire Resistance Directory and in accordance with manufacturer's instruction, and as required by local code officials and plan details.

Provide close fitting sheet metal collar or escutcheon covers at both sides of penetration. See plan details.

E. Install chrome or stainless steel escutcheons at all pipe penetrations in exposed areas.

END OF SECTION 15503

SECTION 15509

DUCTWORK INSULATION

PART 1 GENERAL

1.01 SCOPE

A. Ductwork insulation

B. Insulation jackets

1.02 RELATED SECTIONS

A. Section 09900 - Painting: Painting insulation jackets

B. Section 15505 - Mechanical Identification

1.03 REFERENCES

A. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate

B. ASTM C518 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

C. ASTM C553 - Mineral Fiber Blanket and Felt Insulation

D. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation

E. ASTM E84 - Surface Burning Characteristics of Building Materials

F. ASTM E96 - Water Vapor Transmission of Materials

G. NFPA 255 - Surface Burning Characteristics of Building Materials

H. SMACNA - HVAC Duct Construction Standards - Metal and Flexible

I. UL 723 - Surface Burning Characteristics of Building Materials

1.04 SUBMITTALS

A. Submit under provisions of Division 1 and Section 15500

B. Product Data: Provide product description, list of materials and thickness for each service, and locations.

C. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

A. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, U.L. 723.

1.06 QUALIFICATIONS

A. Applicator: Company specializing in performing the work of this section with minimum five years experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 1 and Section 15500.

B. Deliver materials to site in original factory packaging, labeled with manufacturer's density and thickness.

C. Store insulation in original wrapping and protect from weather and construction traffic.

D. Protect insulation against dirt, water, chemical, and mechanical damage.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 GLASS FIBER, FLEXIBLE

A. Manufacturers:

1. CertainTeed Corporation

2. Knauf Fiber Glass GmbH

3. Owens-Corning Fiberglas

4. Schuller/Manville

5. Substitutions: Under provisions of Section 15500

B. Insulation: ASTM C553, C612; flexible, noncombustible blanket

1. 'K' value: ASTM C518, 0.29 at 75 degrees F

2. Maximum service temperature: 250 degrees F

3. Maximum moisture absorption: 0.20 percent by volume

4. Density: 0.75 lb/cu ft.

C. Vapor Barrier Jacket

a. Indicate assembly dimensions, locations of support posts, and general construction details.

b. Indicate welded connections.

c. Provide a Bill of Materials to include all components of the assembly.

d. Indicate location and type of insulating materials.

2. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film

3. Moisture vapor transmission: ASTM E96

4. Secure with pressure sensitive tape

a. Vapor Barrier Tape

5. Manufacturers:

a. Halstead

b. 3M

c. United McGill

d. Substitutions: Under provisions of Section 15500

6. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that all joints in ductwork have been sealed and that ductwork has been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

B. Insulated ductwork conveying air below and above ambient temperature:

1. Provide insulation with vapor barrier jackets.

2. Finish with tape and vapor barrier jacket.

3. Continue insulation through walls, sleeves, hangers and other duct penetrations.

4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections and expansion joints. Where service access is required, bevel and seal ends of insulation.

3.03 TOLERANCE

A. Substituted insulation materials shall provide thermal resistance within 10 percent at normal conditions, as materials indicated.

3.04 DUCT INSULATION SCHEDULE

A. Provide insulation on exterior of all supply, return and outside air ductwork. Exterior insulation is not required on exhaust ductwork and double-wall pre-insulated ductwork.

B. Ductwork is defined to include housings, mixing boxes, in-line fan housing, and similar components of the duct system. All exposed ends of all coils, including reheat coils shall be insulated the same as for ducts. All supply diffusers and outlets shall have the neck, back of diffuser and bare duct insulated the same as supply ducts, unless otherwise noted.

C. Externally Insulated in Concealed Ceiling Spaces: Two-inch (2") thickness of 3/4 lb.density glass fiber blanket faced with vapor barrier jacket.

D. Externally Insulated in Exposed Spaces (i.e. Mechanical Rooms): Two-inch (2") thickness of rigid vapor seal fiberglass duct insulation of three (3) lb. density with factory-applied embossed aluminum foil facing. Breaks and joints shall be filled with vapor barrier cement on all corners. Finish shall be eight (8) ounce canvas adhered with lagging cement.

END OF SECTION 15509

SECTION 15760

TERMINAL HEAT TRANSFER UNITS

PART 1 GENERAL

1.01 SCOPE

A. Electric Infrared Heaters

B. Radiant Heating Panels

1.02 RELATED SECTIONS

A. Section 15501 Electrical Requirements for HVAC Equipment

1.03 REFERENCES

A. ANSI/NFPA 70

1.04 SUBMITTALS

A. Submit shop drawings under provisions of Division 1 and Section 15500

B. Submit product data under provisions of Division 1 and Section 15500

C. Submit product data indicating typical catalog of information including arrangements.

D. Indicate mechanical and electrical service locations and requirements, specifically indicating deviations from indicated products.

E. Submit manufacturer's installation instructions under provisions of Division 1 and Section 15500

1.05 PROJECT RECORD DOCUMENTS

A. Submit record documents under provisions of Division 1 and Section 15500

1.06 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division 1 and Section 15500

B. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum ten years documented experience.

1.08 REGULATORY REQUIREMENTS

A. Conform to applicable ANSI/NFPA 70 code for internal wiring of factory wired equipment.

1.09 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site under provisions of Division 1 and Section 15500

B. Store and protect products under provisions of Division 1 and Section 15500

C. Protect units from physical damage by storing in protected areas and leaving factory covers in place.

PART 2 PRODUCTS

2.01 MANUFACTURERS - ELECTRIC UNIT HEATERS

A. Electromode

B. Chromalox

C. Markel

D. Modine

E. Raywall

F. Berko

G. Q-Mark

H. Substitutions: Under provisions of Section 15500

2.02 RADIANT CEILING PANELS

A. UL listed and labeled with built-in 36" flexible cable pre-wired.

B. Construction: Electric resistance graphite element embedded between two layers of insulation. Outer shell shall be formed steel with baked enamel finish.

C. Ceiling Panels: 24 x 48 inch pans with white finish. Provide with layin ceiling mounting kit.

D. Provide with wall mounted line voltage thermostat

2.03 ELECTRIC INFRARED HEATERS

A. Assembly: Stainless steel with non-corrosive housing, hardware and brackets, no ferrous metals, UL listed and labeled with terminal box and cover and controls.

B. Heating Element: Clear quartz lamps

C. Enclosure: Stainless steel body with gold anodized aluminum reflector.

D. Accessories: Wire guard to protect heating element and line voltage thermostat capable of controlling multiple heaters

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work and opening dimensions are as indicated on shop drawings and instructed by the manufacturer.

B. Verify that required utilities are available, in proper location, and ready for use.

C. Beginning of installation means installer accepts existing surfaces.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Hang unit heaters from building structure, with hangers anchored to building, not from piping or ductwork. Mount at height indicated. Submit proposed mounting method with equipment shop drawings.

C. Protect units with protective covers during balance of construction.

3.03 CLEANING

A. Clean work under provisions of Division 1 and Section 15500

B. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean the coils and inside of cabinets.

C. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

END OF SECTION

SECTION 15830

VARIABLE REFRIGERANT VOLUME (VRV) HVAC SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Variable refrigerant volume HVAC system includes:

1. Outdoor/Condensing unit(s)

2. Indoor/Evaporator units

3. Heat Recovery Units

4. Refrigerant piping

5. Control panels

6. Control wiring

1.02 REFERENCE STANDARDS

A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; Air-Conditioning, Heating, and Refrigeration Institute; 2008.

B. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2011

C. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; 2009

D. ASHRAE Std 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings; American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc ; 2007, Including All Addenda (ANSI/ASHRAE/

E. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 1995 - Heating and Cooling Equipment; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's standard data sheets showing the following for each item of equipment, marked to correlate to equipment item markings shown in the contract documents:

1. Outdoor/Central Units:

a. Refrigerant Type and Size of Charge

b. Cooling Capacity: Btu/h (W)

c. Heating Capacity: Btu/h (W)

d. Cooling Input Power: Btu/h (kW)

e. Heating Input Power: Btu/h (kW)

f. Operating Temperature Range, Cooling and Heating

g. Air Flow: Cubic feet per minute (Cubic meters per second)

h. Fan Curves

i. External Static Pressure (ESP): Inches WG (Pa)

j. Sound Pressure Level: dB(A)

k. Electrical Data:

i) Maximum Circuit Amps (MCA)

ii) Maximum Fuse Amps (MFA)

iii) Maximum Starting Current (MSC)

iv) Full Load Amps (FLA)

v) Total Over Current Amps (TOCA)

vi) Fan Motor: HP (W)

2. Weight and Dimensions.

a. Maximum number of indoor units that can be served

b. Maximum refrigerant piping run from outdoor/condenser unit to indoor/evaporator unit

c. Maximum height difference between outdoor/condenser unit to indoor/evaporator unit, both above and below

d. Control Options

3. Indoor/Evaporator Units:

a. Cooling Capacity: Btu/h (W)

b. Heating Capacity: Btu/h (W)

c. Cooling Input Power: Btu/h (kW)

d. Heating Input Power: Btu/h (kW)

e. Air Flow: Cubic feet per minute (Cubic meters per second)

f. Fan Curves

g. External Static Pressure (ESP): Inches WG (Pa)

h. Sound Pressure level: dB(A)

i. Electrical Data:

vii) Maximum Circuit Amps (MCA)

viii) Maximum Fuse Amps (MFA)

ix) Maximum Starting Current (MSC)

x) Full Load Amps (FLA)

xi) Total Over Current Amps (TOCA)

xii) Fan Motor: HP (W)

j. Maximum Lift of Built-in Condensate Pump

k. Weight and Dimensions

l. Control Options.

4. Control Panels: Complete description of options, control points, zones/groups

B. Shop Drawings: Installation drawings custom-made for this project; include as-designed HVAC layouts, locations of equipment items, refrigerant piping sizes and locations, condensate piping sizes and locations, remote sensing devices, control components, electrical connections, control wiring connections. Include:

1. Detailed piping diagrams, with branch balancing devices

2. Condensate piping routing, size, and pump connections

3. Detailed power wiring diagrams

4. Detailed control wiring diagrams

5. Locations of required access through fixed construction

6. Drawings required by manufacturer

C. Operating and Maintenance Data:

1. Manufacturer's complete standard instructions for each unit of equipment and control panel.

2. Custom-prepared system operation, troubleshooting, and maintenance instructions and recommendations.

3. Identification of replaceable parts and local source of supply.

D. Project Record Documents: Record the following:

1. As-installed routing of refrigerant piping and condensate piping

2. Locations of access panels

3. Locations of control panels

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Company that has been manufacturing variable refrigerant volume heat pump equipment for at least 5 years.

B. Installer Qualifications: Trained and approved by manufacturer of equipment.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle equipment and refrigerant piping according to manufacturer's recommendations.

1.06 WARRANTY

A. VRF equipment shall be warranted by the manufacturer's limited warranty for a period of two years from date of installation or 30 months from date of delivery whichever is shorter. System shall be commissioned by the manufacturer or certified manufacturer's agent with a report submitted to the VRF manufacturer. Labor is not included.

B. Compressors: Provide manufacturer's warranty for six (6) years from date of installation. During the stated period, should any part fail due to defects in material and workmanship, it shall be repaired or replaced at the discretion of the manufacturer. All warranty service work shall be preformed by a factory trained service professional. Labor is not included.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: The system design shown in the contract documents is based on equipment and system designed by Daikin.

B. Systems designed and manufactured by other manufacturers will be considered by Owner under the terms described for substitutions with the following exceptions:

1. Substitution requests will be considered only if required submittal data is complete; see article SUBMITTALS above.

2. Contractor (not equipment supplier) shall certify that the use of the substitute system and equipment will not require changes to other work or redesign by Architect.

3. Do not assume substitution has been accepted until formal written notice has been issued by Architect.

2.02 HVAC SYSTEM DESIGN

A. System Operation: Heating and cooling, simultaneously.

1. Zoning: Provide capability for temperature control for each individual indoor/evaporator unit independently of all other units.

2. Zoning Provide heating/cooling selection for each individual indoor/evaporator unit independently of all other units.

3. Provide a complete functional system that achieves the specified performance based on the specified design conditions and that is designed and constructed according to the equipment manufacturer's requirements.

4. Conditioned spaces are shown on the drawings

5. Heat Recovery Unit locations are not shown on the drawings

6. Required equipment unit capacities are shown on the drawings

7. Refrigerant piping sizes are not shown on the drawings

8. Connect equipment to condensate piping provided by others; condensate piping is shown on the drawings.

B. Cooling Mode Interior Performance:

1. Daytime Setpoint: 68 degrees F, plus or minus 2 degrees F

2. Setpoint Range: 57 degrees F to 77 degrees F

3. Night Setback: 78 degrees F

4. Interior Relative Humidity: 20 percent, maximum.

C. Heating Mode Interior Performance:

1. Daytime Setpoint: 68 degrees F, plus or minus 2 degrees F

2. Setpoint Range: 59 degrees F to 80 degrees F

3. Night Setback: 60 degrees F

4. Interior Relative Humidity: 10 percent, minimum.

D. Outside Air Design Conditions:

1. Summer Outside Air Design Temperature: 0.4 percent cooling design condition listed in ASHRAE Fundamentals Handbook.

2. Summer Outside Air Design Temperature on the Building Roof: 98 degrees F dry-bulb.

3. Winter Outside Air Design Temperature: 99.6 percent heating design condition listed in ASHRAE Fundamentals Handbook.

E. Energy Design Wind Speed: 25 mph

F. Operating Temperature Ranges:

1. Simultaneous Heating Operating Range: 14 degrees F to 60 degrees F wet bulb.

2. Simultaneous Cooling Operating Range: 14 degrees F to 81 degrees F dry bulb.

3. Cooling Mode Operating Range: 23 degrees F to 115 degrees F dry bulb.

4. Heating Mode Operating Range: minus 4 degrees F to 60 degrees F wet bulb; without low ambient controls or auxiliary heat source.

G. Refrigerant Piping Lengths: Provide equipment capable of serving system with following piping lengths without any oil traps:

1. Minimum Piping Length from Outdoor/Central Unit(s) to Furthest Terminal Unit: 738 feet

2. Total Combined Liquid Line Length: 3280 feet, maximum

3. Maximum indoor unit elevation separation: 49 feet

4. Maximum elevation difference of outdoor unit and indoor unit, outdoor unit either above or below indoor unit, is 360 ft.

5. Maximum equivalent pipe length from first branch to farthest indoor unit is 295 ft.

6. Maximum elevation change between series piped Heat Recovery units is 16 ft.

H. Control Wiring:

1. Provide a minimum 18 AWG, 2 conductors stranded shielded copper cable only. Maintain polarity throughout the communications network.

2. Connect the communications cable between indoor units using a daisy chain configuration only. "Star" or "Home Run" control wiring connections involving soldering or wire caps are not permitted.

3. Provide separate conduits/paths for control wiring and power wiring.

I. Controls: Provide the following control interfaces:

1. For Each Indoor/Evaporator Unit: One wall-mounted wired "local" controller, with temperature sensor; locate where indicated.

2. One central remote control panel for entire system; locate where indicated.

J. Local Controllers: Wall-mounted, wired, containing temperature sensor.

2.03 EQUIPMENT

A. All Units: Factory assembled, wired, and piped and factory tested for function and safety.

1. Refrigerant: R-410A.

2. Performance Certification: Provide systems AHRI 1230 Certified; (www.ahridirectory.org.)

3. Safety Certification: Tested to UL 1995 by UL or Intertek-ETL and bearing the certification label.

4. Provide outdoor/condensing units capable of serving indoor unit capacity up to 100 percent of the capacity of the indoor units.

5. Provide units capable of serving the zones indicated.

6. Energy Efficiency: Report EER and COP based on tests conducted at "full load" in accordance with AHRI 1230

B. Electrical Characteristics:

1. Power - Condensing Units: 208-230 or 460-480 Volts, 3-phase, 60 Hz.

2. Power - Branch Selector Units: 208 to 230 Volts, single phase, 60 Hz.

3. Power - Indoor Units: 208 to 230 Volts, single phase, 60 Hz.

4. 208-230 Voltage Tolerance is plus or minus 10%

5. Control: 24 volts DC

C. Refrigerant Piping:

1. Provide three-pipe refrigerant system, including high/low pressure dedicated hot gas, liquid and suction lines; two-pipe systems utilizing lower tem-

perature mixed liquid/gas refrigerant to perform heat recovery are not permitted due to reduced heating capabilities.

2. Refrigerant Flow Balancing: Provide refrigerant piping joints and headers specifically designed to ensure proper refrigerant balance and flow for optimum system capacity and performance; T-style joints are prohibited.

3. Insulate each refrigerant line individually between the condensing and indoor units.

2.04 OUTDOOR/CONDENSING UNITS

A. Outdoor/Condensing Units: Air-cooled DX refrigeration units, designed specifically for use with indoor/evaporator units; factory assembled and wired with all necessary electronic and refrigerant controls; modular design for ganging multiple units.

1. Refrigeration Circuit: Scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and refrigerant regulator.

2. Refrigerant: Factory charged.

3. Variable Volume Control: Modulate compressor capacity automatically to maintain constant suction and condensing pressures while varying refrigerant volume to suit heating/cooling loads.

4. Capable of being installed with wiring and piping to the left, right, rear or bottom.

5. Capable of heating operation at low end of operating range as specified, without additional low ambient controls or auxiliary heat source.

6. Outdoor unit shall have a tested sound rating no higher than 58 dB (A) per outdoor frame tested per ISO1996.

7. Power Failure Mode: Automatically restart operation after power failure without loss of programmed settings.

8. Provide refrigerant auto-charging feature and refrigerant charge check function.

9. Safety Devices: High pressure sensor and switch, low pressure sensor/switch, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.

10. Provide double spiral tube refrigerant sub-cooling heat exchanger to ensure the liquid refrigerant does not flash when supplying to us indoor units.

11. Oil Management: The outdoor unit shall have a centrifugal oil separator for each compressor and controls to insure sufficient oil supply is maintained for the compressor.

B. Unit Cabinet: Weatherproof and corrosion resistant; rust-proofed galvanized steel panels coated with powder coat baked enamel finish.

1. Designed to allow side-by-side installation with minimum 3 inch spacing.

C. Fans: One or more direct-drive propeller type, vertical discharge, with multiple speed operation via DC (digitally commutating) inverter.

1. External Static Pressure: Factory set at 0.12 in WG (30 Pa), minimum.

2. Indoor Mounted Air-Cooled Units: External static pressure field set at 0.32 in WG (80 Pa), minimum; provide for mounting of field-installed ducts.

3. Fan Airflow: As indicated for specific equipment.

4. Fan Motors: Factory installed; permanently lubricated bearings; inherent protection; fan guard; output as indicated for specific equipment. Maximum speed of fan shall not exceed 1050 rpm.

D. Condenser Coils: Copper tubes expanded into aluminum fins to form mechanical bond; waffle louver fin and rifled bore tube design to ensure high efficiency performance. The coil fins shall have factory applied corrosion resistant with hydrophilic coating. Coil shall be protected with an integral metal guard.

E. Compressors: Scroll type, hermetically sealed, digitally controlled inverter-driven and fixed speed in combination to suit total capacity; minimum of one variable speed, inverter driven compressor per condenser unit; minimum of two compressors per condenser unit;

1. Multiple Condenser Modules: Balance total operation hours of compressors by means of duty cycling function, providing for sequential starting of each module at each start/stop cycle, completion of oil return, and completion of defrost, or every 8 hours.

2. Failure Mode: In the event of compressor failure, operate remaining compressor(s) at proportionally reduced capacity; provide microprocessor and associated controls specifically designed to address this condition.

3. Provide each compressor with crankcase heater, high pressure safety switch, and internal thermal overload protector.

4. Provide oil separators and intelligent oil management system.

5. Provide spring mounted vibration isolators.

2.05 HEAT RECOVERY UNITS

A. Heat Recovery Units: Concealed boxes designed specifically for this type of system to control heating/cooling mode selection of downstream units; consisting of electronic expansion valves, subcooling heat exchanger, refrigerant control piping and electronics to facilitate communications between outdoor unit, heat recovery unit, and indoor/evaporator units.

1. Control direction of refrigerant flow using electronic expansion or solenoid valves.

2. When branch unit is simultaneously heating and cooling, energize double spiral sub-cooling heat exchanger per port as needed.

3. Casing: Galvanized steel sheet; with flame and heat resistant foamed polyethylene sound and thermal insulation.

4. Condensate Drainage: Provide unit that does not require condensate drainage.

5. Heat Recovery Units shall be run tested at the factory.

6. Heat Recovery Units shall have 2, 3, or 4 ports for connections to indoor units. Each port shall be capable of connecting from one to eight indoor units up to a maximum nominal capacity of 54 MBH.

7. Heat Recovery Units shall be permitted to be piped in series or parallel to minimize material cost and labor.

8. The Heat Recovery Unit shall be controlled by integral microprocessors and communicate with the main control in the outdoor unit. The control circuit between the indoor units, heat recovery box, and outdoor unit shall be 24VDC completed using a 2-conductor, stranded and shielded cable for the RS485 daisy chain communication.

2.06 INDOOR/EVAPORATOR UNITS

A. All Indoor/Evaporator Units: Factory assembled and tested DX fan-coil units, with electronic proportional expansion valve, control circuit board, factory wiring and piping, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.

1. Refrigerant: Refrigerant circuits factory-charged with dehydrated air, for field charging.

2. Temperature Control Mechanism: Return air thermistor and computerized Proportional-Integral-Derivative (PID) control of superheat.

3. Coils: Direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond; waffle louver fin and high heat exchange, rifled bore tube design; factory tested.

4. Provide thermistor on liquid and gas lines.

5. Fans: Direct-drive, with statically and dynamically balanced impellers; high and low speeds unless otherwise indicated; motor thermally protected.

6. Return Air Filter: Washable long-life net filter with mildew proof resin, unless otherwise indicated.

7. Condensate Drainage: Built-in condensate drain pan with PVC drain connection.

8. Cabinet Insulation: Sound absorbing foamed polystyrene and polyethylene insulation.

9. The indoor unit shall communicate with the outdoor unit

10. Indoor unit refrigerant circuit shall be filled with a dry nitrogen gas charge from the factory.

B. High Static Ceiling Concealed Units: Ducted horizontal discharge and return; galvanized steel cabinet.

1. Return Air Filter: Factory supplied removable, washable filter

2. Sound Pressure: Measured at low speed at 5 feet (1.5 m) below unit.

3. Provide external static pressure switch adjustable for high efficiency filter operation

4. Fan: The indoor unit fan shall be no more than one assembly with two Sirocco fans direct driven by a single motor. Fan shall be statically and dynamically balanced with permanently lubricated bearings.

5. Condensate Pump: Factory installed, with lift of 27 inches minimum above the bottom of the indoor unit.

C. Vertical/Horizontal Air Handler: Ducted vertical/horizontal discharge and return; 22-gauge coated baked enamel finish steel cabinet. The return air opening will be on the bottom in the vertical position or right end in the horizontal position. Return air plenum subbase to be field provided.

1. Return Air Filter: Field provided for 16" x 20" x 1" filter rack. Filter access is from the front of the unit for easy serviceability.

2. Sound Pressure: Measured at low speed at 5 feet (1.5 m) below unit.

3. Provide external static pressure switch adjustable for high efficiency filter operation

4. Fan: The indoor unit fan shall be no more than one assembly with Sirocco fan direct driven by a single brushless digitally controlled design (BLDC)

motor. Fan shall be statically and dynamically balanced with permanently lubricated bearings.

5. All access panels to be provided with gasket seals to minimize air leakage within the unit.

6. Condensate drain connection for gravity condensate system.

D. Building Controls

1. Provide a central control panel with color touch screen for user interface. The AC Smart shall have the following features and capabilities:

a. Group Control: Group up to 64 devices by refrigerant circuit, floor, tenant, department, area, or any other breakdown. AC Smart panel controls and monitors device operating schedules, room temperatures, and other operating parameters.

b. Scheduling: Panel may be programmed to start and stop each device based on a customizable 365 day schedule.

c. System Backup: Provide an onboard battery that enables continued operation during power outages.

d. USB port: USB port required to provide a backup to AC Smart setup parameters and to update software

e. Provide expansion capability of up to 128 devices if required

f. Provide Digital Output expansion kit for control of additional binary outputs to control specified ancillary devices, such as lighting, exhaust fans, or ventilation dampers.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that required electrical services have been installed and are in the proper locations prior to starting installation.

B. Verify that condensate piping has been installed and is in the proper location prior to starting installation.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install refrigerant piping in accordance with equipment manufacturer's instructions.

C. Perform wiring in accordance with NFPA 70, National Electric Code (NEC).

D. Coordinate with installers of systems and equipment connecting to this system.

3.03 FIELD QUALITY CONTROL

A. Provide manufacturer's field representative to inspect installation prior to startup.

3.04 SYSTEM STARTUP

A. Provide manufacturer's field representative to perform system startup.

B. Prepare and start equipment and system in accordance with manufacturer's instructions and recommendations.

C. Adjust equipment for proper operation within manufacturer's published tolerances.

3.05 CLEANING

A. Clean exposed components of dirt, finger marks, and other disfigurements.

3.06 CLOSEOUT ACTIVITIES

A. Demonstrate proper operation of equipment to Owner's designated representative.

B. Demonstration: Demonstrate operation of system to Owner's personnel.

1. Use operation and maintenance data as reference during demonstration.

2. Briefly describe function, operation, and maintenance of each component.

C. Training: Train Owner's personnel on operation and maintenance of system.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

2. Provide minimum of two hours of training.

END OF SECTION

SECTION 15838

HVAC FANS

PART 1 GENERAL

1.01 SCOPE

A. Inline Fans

B. Shutter Mount Exhaust Fans

C. Fiberglass Wall Ventilator

1.02 RELATED SECTIONS

A. Section 15072 – Vibration Isolation

B. Section 15500 – Basic HVAC Requirements

C. Section 15072 - Supports and Anchors

D. Section 15890 - Ductwork

1.03 REFERENCES

A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

C. AMCA 99 - Standards Handbook.

D. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.

E. AMCA 300 - Test Code for Sound Rating Air Moving Devices.

F. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.

G. NEMA MG1 - Motors and Generators.

H. NFPA 70 - National Electrical Code.

I. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.04 SUBMITTALS

A. Submit under provisions of Division 1 and Section 15500

B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each.

C. Product Data: Provide schedule of vibration isolator type with location and load on each.

D. Manufacturer's Installation Instructions: Indicate special procedures and setting dimensions.

E. Manufacturer's Certificate: Certify that isolators are properly installed and adjusted to meet or exceed specified requirements.

1.05 OPERATION AND MAINTENANCE

A. Submit under provisions of Section 01 78 23.

B. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list and wiring diagrams.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01 31 00.

B. Protect motors, shafts and bearings from weather and construction dust.

1.07 EXTRA MATERIALS

A. Furnish under provisions of Section 01 60 00.

B. Provide two sets of belts for each fan.

1.08 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1 and Section 15500

B. Record actual locations of hangers including attachment points.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Mason Industries, Inc.

B. Kinetics Industries, Inc.

C. Dayton

D. Greenheck

E. Twin City

F. Substitutions: Under provisions of Section 15500

2.02 INLINE FANS

A. Impeller: Centrifugal fans in cabinet with direct drive motors.

B. Electrical Characteristics:

1. Refer to Section 15501

2. Motor: Self-aligning pre-lubricated ball or sleeve bearings.

3. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

4. Frame: One piece, square steel with die formed venturi orifice, mounting flanges and supports, with baked enamel finish.

5. Backdraft Damper: Multiple blade with offset hinge pin, blades linked. Backdraft dampers not required on units not connected to outdoor louvers or gravity ventilators.

6. Safety Screens: One inch galvanized wire cover inlet, motor, and drive

2.03 CORROSION RESISTANT SHUTTER MOUNT EXHAUST FANS

A. Propeller: Fiberglass reinforced polypropylene

B. Electrical Characteristics:

1. Refer to Section 15501

2. Motor: 115 volt totally enclosed motor

3. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

C. Frame: Fiberglass with an automatic shutter with stainless steel hardware

D. Gaurd: OSHA compliant epoxy coated wire guard

E. UL and C-UL Listed

2.04 FIBERGLASS WALL VENTILATOR

A. Fan: Polypropylene backward inclined

B. Electrical Characteristics:

1. Refer to Section 15501

2. Motor: 115 volt totally enclosed motor.

3. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

C. Frame: Molded fiberglass housing

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide sheaves required for final air balance.

C. Provide safety screen where inlet or outlet is exposed.

D. Provide backdraft dampers on discharge of exhaust fans and as indicated.

E. Do not operate fans in normal operation until ductwork is clean, filters are in place, bearings are lubricated, and fan has been test run under observation.

END OF SECTION

SECTION 15840

UNITARY AIR CONDITIONING UNITS

PART 1 SECTION INCLUDES

1.01 GENERAL

A. Computer Room Air Condition (CRAC) Unit

B. Split System Dehumidification Unit

1.02 RELATED SECTIONS

A. Section 16140 – Wiring Devices

1.03 REFERENCES

A. ARI 210 - Unitary Air-Conditioning Equipment.

B. ARI 270 - Sound Rating of Outdoor Unitary Equipment.

C. NFPA 70 - National Electrical Code.

D. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

1.04 SUBMITTALS FOR REVIEW

A. Division 1 - Submittals: Procedures for submittals.

B. Shop Drawings: Indicate capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.

C. Product Data: Provide capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.

D. Division 1 - Submittals: Submittals for information.

E. Submit manufacturer's installation instructions. Indicate assembly, support details, connection requirements, and include start-up instructions.

F. Division 1 - Contract Closeout: Division 1 - Operation and Maintenance Data: Submittals for project closeout.

G. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

1.05 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

B. Unit shall be rated in accordance with ARI Standards 210/240 or 360 and 270. Designed in accordance with UL Standard 1995.

C. Unit shall be designed to conform to ASHRAE 15, latest revision.

D. Unit shall be UL - tested and certified in accordance with ANSI Z21.47 Standards and UL listed and certified under Canadian standards as a total package for safety requirements.

1.06 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for the purpose specified and indicated.

1.07 DELIVERY, STORAGE AND PROTECTION

A. Protect units from physical damage by storing off site permanent mounting pads are in place, ready for immediate installation of units.

1.08 WARRANTY

A. Division 1 – Closeout Procedures.

B. Division 1 – Product Requirements.

C. Provide a five year warranty to include coverage for refrigeration compressors.

1.09 EXTRA MATERIALS

A. Install one new set of filters at the time of substantial completion and furnish one additional set of filters for the indoor units.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Liebert

B. Stulz

C. Data Aire

D. PoolPak

E. Desert Aire

F. Substitutions as identified through documented Substitution process

2.02 COMPUTER ROOM AIR CONDITIONING UNIT

A. System shall consist of an indoor unit and an outdoor condensing unit. The two components shall be connected by refrigerant piping with integral condensate pump.

B. Unit components shall be tested by a Nationally Recognized Testing Laboratory (NRTL)) and bear the ETL label.

C. All wiring shall be in accordance with the National Electrical Code (N.E.C.).

D. The system shall be rated in accordance with Air-conditioning Refrigeration Institute's (ARI) Standard 210 and bear the ARI Certification label.

E. A pressure charge of R410A refrigerant sufficient for 75 feet of refrigerant tubing shall be provided in the condensing unit.

F. System efficiency shall meet or exceed 12.5 SEER.

G. Provide a unit mounted controller for the indoor unit. This controller shall perform input functions necessary to operate the system. The controller shall consist of a power ON/OFF switch, mode selector, temperature setting, timer control, fan speed and select. The unit shall have an emergency operation mode to allow operation without the controller

H. The units shall have a manufacturer's parts and defects warranty for a period one (1) year from the date of the original installation. The compressor shall have a warranty of 6 years from date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. The warranty shall cover material and labor.

I. The indoor unit Component:

1. The indoor unit shall be factory assembled, wired and run tested. The unit shall be factory wired, have all internal piping and control circuit board, fan motor and condensate pump.

2. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function and a test run switch.

3. Indoor unit and refrigerant pipes shall be charged with dry air before shipment from the factory.

4. Install the unit on equipment pad as shown

5. The indoor unit fan shall be in the upflow arrangement; direct driven by a single fan motor.

6. The fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings.

7. The indoor unit fan motor shall operate in three (3) selectable speeds, High, Medium and Low.

8. The return air stream shall have a means for installing a filter.

9. The indoor unit (evaporator) coil shall be of nonferrous construction with smooth, hydrophilic coated aluminum fins on copper tubing.

10. Tubing shall have inner groves for high efficiency heat exchange.

11. All tube joints shall be brazed with PhosCopper or silver alloy.

12. The coil shall be pressure tested at the factory.

13. A sloped condensate pan and drain with extension hose shall be provided under the coil.

14. The electrical power for the indoor and outdoor units will be supplied individually. Refer to equipment schedule for unit voltage.

15. The microprocessor located in the indoor unit shall have the capability of sensing return air temperature and indoor coil temperature, receiving and processing commands from the wall mounted controller, providing emergency operation and controlling the outdoor unit.

16. The system shall be capable of automatic restart when power is restored after power interruption.

J. The Outdoor Condensing Unit :

1. The outdoor unit shall be designed specifically for use with indoor units. The units shall be equipped with a circuit board that interfaces to the indoor unit circuit board. The outdoor unit shall be completely factory assembled, internally piped and wired. Each unit shall be run tested at the factory.

2. The outdoor unit casing shall be fabricated from zinc coated steel, bonderized with an electrostatically applied, thermally bonded, acrylic or polyester powder coating for corrosion protection.

3. Case and mounting feet shall be as follows:
   a) The MS-A09WA base shall be of Aluminum-Zinc-Magnesium alloy coated steel, with welded mounting feet.
   b) The base for the MS-A12WA shall have a galvanized steel base with welded mounting feet.

4. The outdoor unit shall have a direct drive propeller type fan, statically and dynamically balanced for smooth and quiet operation.

5. The fan motor shall have inherent protection, be equipped with permanently lubricated bearings. The fan motor shall be mounted and isolated for quiet operation.

6. The fan shall be provided with a raised guard to prevent contact with moving parts.

7. The condenser coil shall be of nonferrous construction with pre-coated with E-Coat Epoxy paint or equivalent sea coast coating.

8. The coil shall be protected with an integral metal guard.

9. Refrigerant flow from the condenser shall be controlled by means of a metering orifice.

10. The compressor shall be a high performance, hermetic, rolling piston, rotary type.

11. Compressor shall be mounted using rubber isolating bushings to avoid the transmission of vibration.

12. Compressor shall be protected by an automatic over current relay and a thermal overload switch

13. The outdoor unit shall have an accumulator.

14. The outdoor unit must have the ability to operate with a maximum height difference of 35 feet between indoor and outdoor units.

15. The unit shall have a maximum refrigerant tubing length of 75 feet between in door and outdoor units without the need for line size changes, traps or additional oil.

16. The unit shall be pre-charged for a maximum of 75 feet of refrigerant tubing.

17. Provide an integral condensate pump with the unit. Provide separate power connection for the pump from the unit controller. Install condensate piping from the pump up through the ceiling space to discharge at the location indicated on the drawings.

18. The unit shall be capable of low ambient operation.

2.03 SPLIT SYSTEM DEHUMIDIFICATION UNITS

A. System shall consist of an indoor unit and an outdoor condensing unit. The two components shall be connected by refrigerant piping. The unit shall be capable of hot gas reheat.

B. Unit components shall be tested by a Nationally Recognized Testing Laboratory (NRTL)) and bear the ETL label.

C. All wiring shall be in accordance with the National Electrical Code (N.E.C.).

D. The system shall be rated in accordance with Air-conditioning Refrigeration Institute's (ARI) Standard 210 and bear the ARI Certification label.

E. System efficiency shall meet or exceed 12.5 SEER.

F. Provide unitary controls to maintain constant discharge air temperature and relative humidity.

G. The units shall have a manufacturer's parts and defects warranty for a period one (1) year from the date of the original installation. The compressor shall have a warranty of 6 years from date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. The warranty shall cover material costs only.

H. The indoor unit Component:

1. The indoor unit shall be factory assembled, wired and run tested. The unit shall be factory wired, have all internal piping and control circuit board and fan motor.

2. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function and a test run switch.

3. Indoor unit and refrigerant pipes shall be charged with dry air before shipment from the factory.

4. The indoor unit casing shall have a factory finish.

5. The fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings.

6. The return inlet air stream shall have a means for installing a filter.

7. The indoor unit coils shall be coated for chemically resistant operations.

8. The indoor unit (evaporator) coil shall be of nonferrous construction with smooth, pre-coated aluminum fins on copper tubing.

9. Tubing shall have inner groves for high efficiency heat exchange.

10. All tube joints shall be brazed with PhosCopper or silver alloy.

11. The coil shall be pressure tested at the factory.

12. A condensate pan and drain with extension hose shall be provided with the unit.

13. The system shall be capable of automatic restart when power is restored after power interruption.

I. The outdoor condensing unit Component:

1. The outdoor unit shall be designed specifically for use with the associated indoor unit. The unit shall be equipped with a circuit board that interfaces to the indoor unit circuit board. The outdoor unit shall be completely factory assembled, internally piped and wired. Each unit shall be run tested at the factory.

2. The outdoor unit casing shall be fabricated from zinc coated steel, bonderized with an electrostatically applied, thermally bonded, acrylic or polyester powder coating for corrosion protection.

3. The outdoor unit shall have a direct drive propeller type fan, statically and dynamically balanced for smooth and quiet operation.

4. The fan motor shall have inherent protection, be equipped with permanently lubricated bearings. The fan motor shall be mounted and isolated for quiet operation.

5. The fan shall be provided with a raised guard to prevent contact with moving parts.

6. The condenser coil shall be of nonferrous construction with pre-coated aluminum strake fins on copper tubing.

7. The coil shall be protected with an integral metal guard.

8. Refrigerant flow from the condenser shall be controlled by means of a metering orifice.

9. The compressor shall be a high performance, hermetic, rolling piston, rotary type.

10. Compressor shall be mounted using rubber isolating bushings to avoid the transmission of vibration.

11. Compressor shall be protected by an automatic over current relay and a thermal overload switch

12. The outdoor unit shall have an accumulator.

13. The outdoor unit must have the ability to operate with a maximum height difference of 35 feet between indoor and outdoor units.

14. The unit shall have a maximum refrigerant tubing length of 75 feet between in door and outdoor units without the need for line size changes, traps or additional oil.

15. The unit shall be pre-charged for a maximum of 75 feet of refrigerant tubing.

16. The unit shall be capable of low ambient operation

PART 3 EXECUTION

3.01 EXAMINATION

A. Division 1 – Project Management and Coordination: Verification of existing conditions prior to beginning work.

1. Verify that proper power supply is available.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions and NFPA 90A.

B. Install indoor air conditioning units on wall. Install units level.

C. Install indoor dehumidification units and indoor dedicated outdoor air units on floor with leveling legs.

D. Install condensing units on pads on grade. Install units level.

3.03 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under provisions of Division 1 – Quality Requirements.

B. Provide initial start-up and shut-down during first year of operation, including routine servicing and check-out.

END OF SECTION 1584

SECTION 15890

DUCTWORK

PART 1 SECTION INCLUDES

1.01 GENERAL

A. Metal ductwork

B. Nonmetal ductwork

C. Casing and plenums

D. Duct cleaning

1.02 RELATED SECTIONS

A. Section 09900 - Painting: Weld priming, weather-resistant paint or coating

B. Section 15503 - Supports and Anchors

C. Section 15509 - Duct Insulation

D. Section 15910 - Ductwork Accessories

E. Section 15940 - Air Distribution

F. Section 15990 - Testing, Adjusting and Balancing

1.03 REFERENCES

A. ASTM A 36 - Structural Steel

B. ASTM A 90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles

C. ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

D. ASTM A 366 - Steel, Sheet, Carbon, Cold Rolled, Commercial Quantity

E. ASTM A 480 - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

F. ASTM A 525 - General Requirements for Steel Sheet, Zinc- Coated (Galvanized) by the Hot-Dip Process

G. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality

H. ASTM A 568 - Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled

I. ASTM A 569 - Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality

J. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate

K. AWS D9.1 - Welding of Sheet Metal

L. NFPA 90A - Installation of Air Conditioning and Ventilating Systems

M. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems

N. NFPA 91 - Installation of Blower and Exhaust Systems for Dust, Stock and Vapor Removal or Conveying

O. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment

P. SMACNA - HVAC Air Duct Leakage Test Manual

Q. SMACNA - HVAC Duct Construction Standards - Metal and Flexible

R. SMACNA - Fibrous Glass Duct Construction Standards

S. UL 181 - Factory-Made Air Ducts and Connectors

1.04 PERFORMANCE REQUIREMENTS

A. No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.05 SUBMITTALS

A. Submit under provisions of Division 1

B. Shop Drawings: Indicate duct fittings and particulars such as gauges, sizes, welds, and configuration prior to start of work. Prepare and submit to the Engineer coordinated composite layouts of all sheet metal ductwork. The drawings shall be drawn at not less than 1/4-inch per foot and shall include dimensions for connections and offsets. Include sectional views, installation details and other items that must be shown to assure a coordinated installation.

C. Product Data: Provide data for duct materials, fittings, duct connectors, etc.

D. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

1.06 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1 and Section 15500

B. Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.07 QUALITY ASSURANCE

A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.08 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing the work of this section with minimum five years documented experience.

1.09 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A, NFPA 90B and NFPA 96 standards

1.10 ENVIRONMENTAL REQUIREMENTS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures during and after installation of duct sealants.

PART 2 PRODUCTS

2.01 MATERIALS

A. Galvanized Steel Ducts: ASTM A525 and ASTM A527 galvanized steel sheet, lock-forming quality, having G60 zinc coating of in conformance with ASTM A90.

B. Aluminum Ducts: ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061- T6 or of equivalent strength.

C. Flexible Ducts:

1. Manufacturers:

a. The Flexaust Co.

b. Hart & Cooley

c. The Wagner Group

d. Therma Flex

e. Substitutions: Under provisions of Section 15500

2. UL labeled multiple layers of aluminum laminate supported by helically wound spring steel wire.

3. Pressure Rating: 10 inches WG positive and 1.0 inches negative

4. Maximum Velocity: 4000 fpm

5. Temperature Range: -20 degrees F. to 210 degrees F

D. Insulated Flexible Ducts:

1. Manufacturers:

a. Certain Teed

b. Knauf Fiber Glass

c. Owens Corning

d. Therma Flex

e. Substitutions: Under provisions of Section 15500

2. UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire; fiberglass insulation; aluminized vapor barrier film.

3. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative.

4. Maximum Velocity: 4000 fpm.

5. Temperature Range: -20 degrees F. to 210 degrees F

E. Stainless Steel Ducts: ASTM A167, Type 304 or 316.

F. Fasteners: Rivets, bolts, or sheet metal screws.

G. Sealant:

1. Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.

H. Hanger Rod: ASTM A36; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

I. Fiberglass Reinforced Plastic Ductwork

1. Manufacturers:

a. Monoxivent

b. Perry Fiberglass Products, Inc.

c. Vari-Tech LLC

d. ATS Inc.

e. Substitutions: Under provisions of Section 15500

2. FRP – Fiberglass Reinforced Plastic ductwork and appurtenances, complete and in place, in accordance with the requirements of the Drawings.

3. All supply and return ductwork from the dehumidification units into the main process area of the Water Treatment Plant shall be FRP as indicated. All ductwork in chemical storage rooms shall be FRP as indicated.

4. Comply with the latest revision of the following codes, standards and specifications, except where more stringent requirements have been specified herein:

   a. ASTM C 582 – Standard specification for contact – molded reinforced thermosetting plastic laminates for corrosion resistant equipment.

   b. ASTM D 3982 – Standard specification for contact-molded fiberglass ducts and hoods.

   c. ASTM D 2996 – Standard specification for Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Pipe.

   d. NPS 15-69 - Standards specification for Custom Contact-Molded Reinforced - Polyester Chemical - Resistant Process Equipment.

   e. SMACNA Thermoset FRP Duct Construction Manual

   f. ASTM E 84 - Test for low flame

5. Fittings:

   a. Fittings shall be hand lay-up construction fabricated from the same resin and have the same strength as the FRP duct.

   b. The internal diameter of fittings shall be equal to the adjacent duct.

   c. The centerline radius of all elbows shall be 1.5 times the diameter.

   d. Elbows 24" (610mm) diameter and smaller shall be smooth radius. Elbows larger than 24" (610mm) diameter shall be mitered.

   e. Elbows 45 degrees or less shall be at least two (2) miter/three (3) gore. Elbows greater than 45 degrees shall be at least four (4) miter/five (5) gore.

6. Flanges:

   a. Provide flanged connections as required to flexible connectors, expansion joints, vessels, demisters, fans, silencers and other locations as shown.

b. Flanges shall be hand lay-up construction. Dimensions shall be in accordance with PS 15-69 – Table 2 and the duct dimension schedule.

c. Flange faces shall be perpendicular to the axis of the duct within 0.5 degree.

d. Flange faces shall be flat to within 0.0313" (0.8mm) up to and including 18" (457mm) diameter and within 0.0625" (1.6mm) for 20" (508mm) diameter and larger.

e. Gaskets shall be EPDM/Neoprene, full face and minimum 0.125" (3.2mm) thickness.

f. Bolts, nuts and washers shall be Type 316 stainless steel.

7. Joints:

a. Provide butt and wrap joints in accordance with ASTM D 3982.

b. Field weld materials shall be supplied by the duct manufacturer. Complete written and online video instructions shall be provided along with Material Safety Data Sheets.

c. Resin, catalyst and fiberglass materials shall be supplied in bulk for the total number of joints plus 20% extra.

2.02 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

1. Supply ductwork - 2" W.G.

2. Return, relief, outdoor air and exhaust ductwork (-) 2" W.G.

3. Exhaust ductwork downstream of cabinet fan (-) 4" W.G.

B. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide air foil turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.

C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream. No duct taps will be allowed in any diverging or converging transitions.

D. Fabricate continuously welded round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.

E. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

2.03 MANUFACTURED DUCTWORK AND FITTINGS

A. Manufacture in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

B. Round Ducts:

1. Manufacturers:

a. Monroe Metal

b. United McGill

c. R. V. Money

d. Dixie Steel

e. Eastern Sheet Metal

f. Spiral Pipe of Texas

g. Substitutions: Under provisions of Section 15500

2. Machine made from round spiral lockseam duct with light reinforcing corrugations; fittings manufactured of at least two gauges heavier metal than duct.

3. Double wall spiral duct, with 2" of insulation.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible. Provide sealant on all duct joints.

C. Provide duct leakage tests on all ductwork in accordance with SMACNA Air Duct Leakage Test Manual. Test pressure shall be 2" w.g. Allowable leakage rate shall not exceed 1%.

D. Duct Sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.

E. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage.

Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

F. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

G. Use crimp joints with or without bead for joining round duct sizes 8 inches and smaller with crimp in direction of air flow.

H. Use double nuts and lock washers on threaded rod supports.

I. Connect diffusers to low pressure ducts with 5 feet maximum length of flexible duct held in place with strap or clamp.

J. Connect flexible ducts to metal ducts with draw bands and sheet metal screws.

K. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

L. No ductwork shall be hung or supported from structural bridging or the roof deck material.

M. Support flexible duct maximum 3'-0" O.C. and in any change in direction.

N. FRP ducts shall be installed in a neat and workmanlike manner, properly aligned and cut from measurements taken at the site to avoid interferences with structural members, architectural features, openings and equipment.

O. Supports and anchors: All ducting shall be firmly supported with fabricated or commercial hangers or supports in accordance with SMACNA requirements. Where necessary to avoid stress on equipment or structural members, the ducts shall be anchored or harnessed.

P. Expansion joints and guides as shown on drawings shall compensate for expansion due to temperature differences.

Q. Support duct risers in accordance with ASHRAE and SMACNA as indicated.

3.02 CLEANING

A. Clean work under provisions of Division 1 and Section 15500.

B. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.

C. Clean duct systems with high power vacuum machines. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.

END OF SECTION 15890

SECTION 15910

DUCTWORK ACCESSORIES

PART 1 PART 1 - GENERAL

1.01 SCOPE

A. Backdraft dampers

B. Duct access doors

C. Duct test holes

D. Fire dampers

E. Flexible duct connections

F. Volume control dampers

1.02 RELATED SECTIONS

A. Section 15890 - Ductwork

B. Section 16180 - Equipment Wiring Systems: Electrical characteristics and wiring connections

1.03 REFERENCES

A. NFPA 90A - Installation of Air Conditioning and Ventilating Systems

B. NFPA 70 - National Electrical Code

C. SMACNA - HVAC Duct Construction Standards - Metal and Flexible

D. UL 33 - Heat Responsive Links for Fire-Protection Service

E. UL 555 - Fire Dampers and Ceiling Dampers

1.04 SUBMITTALS

A. Submit under provisions of Division 1 and Section 15500

B. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors and duct test holes.

C. Product Data: Provide for shop fabricated assembles including volume control dampers, duct access doors, duct test holes and hardware used. Include electrical characteristics and connection requirements.

D. Manufacturer's Installation Instructions: Indicate for fire dampers and for combination fire dampers.

1.05 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1 and Section 15500

B. Record actual locations of access doors & test holes.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

1.07 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories Inc., as suitable for the purpose specified and indicated.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 1 and Section 15500.

B. Protect dampers from damage to operating linkages and blades

1.09 EXTRA MATERIALS

A. Furnish under provisions of Division 1 and Section 15500

B. Provide two of each size and type of fusible link

PART 2 PART 2 - PRODUCTS

2.01 BACKDRAFT DAMPERS

A. Gravity Backdraft Dampers, Size 18 x 18 inches or smaller, furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.

B. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: 16 gauge thick galvanized steel, or extruded aluminum, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.02 DUCT ACCESS DOORS

A. Manufacturers:

1. United McGill

2. Duro-Dyne

3. Ductmate Ind.

4. Substitutions: Under provisions of Section 15500

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

C. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover.

1. Less Than 12 Inches Square: Secure with sash locks

2. Up to 18 Inches Square: Provide two hinges and two sash locks

3. Up to 24 x 48 Inches: Three hinges and two compression latches with outside and inside handles

4. Larger Sizes: Provide an additional hinge

D. Access doors with sheet metal screw fasteners are not acceptable

2.03 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill-in ducts are required. Cap with neoprene plugs, threaded plugs, or threaded or twist-on metal caps

B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation

2.04 FIRE DAMPERS

A. Manufacturers:

1. Ruskin Mfg.

2. Air Balance, Inc.

3. Vent Products Co.

4. Greenheck

5. Penn Ventilator

6. Prefco

7. NCA Manufacturing

8. United Air

9. Substitutions: Under provisions of Section 15500

B. Fabricate in accordance with NFPA 90A and UL 555, and as indicated

C. Ceiling Radiation Dampers for Round Neck Diffusers: 1-1/2 hour rated, galvanized steel, 20 gauge frame and 20 gauge blade with UL Classified insulation. Provide with thermal insulating blanket for diffuser and UL listed fusible link air volume adjustment. Provide extended neck type where flexible ductwork connects to diffusers.

D. Ceiling Radiation Dampers for Square Neck Diffusers: 1 hour rated, UL classified, square curtain type damper, one-piece 22 gauge roll formed galvanized steel ramp, tightly woven reinforced fiberglass fabric with aluminum impregnated coating, stainless steel negator springs, 165 deg. F. fusible link, fabric riveted to blade.

E. Curtain Type Dampers: 1-1/2 or 3 hour rated as indicated galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations closure under air flow conditions. Configure with blades out of air stream except for ducts up to 12 inches in height.

F. Multiple Blade Dampers: 16 gauge galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles; 1/8 x 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

G. Fusible Links: UL 33, separate at 165 degrees F.

2.05 FLEXIBLE DUCT CONNECTIONS

A. Manufacturers:

1. Duro-Dyne Corp.

2. United McGill Corp.

3. Vibration Mountings & Controls, Inc.

4. Substitutions: Under provisions of Section 15500

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated

C. Connector: Fabric crimped into metal edging strip

1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz. per sq. yd.

2. Net Fabric Width: Approximately 3 inches wide

3. Metal: 3 inches wide, 24 gauge galvanized steel

2.06 VOLUME CONTROL DAMPERS

A. Manufacturers:

1. Ruskin Mfg.

2. United McGill Corp.

3. Air Balance Corp.

4. Greenheck

5. Penn Ventilator

6. Duro-Dyne

7. NCA Manufacturing

8. Substitutions: Under provisions of Section 15500

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

C. Single Blade Dampers: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

D. End Bearings: Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

E. Quadrants:

1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.

2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

3. Where rod lengths exceed 30 inches provide regulator at both ends.

2.07 BACK PRESSURE DAMPER

A. Back draft damper, end-pivoted counter-balanced blades, airfoil blades, galvanized steel construction equal to American Warming and Ventilating Model BD-52.

B. Provide external linkage for motor operation.

C. Damper shall be motor operated, but shall also open or close in response to air pressure.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

A. Install accessories in accordance with manufacture's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, smoke detectors, smoke dampers, and elsewhere as indicated.

D. Provide duct test holes where indicated and required for testing and balancing purposes.

E. Provide fire dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

F. Demonstrate re-setting of fire dampers to Owner's representative.

G. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment, and supported by vibration isolators.

H. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.

I. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 15940

AIR DISTRIBUTION

PART 1 GENERAL

1.01 SCOPE

A. Diffusers

B. Registers/grilles

C. Gravity Ventilators

D. Louvers

E. FRP Diffusers

F. FRP Louvers

1.02 RELATED SECTIONS

A. Section 15890 - Ductwork: Insulated flexible duct

B. Section 15910 - Ductwork Accessories: Volume dampers and air extractors

1.03 REFERENCES

A. ADC 1062 - Certification, Rating and Test Manual

B. AMCA 500 - Test Method for Louvers, Dampers and Shutters

C. ARI 650 - Air Outlets and Inlets

D. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets

E. SMACNA - HVAC Duct Construction Standard - Metal and Flexible

F. NFPA 70 - National Electrical Code

G. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

1.04 SUBMITTALS

A. Submit under provisions of Division 1 and Section 15500

B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

C. Samples: Submit one sample of a square ceiling diffuser

1.05 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1 and Section 15500

B. Record actual locations of air outlets and inlets

1.06 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ADC Equipment Test Code 1062 and ASHRAE 70

B. Test and rate louver performance in accordance with AMCA 500

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Titus

B. Greenheck

C. Loren Cook

D. Carnes

E. Acme

F. Metalaire

G. E. H. Price

H. Krueger

I. Tuttle & Bailey

J. Primary Plastics Inc.

K.

L. Substitutions: Under provisions of Section 15500

2.02 SQUARE CEILING DIFFUSERS (SUPPLY)

A. Type: Square steel diffuser with adjustable discharge on supply and fixed discharge on return. Square inlet integral to diffuser with square to round adaptor. Outer frame assembly of size shown on schedule. Inner core assembly consists of fixed deflection louvers set in a 4-way discharge pattern. Inner core diffusers shall be a minimum of 20" x 20" on all 24" x 24" diffusers. Inner core assembly

shall be removable in the field without the use of tools for easy cleaning, installation and damper adjustment.

B. Frame: Inverted T-bar type. In gypsum board ceilings, provide surface-mount ceiling frame.

C. Fabrication: Steel with baked enamel off-white finish.

D. All diffusers installed in gypsum board ceilings shall be furnished with an opposed blade volume damper adjustable from the face of the diffuser. Refer to reflected ceiling plans and mechanical plans for locations.

2.03 SQUARE CEILING RETURN AND EXHAUST GRILLES

A. Type: Eggcrate aluminum grid with 1/2" x 1/2" x 1/2" cubes with minimum 90% free area.

B. Frame: Outer border shall be constructed of heavy extruded aluminum (thickness of 0.040" - 0.050") and shall have countersunk screw holes for a neat appearance.

C. Damper: Integral, opposed blade volume damper constructed of heavy gauge steel or aluminum operable from face of grille at all locations where grille is installed in non-accessible ceilings.

2.04 GRAVITY VENTILATORS

A. Fabricate air inlet or exhaust hoods in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Fabricate of galvanized steel, minimum 16 gauge base and 20 gauge hood, or aluminum, minimum 16 gauge base and 18 gauge hood; suitably reinforced; with removable hood; birdscreen with 1/2 inch square mesh for exhaust and 3/4 inch for intake, and factory baked enamel finish.

C. Mount unit on minimum 12 inch high curb base with insulation between duct and curb.

D. Make hood outlet area minimum of twice throat area.

2.05 LOUVERS

A. Type: Weather proof louver designed to protect air intakes and exhaust openings. Unit shall have stationary drainable horizontal blades that channels water to the jambs to drain through the sill. AMCA licensed performance required.

B. Frame: Heavy gauge extruded 6063-t5 Aluminum 4" x 0.081" nominal wall thickness

C. Fabrication: Aluminum mechanically fastened, mill finish

D. All louvers shall be provided with birdscreen

2.06 FRP LOUVERS

A. Type: Fiberglass Reinforced Plastic FRP louver. Louvers shyall be flush construction with a 20 mil gelcoated finish; color defined by purchaser.

B. Frame: Jambs, sill, header, slats and vanes shall be fabricated of gelcoated FRP.

C. Fabrication: FRP owner and architect to select color.

D. All louvers designated as FRP construction shall meet flamespread rating per ASTM E-84 and should be self-extinguishing per ASTM D-635.

2.07 SCHEDULE

A. Refer to Air Distribution Schedule for specific requirements and special accessories.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

C. Install diffusers to ductwork with air tight connection.

D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, grille or register assembly.

E. Provide ceiling radiation dampers and thermal blankets on ceiling diffusers in accordance with plans and Section 15910.

END OF SECTION 15904

SECTION 15990

TESTING, ADJUSTING, AND BALANCING

PART 1 GENERAL

1.01 SCOPE

A. Testing, adjustment, and balancing of air systems.

B. Testing, adjustment, and balancing of refrigerating systems.

C. Measurement of final operating condition of HVAC systems.

D. Sound measurement of equipment operating conditions.

E. Vibration measurement of equipment operating conditions.

1.02 RELATED SECTIONS

A. General requirements for testing agencies are specified in the Division 1 Section Quality Control Services.

B. Other Division 15 Sections specify balancing devices and their installation, and materials and installations of HVAC systems.

C. Individual Division 15 system sections specify leak testing requirements and procedures.

1.03 REFERENCES

A. AABC - National Standards for Field Measurement and Instrumentation, Total System Balance

B. ADC - Test Code for Grilles, Registers, and Diffusers

C. ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air conditioning, and Refrigeration Systems

D. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems

E. SMACNA - HVAC Systems Testing, Adjusting, and Balancing

1.04 SUBMITTALS

A. Submit under provisions of Division 1

B. Submit name qualifications and references of adjusting and balancing agency for approval within 48 hours after bid opening.

C. Test Reports: Submit under provisions of Division 1

1. All specified tests shall be documented in writing listing date, item tested, section tested, witnesses to the test (signed), and specification section which requires testing. Reports on testing shall be provided to the Architect within seven (7) days of completion of each test. In addition all test reports shall be complied in a spiral bound 8 1/2" x 11" document and submitted at the same time and in the same quantity as required for Operation and Maintenance manuals.

D. Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

E. Prior to commencing work, submit report forms or outlines indicating adjusting, balancing, and equipment data required.

F. Submit draft copies of report for review prior to final acceptance of Project. Provide final typed copies for Architect/Engineer and for inclusion in operating and maintenance manuals.

G. Provide typed reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

H. Include detailed procedures, agenda, sample report forms, and copy of AABC National Project Performance Guaranty prior to commencing system balance.

I. Test Reports: Indicate data on AABC National Standards for Total System Balance forms, forms prepared following ASHRAE 111 or NEBB forms.

1.05 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1

B. Record actual locations of flow measuring stations, balancing valves and rough setting.

1.06 QUALITY ASSURANCE

A. A certified testing and balancing agency shall perform total system balance in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance ASHRAE 111 or NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

B. Maintain one copy of each document on site.

1.07 PRE-BALANCING CONFERENCE

A. Convene with Owner and Architect one week prior to commencing work of this section, under provisions of Division 1.

PART 2 PRODUCTS

Not Used

PART 3 PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:

1. Systems are started and operating in a safe and normal condition.

2. Temperature control systems are installed complete and operable.

3. Proper thermal overload protection is in place for electrical equipment.

4. Final filters are clean and in place. If required, install temporary media in addition to final filters.

5. Duct systems are clean of debris.

6. Fans are rotating correctly.

7. Fire and volume dampers are in place and open.

8. Air coil fins are cleaned and combed.

9. Access doors are closed and duct end caps are in place.

10. Air outlets are installed and connected.

11. Duct system leakage is minimized.

B. Submit field reports promptly to Owner and Architect. Report defects and deficiencies noted during performance of services which prevent system balance.

C. Beginning of work means acceptance of existing conditions.

3.02 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

B. Provide additional balancing devices as required.

3.03 INSTALLATION TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

3.04 ADJUSTING

A. Ensure recorded data represents actual measured or observed conditions.

B. Permanently mark final settings of valves, dampers, and other adjustment devices with paint or engraved devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

F. Check and adjust systems approximately six months after final acceptance and submit report.

3.05 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to the extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. If total air quantities cannot be attained with equipment in place, the Balancing Contractor shall notify the Owner and Architect. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.

3.06 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing

1. Split System Dehumidification Units
2. Variable Refrigerant System
3. Exhaust Fans
4. Air Filters
5. Air Inlets and Outlets

B. Report Forms

1. Title Page:
   a. Project name
   b. Project location
   c. Project Architect
   d. Project Engineer
   e. Project Contractor
   f. Project altitude
   g. Report date
2. Summary Comments:
   a. Design versus final performance
   b. Notable characteristics of system
   c. Description of systems operation sequence

d. Summary of outdoor and exhaust flows to indicate amount of building pressurization

e. Nomenclature used throughout report

f. Test conditions

3. Instrument List:

a. Instrument

b. Manufacturer

c. Model number

d. Serial number

e. Range

f. Calibration date

4. Electric Motors:

a. Manufacturer

b. Model/Frame

c. HP/BHP

d. Phase, voltage, amperage; nameplate, actual, no load

e. RPM

f. Service factor

g. Starter size, rating, heater elements

h. Sheave Make/Size/Bore

5. V-Belt Drive:

a. Identification/location

b. Required driven RPM

c. Driven sheave, diameter and RPM

d. Belt, size and quantity

e. Motor sheave diameter and RPM

f. Center to center distance, maximum, minimum, and actual

6. Air Moving Equipment

a. Location

b. Manufacturer

c. Model number

d. Serial number

e. Arrangement/Class/Discharge

f. Air flow, specified and actual

g. Return air flow, specified and actual

h. Outside air flow, specified and actual

i. Total static pressure (total external), specified and actual

j. Inlet pressure

k. Discharge pressure

l. Sheave Make/Size/Bore

m. Number of Belts/Make/Size

n. Fan RPM

7. Return Air/Outside Air Data:

a. Identification/location

b. Design air flow

c. Actual air flow

d. Design return air flow

e. Actual return air flow

f. Design outside air flow

g. Actual outside air flow

h. Return air temperature

i. Outside air temperature

j. Required mixed air temperature

k. Actual mixed air temperature

l. Design outside/return air ratio

m. Actual outside/return air ratio

8. Exhaust Fan Data:

a. Location

b. Manufacturer

c. Model number

d. Serial number

e. Air flow, specified and actual

f. Total static pressure (total external), specified and actual

g. Inlet pressure

h. Discharge pressure

i. Sheave Make/Size/Bore

j. Number of Belts/Make/Size

k. Fan RPM

9. Duct Traverse:

a. System zone/branch

b. Duct size

c. Area

d. Design velocity

e. Design air flow

f. Test velocity

g. Test air flow

h. Duct static pressure

i. Air temperature

j. Air correction factor

10. Air Distribution Test Sheet:

a. Air terminal number

b. Room number/location

c. Terminal type

d. Terminal size

e. Area factor

f. Design velocity

g. Design air flow

h. Test (final) velocity

i. Test (final) air flow

j. Percent of design air flow

END OF SECTION 15990

SECTION 15995

HVAC SYSTEMS COMMISSIONING

PART 1 GENERAL

1.01 GENERAL PROVISIONS

A. Drawings and general provisions of the Contract, including General Conditions and Supplemental Conditions and Division 1 apply to Work of this section.

B. Provisions of Divisions 15 and 16 of the project specifications which are applicable to Commissioning of the HVAC System are an integral part of this Section.

C. Commissioning is an important and integral part of the Contractor's Quality Control program.

D. In addition to coordination activities with the Owner and the Engineer, the Contractor shall coordinate inspections with the Commissioning Agent.

1.02 WORK INCLUDED

A. "Active participation" in the Commissioning program as generally outlined in this section.

1.03 COMMISSIONING PROGRAM CRITERIA

A. Intent:
1. The intent of Building System Commissioning is to assure delivery to the Owner of systems which are properly installed and fully functioning in accordance with the contract documents and to assure the Owner's personnel are fully trained and equipped to operate, maintain and troubleshoot the delivered systems.
2. The HVAC Contractor, in conjunction with the Owner and Design Consultant shall prepare and implement a Commissioning program which achieves these objectives and the scope of work as defined in this Section. The scheduled work of Commissioning must be included in the Detailed Project Construction Schedule.
3. This Section provides only a general overview of the minimum Commissioning program requirements.
4. The HVAC Contractor shall exceed those requirements whenever necessary to achieve the stated intent of Building Commissioning.

B. Definitions and Abbreviations:
1. Maintenance Orientation and Periodic Inspection: At prescribed times during the work the HVAC Contractor shall walk the site with the Engineer's representative and designated Owner's staff, to orient them to equipment types and locations, assist them with access for periodic quality assurance and answer questions concerning the Work. Prescribed training sessions

and submittal of Operation and Maintenance Manuals shall be completed in conjunction with the Commissioning effort.

2. Equipment Placement Completion: Stage of the Work at which the major items of Division 15 equipment have been placed at final locations, but have not received ductwork, piping and electrical connections. Major equipment includes, but is not limited to, heating and cooling plant equipment and air-handlers.
3. Distribution Completion: Stage of Work at which distribution piping and ductwork have been installed and tested, but not insulated or concealed by further Work.
4. O. & M. Manuals: Operation and Maintenance Manuals as specified in Contract Documents.
5. TAB: Testing, Adjusting and flow Balance of Division 15 equipment as specified in Contract Documents.
6. Trade Representative: Person who competently represents the work force engaged by the Contractor for the individual trade named. This person shall be completely familiar with the Work performed for this Contract at all levels of detail of his trade and with coordination to other trades. This person shall be capable of and have authority to execute all commissioning responsibilities of the trade as described in these Contract Documents.
7. Active Participation: Attend Commissioning events, provide technical expertise and knowledge, equipment measurements and observation needed or requested by the Design Consultant or designated Owner's staff. Provide training follow-up analysis, equipment data, design data and other trade or manufacturer's representative service needed in response to Commissioning events or systems operation and testing.
8. Verify: To positively determine that the measured or observed readings, quantities and data gathered satisfies all requirements of the Contract Documents. Simply performing the tests, measurements or observations does not constitute "verification." Tests which fail or data gathered which is not in compliance with the Contract Documents must be repeated and data re-collected at no additional cost to the Owner.

C. Scope:
   1. For coordination purposes, the Commissioning scope is generally outlined below:
      a. Air Systems Balancing:
         1. 100% of air distribution (supply, return, outside and exhaust) will be verified.
         2. Dehumidification Units
         3. Fan coil units
         4. Computer Room Air Conditioning Unit
      b. Owner Training of Mechanical Systems as specified in this section and related sections.
      c. Verify that equipment and systems have been properly installed in accordance with the contract documents and manufacturer's written installation instructions.
      d. Verify that piping systems have been properly cleaned.

e. Verify that equipment has been placed into operation with the appropriate manufacturer's oversight and approval.
f. Verify that adjusting, balancing and system testing has been properly done.
g. Assemble record drawings and other specified project data
h. Assemble operation and maintenance instructions and submittal data on equipment and systems incorporated into the project; review this information in a session with Owner's designated staff.
i. Verify the satisfactory performance of each piece of equipment and key components of each system.
j. Train Owner's designated staff in the proper operation and maintenance of each piece of equipment and key components of each system.
k. Document and review warranty start and end dates.

D. Commissioning Cost:
1. All cost of the Commissioning of Building Systems for this project shall be included in the Bid Breakdown Item included on the Bid Proposal Form.

E. Submittals:
1. All submittals, product data, equipment schedules, etc., relevant to the work included in this section, shall be reviewed by the Owner, in addition to the Design Consultant and Contractor(s), prior to proceeding with the work.

PART 2 PRODUCTS

NOT APPLICABLE TO THIS SPECIFICATION

PART 3 EXECUTION

3.01 COMMISSIONING TEAM

A. The Owner shall assemble the Commissioning Team which shall consist of the following persons:
1. HVAC Contractor and Trade Representative(s)
2. Control System Trade Representative(s)
3. Test, Adjust and Balance (TAB) Trade Representative
4. Electrical Contractor's Representative (limited participation)
5. Owner's Project Manager
6. Owner's Maintenance staff
7. Owner's Commissioning staff
8. Third Party Commissioning Agency (if applicable)
9. Engineer of Record

B. The Commissioning Team shall develop and generally follow a schedule of Commissioning events for the project.

3.02 RESPONSIBILITIES

A. Commissioning Authority (Owner's CxA or Third Party Commissioning Agency)
   1. Assign appropriate staff and schedule them to participate in the various meetings, training sessions and inspections as follows:
      a. Pre-commissioning coordination and schedule of events meeting.
      b. Installation progress inspections
      c. Maintenance orientation and inspection at connection of distribution systems.
      d. Procedures meeting to agree on Testing, Adjusting and Balancing methodology.
      e. Observation of factory start-ups including, but not limited to, dehumidifiers, variable refrigerant system and fan coil units
      f. Validate final Testing and balancing report.
      g. Owner's training and demonstration session(s).
      h. Review of operation and maintenance manuals and submittals for key components of the building systems.
      i. Participate in overhead and substantial completions inspections.
      j. Prepare and maintain a Commissioning Issues Log during the commissioning process of all non-compliance items including submittals, inspections, and systems verification phases of the work. This log shall periodically be distributed to and reviewed by the Commissioning Team for necessary and appropriate action to resolve these items.
      k. Review of submittals from the Contractors; comments to be provide to the design consultant to incorporate into his review and approval process.
      l. Prepare final commissioning report and submit to appropriate owner, architect and engineer.

B. HVAC Contractor
   1. Review all Commissioning requirements and intent of the Contract Documents. Assure all specialty Trade Subcontractors include their active participation in the Commissioning of the building systems.
   2. Coordinate the implementation of the Commissioning program, through organization of all meetings, tests, demonstrations, training events and performance verifications described in the Contract Documents and the Commissioning program.
   3. The plan and specification review by the HVAC Contractor does not include any responsibility for the system evaluation, adequacy of the system to meet design intent, capacity of the system or any of the other elements of the system design which are the strict responsibility of the Engineer of Record.
   4. Schedule a pre-commissioning coordination meeting with the Commissioning Team within 45 days of the award of the contract, at a convenient location. This pre-commissioning meeting will be for the purpose of reviewing the complete Commissioning program and establishing tentative schedules for maintenance orientation and

inspections, O. & M. submittals, training sessions, system flushing and testing, job completion, system start-up and test, adjust and balance work.

5. Schedule, notify and conduct all required Commissioning demonstrations, inspections and sessions which are included in this Commissioning program. These demonstrations will be conducted by the HVAC Contractor and his Trade Representative(s) and witnessed by the Commissioning Team. These shall include but are not limited to the following:
   a. Dehumidification Air Handling Unit pre-installation meeting
   b. Variable Refrigerant System pre-installation meeting
   c. Pre-TAB meeting with TAB Contractor
   d. TAB validation and checkout of final TAB report
   e. Dehumidification Air Handling Unit and associated equipment checkout and performance testing
   f. Variable Refrigerant System and associated equipment checkout and performance testing
   g. Exhaust fan checkout and testing
   h. Radiant Heater checkout and testing
   i. Fire Alarm checkout and testing
   j. Overhead inspections
   k. Substantial completion inspections.
6. Contractor will provide a copy of selected submittals for Commissioning Authority review for equipment that is being commissioned. These submittals will be provided at the same time submittals are provided to the design consultants to allow parallel reviews.
7. Collect and review operation and maintenance manuals and submit to the Engineer of Record for review.
8. Schedule a meeting with the test, adjust and balance (TAB) Trade Representative prior to the start of the test, adjust and balance procedure. This meeting should be attended by the Commissioning Team. The TAB Trade Representative will outline the TAB procedure and get concurrence from the Engineer of Record and HVAC Contractor. Ensure that the TAB Trade Representative has all forms required for the job data-base and understands their importance and use.
9. Schedule and conduct the Owner training sessions. A training outline will be submitted by the Contractor to the Commissioning Authority for approval two weeks prior to conducting the training sessions. These training sessions are to be attended by appropriate members of the Commissioning Team.
10. Prepare and provide to the Commissioning Team a schedule for tracking maintenance (both scheduled and non-scheduled work) for each piece of equipment. This schedule should include preventive maintenance plan. This schedule will be included in the Operational and Maintenance Manuals provided by the HVAC Contractor.
11. Review as-built drawings for accuracy against installed systems. Forward final checked record drawings to the Engineer of Record.
12. Provide written certification that the following work has been completed in accordance with the plans and specifications and that they are functioning as designed. Where the Work has been subcontracted, the Trade

Representative shall be responsible for the initial certification with the HVAC Contractor recertifying that he has inspected the Work and that it has been completed and functioning as designed. These certifications must be submitted to the Commissioning Authority and included in the Final Report.

a. HVAC equipment including all fans, air handling units, dehumidification units, ductwork, dampers, terminals, and all Division 15 equipment.
b. Refrigeration equipment, pumping systems and heat rejection equipment.
c. Fire stopping in the fire rated construction including fire and smoke damper installation, caulking, gasketing and sealing of smoke barriers.
d. Fire detection and smoke detection devices furnished by others as they affect the operation of the smoke control systems.
e. That unitary controlers are functioning properly to monitor, control, and address HVAC equipment, smoke control and lighting control systems.

C. Engineer of Record

1. Provide clarification of any design intent questions raised by the Commissioning Team.
2. Attend and actively participate in initial pre-commissioning coordination meeting to be scheduled by the Commissioning Coordinator within 45 days of the award of the contract.
3. Review and understand the Commissioning program as outlined in this specification.
4. The Engineer of Record shall verify adequate maintenance accessibility for each piece of equipment in shop drawing reviews and actual installation.
5. Receive and review operation and maintenance manuals as submitted by the Contractor.
6. Attend Owner training sessions as appropriate.
7. Review TAB report from HVAC Contractor against design assumptions and system requirements. Issue a report noting deficiencies requiring correction to the Commissioning Team.
8. Prepare record drawings for the project promptly after receipt from the HVAC Contractor.

3.03 TRAINING OF OWNER'S PERSONNEL

A. The Owner's staff shall be given comprehensive training in the operation and maintenance of each major piece of equipment.

B. The HVAC Contractor shall provide to the Commissioning Team, during the submittal phase, a detailed training schedule outlining the proposed timeframes and topics to be included in the training sessions. A training outline will be submitted by the Contractor to the Commissioning Authority for approval two weeks prior to conducting the training sessions.

C. The HVAC Contractor, in cooperation with the Commissioning Team, will be responsible for scheduling and actively participating in the training. Hands on training shall include start-up, operation in all modes possible, shut-down and any emergency procedures.

D. The manufacturer's representative shall provide the instructions on each major piece of equipment. These sessions shall use the printed installation, operation and maintenance instruction material included in the operation and maintenance manuals and shall include a review of the written operation and maintenance manuals. Training will be included for all major pieces of equipment. Equipment training shall be done by qualified service representatives employed by the manufacturers.

3.04 NOTIFICATION OF SYSTEM COMPLETION AND REQUEST FOR FINAL HVAC SYSTEM COMMISSIONING VERIFICATION

A. When systems are ready for final commissioning verifications, demonstrations, and/or inspections, the HVAC Contractor shall certify to the Commissioning Authority, in writing, that all systems are complete and fully functional. The completion of the Schedules provided in this Specification is one acceptable manner of providing for this written certification. Other means of providing this certification must be approved by the Commissioning Authority. This notification shall be made as soon as possible to allow completion of all verification prior to Substantial Completion. Any inspection, verifications or demonstrations required by this Specification not completed by Substantial Completion shall be added to the Substantial Completion Punch List. In addition, any unsatisfactory items identified during these demonstration or inspections shall be added to the Substantial Completion Punch List.

B. Should the verification test reveal that the equipment is not performing as specified or control operation is not acceptable, the HVAC Contractor will be entitled to one re-inspection of any failed item at no additional cost.

C. Should the verification test determine that the equipment is still not performing as specified or control operation is not acceptable on the second inspection, the time and expenses of the Engineer of Record and Owner to make further verification shall be considered as additional cost to the Owner. The total sum of such costs shall be deducted from the final payment to the HVAC Contractor. Billing rates shall be defined as specified in the Supplemental Conditions. The hourly rate identified in the Supplemental Conditions shall apply to both the Design Consultant and Owner's additional time necessary to perform re-inspections.

3.05 VERIFICATION OF PERFORMANCE

A. Verification of system and component performance will take place after the Contractor and Design Consultant certify that all Work is complete and the building systems are fully operational.

B. Verification will be completed by the Contractor and Commissioning Authority utilizing Schedules contained in these specifications. Any check-out sheets utilized other than those found in this specification shall be approved by the Commissioning Authority.

C. Verification to include demonstration of performance as required by the Contract Documents. The specified Contractor's verifications shall be entered on the attached Commissioning Data Sheets prior to the Commissioning Authority's verification. The witnessed (Commissioned) performance data shall be added to the data sheet at the time of verification.

D. The following demonstrations will be required:
   1. Major duct flow and pressure checks:
      a. The TAB Representative will provide a copy of the TAB report to be used to document testing results. The TAB Trade Representative shall identify all places where temperature, pressure, and/or velocity readings were taken. All locations must be per AABC or NEEB Standards.
   2. Dehumidification Unit Performance:
      a. Coil Performance - Packaged Dehumidification Unit
      b. Both cooling and reheat coils shall be demonstrated with the unit under control and at full air flow. Air temperature data and pressure loss shall be recorded together with air flow.
   3. Fan and motor performance:
      a. Fan and Motor Performance – Dehumidification Unit
      b. Demonstrate performance with the unit under control and at full flow. CFM, Static Pressure and motor volts/amps shall be recorded.
   4. Variable Refrigerant System performance:
      a. Outdoor Unit Performance
      b. Record under operating conditions. Note O.A. ambient condition. Plot on performance chart with part load conditions.
   5. Exhaust fan performance:
      a. Exhaust Fan Schedule – Schedule PC-06.
      b. Demonstrate during normal operation.
   6. HVAC Unitary Controlers: The Mechanicall Contractor is required to provide checkout procedures and checkout data sheets to verify all items noted below. These checkout procedures and data sheets shall be submitted to the Commissioning Authority for approval two weeks prior to start of verification demonstrations.
      a. Verification of all sequences of operation during both heating and cooling seasons.
      b. ON/OFF control of each applicable piece of equipment.
      c. Sequential operation
      d. All control loops:
      e. Demonstrate control to set point without excessive hunting.
      f. Measurement of Building Pressure

3.06 REPORT REQUIREMENTS

A. The HVAC Contractor shall document each Commissioning event by completion date. The schedules shall separately list deficiencies observed or discovered during the event. These documents shall be distributed to the Commissioning Authority as they are completed.

B. The HVAC Contractor shall transmit the following to the Commissioning Authority:
   1. Completed Commissioning Data Sheets
   2. TAB Balancing Report
   3. Confirmation that any system changes resulting from the Commissioning program have been included in the final operations and maintenance manuals or are depicted on the final Record Drawings.

END OF SECTION