

**SECTION 23 05 00  
BASIC HVAC REQUIREMENTS**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. The general provisions of the Contract, including General Conditions, General Requirements, and Division 1 of the Specifications, apply to all Sections of Division 23.
- B. Other Contract Documents complement the requirements and apply to the work of Division 23.

**1.2 SCOPE OF WORK**

- A. The work of this Section shall include the furnishing of systems, equipment and materials specified in this Division, and as called for in the Mechanical Drawings.
  - 1. All facilities, supervision, coordination, transportation, handling, labor and methods for the fabrication, installation, interconnections, painting and other finishes, start-up, tests, adjustments, clean-up and other necessary work for the complete and satisfactory systems and equipment, ready for operation and use, shall be included.
  - 2. Whenever the words "Contractor" appear in this Division, they refer to the Contractor responsible for work specified in that Section.
  - 3. The Contractor shall examine all Contract Documents including all drawings, all sections of the Specifications, HVAC, Plumbing, Fire Protection System Design Details, and Energy Management Controls shall be responsible for ascertaining to what extent all those documents, drawings, sections of specifications, design requirements, and system design details affect work herein specified.
  - 4. Report all errors, omissions, conflicts or code violations to Architect and Owner prior to commencement of work.
- B. Drawings for the work are diagrammatic, intended to convey the scope of the work and indicate the general arrangement and locations of the work, follow as closely as actual construction and as other work permits.
  - 1. Because of the scale of the drawings, not all basic items such as necessary duct and pipe offsets, pipefittings, access panels and sleeves may be on the plans.
  - 2. Contract documents show design basis equipment.
  - 3. Mechanical Contractor shall be responsible for selecting the District approved equipment of equal quality, capacity, performance, efficiency, weight, physical size, and configuration to fit in the space provided for the design basis equipment.
  - 4. If the Contractor selects equipment other than the design basis, he is responsible for the necessary design modifications and for coordination with other trades to meet all intended requirements of the original design documents.
  - 5. The location and the sizes of equipment, duct and pipefittings, access panels, sleeves, inserts, and other basic items required by code or other Sections shall be coordinated and included for the proper installation of the Work.
- C. The Contractor shall make any required changes from the Contract Documents to make this work conform to the building construction or the work of other trades at no additional cost to the Owner and shall not affect the project's time schedule.
  - 1. The Contractor shall clearly indicate and list all changes from the Contract Documents on the shop drawings and submit them to the Architect, Engineer, and Owner for approval before commencing the work.
  - 2. Failure to follow the approval procedure may result in the forced removal of all work, performed prior to approval.
  - 3. Final "as built" documents shall include all changes.

- D. Equipment specification may not deal individually with the minor items required such as components, parts, controls, and devices that may be required to produce the equipment performance specified or as required to meet the equipment design performance and warranties.
  - 1. The equipment supplier shall include such required items whether or not specifically called for in the Contract Documents and the Contractor shall properly install them.
- E. Contractor shall verify with the supplier of the equipment the requirements for the complete installation to insure proper operation of the equipment furnished under Division 25 of the Specifications.
- F. Contract Documents may call for Mechanical Contractor to install specific equipment furnished by others, including Owner purchased equipment.
- G. Consider the specifications and drawings as complimentary one to the other.
  - 1. Where equipment items, material and labor are specified, indicated, called for or implied by either the drawings or the specifications, they shall be deemed as specified by both and included as part of the contract.
  - 2. Should conflicts occur between the drawings and the Division 25 Specifications, the more stringent requirements shall apply and take precedent.

### 1.3 DEFINITION OF THE WORK

- A. Mechanical work including Heating, Ventilation, and Air Conditioning (HVAC) work as specified in the following applicable sections of the Division 23.

23 05 00	Basic HVAC Requirements
23 05 10	Minor HVAC Demolition
23 05 19	Meters and Gages for HVAC Piping
23 05 29	Curbs, Hangers & Supports for HVAC Equipment
23 05 13	Motor Requirements for HVAC Equipment
23 05 53	HVAC Piping & Equipment Identification
23 05 48	HVAC Vibration Control
23 07 19	HVAC Piping Insulation
23 07 16	HVAC Equipment Insulation
23 07 13	Ductwork Insulation
23 21 13	Hydronic Piping
23 21 16	Hydronic Specialties
23 23 00	Refrigeration Piping
23 21 23	Hydronic Pumps
23 63 13	Air Cooled Refrigerant Condensers
23 64 10	Air Cooled Water Chillers
23 64 16	Centrifugal Water Chillers
23 64 26	Rotary Screw Water Chillers
23 65 00	Cooling Towers
23 29 23	Variable Frequency Motor Controls
23 81 00	Decentralized HVAC Equipment
23 25 00	HVAC Water Treatment
23 82 19	Electric Resistance Duct Heaters
23 70 00	Air Handling Units
23 34 23	HVAC Power Ventilators
23 40 00	HVAC Air Filters
23 31 00	Ductwork
23 33 00	Air Ductwork Accessories
23 09 00	Energy Management and Control System

The School District of Palm Beach County

Project Name:

SDPBC Project No.:

- 23 36 16 Variable Air Volume Units
- 23 37 13 Grilles Registers, Diffusers
- 23 08 00 Commissioning of HVAC Systems
- 23 05 93 HVAC Testing, Adjusting and Balancing
- 23 05 93 Tests HVAC Piping Systems

- B. Additional Associated Sections from Division 26
  - 25 50 00 Energy Management and Control System

C. DEFINITIONS

1. PIPING - As used in these documents, means pipe, fittings, valves, flanges, unions, specialties, accessories and appurtenances necessary for, or incidental to, a complete system.
2. DUCTWORK - As used in these documents, means all air delivery and recirculation and exhaust ducts whether of sheet metal or other material, and includes all connections, accessories and appurtenances necessary for and incidental to a complete system.
3. PROVIDE - As used in these documents, means to furnish and install. The words "furnish" "include" or "install" used in the Specifications or on the Drawings, means to deliver to the job site or to install and test complete and ready for operation systems and items mentioned. The word "install" shall also apply to equipment furnished by others, including Owner purchased equipment. Any item indicated in the Specification or on the Drawings shall be included in the Work.
4. CONCEALED WORK - As used herein refers to piping, ductwork, and accessories above solid material ceilings and within walls, partitions, shafts, service spaces, underground, or not normally exposed to view and enclosed on all sides by finish materials. Access to piping and ductwork would demolish finish materials.
5. CONCEALED BUT ACCESSIBLE - As used in these documents, refers to piping, ductwork, and accessories accessible above or through suspended ceilings, in walls at access panels or in chases with access doors.
6. EXPOSED WORK - Refers to ductwork, piping, or equipment normally exposed to view within rooms or open area. Consider ductwork, piping, or equipment in mechanical or electrical equipment rooms as "Exposed Work", unless noted otherwise on the plans.

1.4 QUALITY ASSURANCE

- A. Codes and Standards: All work shall be in compliance with, of all applicable Laws, Codes, Standards and Regulations of Governmental Bodies having jurisdiction over work performed for or on behalf of the SDPBC, and over the applicable job site

1. See Section 01 41 00 - Regulatory Requirements
2. The following documents developed for and approved by the SDPBC:
  - a. Educational Specifications
  - b. District Design Criteria
  - c. District Master Specifications
  - d. Typical HVAC, plumbing and fire-protection details
  - e. If there should be conflicting requirements between above referenced codes than the following rules shall apply:
    1. School District Building Official shall provide final code interpretations and resolutions of conflicts.
    2. The code that affords the greatest degree of life safety shall take precedent.

- B. Contractor shall request the A/E for clarification of any part of the contract documents, which may be in conflict with the above codes and regulations.

1. Contractor shall prepare proposed changes for review and approval by A/E and Owner.

1.5 FEES, PERMITS AND INSPECTIONS

- A. Contractor shall pay all fees, obtain required permits, and coordinate inspections as are required by the Authorities having jurisdiction over the site.

#### 1.6 ACTIVE SERVICES

- A. Protect any existing active services: water, gas, sewer, and electric, against damage.
- B. Do not prevent or disturb operation of active services that are to remain.
- C. If contractor encounters active services requiring temporary interruption or relocation, the contractor shall contact the authorities having jurisdiction for procedures and coordination of work with the utility service users.
- D. Where abandoning existing utility services terminate them in conformance with the Utility or Municipality having jurisdiction and shown the termination points on "as-built" construction plans.

#### 1.7 SITE INSPECTION

- A. Contractor shall carefully inspect the site to be familiar with conditions that affect the work.
  - 1. Contractor shall verify points of connection of utilities, routing of outside piping to include required clearances from any existing structures, trees or other obstacles.
  - 2. Contractor shall verify available space in the existing structure and accessibility required for the installation of work under this contract and inform the A/E to conditions, which may be detrimental or will prevent proper execution of the work.
- B. The submittal of a bid is an acknowledgement that the Contractor performed the site inspection and has no conflicts with performing the work.
  - 1. If a conflict arises do to an observable condition the Contractor should have seen in the pre-bid site visit, the District is under no obligation to authorize any additional payments.
- C. Submittal of bid shall indicate that the Contractor has included all required allowances in the bid.
  - 1. The District shall not make allowances for any code violations or errors resulting from Contractor's failure to visit job site and review all contract documents, applicable codes, and standards.

#### 1.8 COMMISSIONING

- A. Commissioning of a system or systems specified in this section is part of the construction process.
- B. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Authority.
- C. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and closure of all issues; refer to Section 01 77 00 - Contract Closeout, for substantial completion details.
- D. Refer to Section 01 91 00, Commissioning, for detailed commissioning requirements

## **PART 2 MATERIALS**

### 2.1 GENERAL

- A. Each system component installed by Contractor shall meet or exceed the performance specification requirements listed in the Contract Documents including drawings, and specifications.
  - 1. Components with a lesser degree of performance or quality as determined by the Owner, Building Department, design A/E or documented as inferior in the final Test and Balance Report is not acceptable, and Contractor shall replace with no additional charge to Owner.
- B. Materials and equipment shall be new, unused, standard current products from manufacturers regularly engaged in the production of such equipment and shall bear label of the Underwriters' Laboratory for the intent use or shall be materials approved by the code-enforcing agency.

- C. Facility Services pre-approved remanufactured equipment used for repair/replacement work in existing structures.
- D. Where two or more units of the same class of equipment or material are required, these shall be the product of a single manufacturer throughout entire project and shall fit in the allocated spaces provided, complying with all clearances and codes.
- E. All hardware and accessory fittings shall be a type designed, intended or appropriate for use, be compatible, and compliment the item with which they are used.
  - 1. They shall have corrosion protection suitable for atmosphere they are installed.
  - 2. All such hardware shall be U.S. standard size.
- F. All materials including insulation, jackets, and adhesives shall have a Flame Spread Rating not exceeding 25, and Smoke Developed Rating not exceeding 50, when tested in accordance with NFPA 255, "Methods of Test of Surface Burning Characteristics of Building Materials".
  - 1. Submittal data shall specifically indicate those ratings.
- G. Use materials and equipment fabricated in the United States of America and labeled accordingly, when possible, for all piping materials.
- H. All equipment and piping supports shall be hot dipped galvanized except as otherwise noted in Contract Documents.
  - 1. Hangers for copper pipe shall be vinyl coated.
  - 2. Do not use copper clad hangers.
- I. Air conditioning system components shall conform to federal, state, and local sound emission and vibration isolation guidelines.
  - 1. Objectionable noise or excessive vibration created in any part of the building by operation of any equipment under this contract is prohibited.
  - 2. Contractor shall attenuate noise, and isolate various items of equipment from the building structure and take all steps that may be necessary to eliminate objectionable noise or excessive vibration produced by Division 23 equipment.
  - 3. If noise attenuation or vibration isolation measures do not produce, satisfactory results replace all components, which prove to be in violation at no additional cost to the Owner, to comply with codes and ordinances having jurisdiction at the job site.
- J. Follow installations directions and recommendations of material and equipment manufacturers.

### **PART 3 EXECUTION**

#### **3.1 GENERAL**

- A. The Mechanical Contractor must be in good standing with the SDPBC.
- B. Florida Licensed Contractors shall perform construction work.
  - 1. The Contractor shall not work outside the scope of his license.
  - 2. Any person who is not licensed must work under direct supervision of a person who has a license required by the state law and by the county or municipal licensing ordinances.
  - 3. The job supervisor must speak English and must have 10-years experience of installing the tonnage of HVAC equipment specified in the contract documents.
  - 4. The District may request the change of the job supervisor.
  - 5. Workers skilled and competent in the type of work involved shall accomplish the installation.
  - 6. Workmanship throughout shall correspond to the standards of the best trade practices.
- C. Work other than interior work shall commence as soon as the building has sufficiently advanced in construction layout.
  - 1. No interior work shall be installed until the building roof is in place and watertight and the building is completed to a stage, that in opinion of the A/E, is acceptable and not detrimental to work to be installed.

- D. Contractor shall install all systems and equipment in accordance with the Contract Documents, and equipment or material manufacturer recommendations and instructions.
  - 1. Contractor shall commission, prepare, and adjust HVAC and other mechanical systems prior to Owner's independent test & balancing work.
- E. Work lines and established grades shall be in strict accordance with the Contract Documents.
  - 1. The Contractor shall furnish to all trades, in ample time, any information they need to construct all equipment bases, trenches, pits, chases, and openings in floors, walls, and finishes to provide required working clearances.
  - 2. The contractor shall set all sleeves, anchor bolts, or inserts to fasten equipment before pouring of adjacent concrete.
- F. Coordinate location of all Division 23 work with Divisions 25, 26, 27, and 28.
  - 1. Do not run piping, ductwork and similar Division 23 work in NEC dedicated service areas for electrical equipment, including above panel boards, starters, communication panels, control panels, telephone backboards, data panels, and similar electrical elements.
  - 2. Do not install chilled water potable water (hot or cold), or condensate drain piping directly above electrical equipment.
  - 3. In electrical rooms with required piping, provide drain pan(s) to protect the electrical equipment.
  - 4. Refer questionable locations to the A/E for resolution prior to installation and correct non-conforming installed work at no additional cost to the Owner.
- G. Cap or plug all piping systems (chilled water, hot water, potable water, refrigerant piping, pneumatic piping,) at the end of each workday until system is complete to prevent contamination.
- H. Provide a schematic wiring diagram for each component of HVAC system including controls.
  - 1. Diagrams shall be located in mechanical rooms and mounted on wall at eye level.
- I. Provide a schematic duct diagram indicating room numbers and component locations.
- J. Locate the diagram for each air handler in mechanical room, mounted on wall at eye level.

### 3.2 COORDINATION OF WORK AND DRAWINGS

- A. Each contractor and subcontractor shall be responsible for coordinating the installation of his equipment/labor with the General Contractor and work of other Contractors and trades.
  - 1. The contractor shall coordinate the work of different trades to prevent interference between piping, ductwork, equipment, and structural work.
- B. Recommend each contractor prepare their shop drawings at 1/4" to 1'-0" scale clearly indicating all applicable components and coordinate the same with other trades.
  - 1. Shop coordination drawings shall show in detail the space conditions of all concerned trades and follow the equipment orientation outlined in the contract drawing unless approved by the A/E. Shop drawings shall be reviewed and accepted by the A/E of record and the District Commissioning Agent
  - 2. Contractor's failure to coordinate work between trades using coordination shop drawings or other means will not cause for any additional cost changes to the Owner, and/or changes to the project schedule.
  - 3. If the contractor installs his work before coordinating with other trades or causes interference with work of other trades, the contractor shall make necessary changes in the work to correct the condition, at no additional cost to the Owner, and/or changes to the project schedule.

### 3.3 SUBMITTALS

- A. Method or procedures for submitting shop drawings and submittal data shall comply with the General Conditions.

- B. Prior to ordering equipment and material, the Contractor shall submit 3 copies of the manufacturer's cut sheets to the Engineer for review and acceptance
  - 1. Submittal data shall consist of shop drawings and/or catalog cuts showing technical data necessary to evaluate the material or equipment.
  - 2. Including dimensions, required service and maintenance clearances, wiring diagrams, performance curves, ratings, control sequence.
  - 3. Layout plan showing the arrangement of the equipment with piping and ductwork, and other data necessary to describe fully the item proposed and its operating characteristics.
- C. Other submittals shall include, but not be limited to:
  - 1. Valves
  - 2. Pipe insulation
  - 3. Vibration isolation
  - 4. Controls
  - 5. Hydronic specialties
  - 6. Thermometers and gauges

#### 3.4 SUBSTITUTIONS

- A. Contractor shall follow the contract drawings and specifications, unless he submits written request for a substitution and receives written acceptance from the Engineer and SDPBC.
  - 1. Owner's representative shall review the request and either approve or deny the in writing.
- B. All approval procedures regarding proposed substitutions as "approved equal" or "Engineer and Owner approved" shall meet the requirements of Section 01 60 00.

#### 3.5 ACCESS PANELS

- A. Contractor shall provide required access panels or doors for all serviceable equipment in concealed locations whether or not called for on the drawings.

#### 3.6 ACCESS AND SERVICE SPACE

- A. Provide clearances, service space, and access to appliances and equipment in rooms, attics, under floors, on roofs or elevated structures or on sloped roofs in accordance with FBC-M Section 306.

### 3.7 CUTTING AND PATCHING

- A. Coordinate the placing of openings in the existing or new structures as required for installation of the HVAC Work.
- B. Any additional patching and finish work required for unnecessary openings due to failure to inspect and coordinate work shall restore walls, floors, or ceilings to appropriate fire ratings, at no additional cost to the Owner.
- C. Any additional cutting and patching of the structure necessary due to failure to install piping, ducts, sleeves or equipment on schedule, or due to failure to furnish, on schedule, the information required for leaving of openings, is at no additional cost to the Owner.
- D. Provide cutting and patching, surface finishing and painting in the existing structure, as required for the installation of work, and furnish lintels and supports as required for openings.
  - 1. Do not cut structural members without written prior approval of the A/E.
  - 2. Minimize cutting by using core drills, power saws, or other machines that will provide neat, minimum openings.
  - 3. Patching shall match adjacent materials and surfaces and be performed by craftsmen skilled in the respective craft.

### 3.8 SLEEVES

- A. Sleeves are required for all piping passing through masonry or concrete partitions (walls, floors ceilings, roofs) and through concrete beams, foundations, and footings.
  - 1. Position sleeves in formwork prior to placement of concrete.
  - 2. Provide concrete reinforcing around sleeves.
- B. Sleeves for piping passing through non-load bearing or non-fire or smoke rated walls and partitions may be required if included in the design documents by the Engineer.
  - 1. When required, sleeves shall be galvanized sheet steel with lock seam joints of minimum gauges as follows: pipes 2½" and smaller - 24 gage; 3" to 6" - 22 gage; over 6" - 20 gage.
- C. Sleeves for piping passing through load bearing walls, concrete beams, foundations, footings and waterproof floors shall be Schedule 40 galvanized steel pipe or 18 gage galvanized sheet steel.
- D. Sleeves for insulated piping shall be of sufficient internal diameter to take pipe and insulation and to allow free movement of pipe due to expansion and contraction.
  - 1. Provide for continuous insulation wrapping.
  - 2. Waterproof sleeves shall be of sufficient internal diameter for pipe and waterproofing material.
- E. In finished areas where pipes are exposed, terminate sleeves flush with wall, partitions, and ceilings, and shall extend ½" above finished floor level.
  - 1. Extend sleeves 1" above finished floors in areas likely to entrap water.
  - 2. Caulk floor sleeves.
- F. Flash sleeves passing through waterproofing membrane as required by Division 7.
- G. Protect pipe penetrations through fire-rated partitions (walls, floors, or ceilings) in per with FBC.
  - 1. Protected penetration shall retain the original integrity of the fire rated partition.
  - 2. Unprotected penetrations through fire-rated partitions are not allowed.
  - 3. All materials, products, and procedures used to complete the fire stopping assemblies shall be tested, listed, and approved by testing laboratories such as U.L. or Factory Mutual and comply with requirements of ASTM-E119.
  - 4. Securely fasten sleeves to the partition that are part of the required approved fire stopping.
  - 5. Close off annular spaces between sleeves and pipes, and between penetrating item and adjacent work with UL listed and approved fire stopping materials and caulk airtight.
  - 6. Insulation and coverings shall not penetrate the fire-rated partition unless it is part of the approved U.L or Factory Mutual fire-stopping assembly.

7. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- H. Sleeves for round and rectangular ductwork shall be galvanized sheet steel.
  1. Duct coverings shall not penetrate a wall or floor required to have fire-resistance rating or required to be fireblocked – refer to FBC-M 604.6.

### 3.9 ESCUTCHEONS

- A. Provide chrome-plated escutcheons at each sleeve opening into finished spaces.
- B. Escutcheons shall fit around insulation or around pipe when not insulated; outside diameter shall cover sleeve.
- C. Where sleeve extends above finished floor, escutcheon shall be high cap type and shall clear sleeve extension.
- D. Secure escutcheons or plates to sleeve but not to insulation with setscrews or other approved devices.

### 3.10 PROTECTION

- A. Take special care for the protection of equipment and materials furnished.
  1. Store and completely protect all materials from damage.
  2. Keep materials and equipment clean and dry, free from deterioration by weather elements, painting, plaster, etc., until the project is completed.
  3. Do not install damaged or defective materials.
  4. Touch up any damage from rust, paint, etc., and scratched or marred finishes on equipment to match original finish or completely refinished to restore equipment to original condition.
- B. Provide protect of any previously finished area from mars or other damage when an installation or connection of equipment requires work in areas previously finished by other Contractors.
  1. The Contractor shall provide drop cloths, or any other materials necessary to protect floors, walls, furniture, equipment, etc. from soil or damage.
- C. Contractor shall arrange with other Contractors for promptly repairing and refinishing any damage to the building or its contents incurred by the installation or testing of the systems installed at no charge to the Owner.
- D. Where insulated piping extends to exposed areas, or to weather exposed areas, provide finish or jacket as specified in section 23 07 19.
- E. Welding is allowed in the existing buildings as long as the contractor provides for an approved fire watch and other required safety measures.
  1. Contractor's work, and construction means, methods, materials, and equipment used shall not compromise the building fire safety, as well as safety and welfare of coworkers and building occupants.

### 3.11 HVAC IDENTIFICATION

- A. Identification of HVAC systems shall be as specified in Section 23 05 53, HVAC Piping & Equipment Identification.

### 3.12 WIRING AND ELECTRICAL WORK FOR HVAC EQUIPMENT

- A. All electrical work, equipment, and wiring shall comply with NEC.
- B. A standard wiring color code shall be established for each electrical and control component of the system and all similar devices shall be wired alike, maintaining the established color code throughout the entire project.
- C. The Mechanical Contractor, unless specified otherwise, shall furnish all Division 23 equipment, complete with motors and controls.
  1. The Mechanical Contractor shall set the motors in place.
  2. Some low power single-phase equipment may be furnished with unit mounted disconnects.

- D. Division 16 shall provide power services for motors and equipment furnished by Mechanical Contractor to include safety disconnect switches, (except unit mounted disconnects), motor starters, wiring and final connections.
  - 1. For special requirements for starters and disconnects in kitchen and exterior locations refer to Division 26.
  - 2. Provide the entire fire alarm system including interlock wiring required for air handling unit shutdown under Division 28.
- E. The Mechanical Contractor shall provide internal wiring, equipment control wiring, interlock wiring (except fire alarm system) for equipment furnished and temperature control wiring.
- F. The Mechanical Contractor shall check all electrical service and control connections to ensure proper operation of equipment and systems installed under work in Division 23.
- G. Division 26 shall furnish motor starters for motors furnished by Mechanical Contractor, except where other sections specify the equipment supplier furnishes them (e.g. chillers).
- H. Mechanical Contractor shall furnish variable frequency drives (VFD) and set the same in place, ready for wiring under Division 26 requirements unless the Controls Contractor as part of the project supplies the VFDs.

### 3.13 EXCAVATING TRENCHING AND BACKFILLING

- A. Provide excavation necessary for water supply piping, underground chilled water piping, etc., and backfill such trenches and excavations after the installation, testing, and approval of work observing OSHA's trench requirements.
  - 1. Take care in excavating, that walls and footings and adjacent load bearing soils are not disturbed, except where lines must cross under a wall footing.
  - 2. Where a line must pass under footing, make the crossing by the smallest possible trench to accommodate the pipe.
  - 3. Keep excavation free from water by pumping if necessary.
- B. Trenches for piping and utilities located inside foundation walls and five-foot outside of the wall shall be at less than 16" but no more than 24" wider than the outside diameter of the pipe.
  - 1. Site conditions shall govern the width of trenches for piping and utilities located more than five-feet outside of building foundation walls, except for sewers.
- C. Excavate trenches for sewers so the pipe is laid at the proper alignment and depth and the maximum trench width at the outside top of the pipe is less than 24".
  - 1. Site conditions govern other trench widths.
- D. Shape the trench bottom to support the lower fourth pipe circumference for the full length of the barrel on compacted fill.
  - 1. Dig bell holes so that no part of the weight of the pipe is supported by the bell, and not larger than necessary for proper jointing.
  - 2. All piping requiring excavation below the required compacted fill for the structure, excavate at least 6" below pipe invert.
- E. Make trenches true to grade by means of substantial and accurately set batter-boards.
- F. Immediately after testing and/or inspection, carefully backfill the trench with earth free from clods, brick, etc., to a depth one-half the pipe diameter and then firmly puddle and tamp in such a manner as not to disturb the alignment or joints of the pipe.
  - 1. Thereafter, puddle and tamp the every vertical foot.
- G. Burial depth of gravity drain lines shall have precedence over non-gravity systems.
  - 1. Offset chilled water and domestic water lines as required to coordinate with gravity lines.
- H. The Contractor shall coordinate exact location, depth, and scope of underground piping, electrical conduits, and similar utilities.

1. Routing shown on drawings is schematic coordinate actual routing with field conditions, grades, and work of other trades, then document in "as-built" drawings.

#### 3.14 CONCRETE WORK

- A. Provide concrete bases and housekeeping pads for HVAC equipment unless indicated otherwise.
  1. Concrete work shall be as specified in Section; Concrete.
  2. This Contractor shall provide vibration pads and equipment base.
  3. The General Contractor shall provide chiller pads.
- B. Provide equipment anchor bolts and coordinate their proper installation and accurate location.

#### 3.15 ANCHORING EQUIPMENT

- A. All equipment designed permanent mounting, anchor to its supporting surface in compliance with FBC, 423.14.7.
- B. A minimum of two bolts are required per each piece of equipment.
  1. Bolts shall be of sufficient size and rating to prevent equipment from overturning or moving from original mounting position.

#### 3.16 CORROSION

- A. Make provisions to prevent corrosion due to contact of metallic pipe and equipment with moisture or dissimilar materials.
- B. When joining a pipe with another pipe, valve, fitting, or piece of equipment constructed of dissimilar metal install an insulated joint to prevent formation of galvanic couple.
- C. Pipe hangers and supports of dissimilar metal shall be isolated from contact with pipe.
- D. Metal pipe and equipment shall be isolated from direct contact with concrete or other corrosive materials and soils.

#### 3.17 PAINTING AND FINISHING

- A. Paint all exposed metal surfaces, unless specified otherwise.
  1. HVAC equipment shall have factory finish as specified; any damage to that finish shall be field primed and painted to match existing.
  2. Clean and prime all ferrous metal equipment and supports, not factory finished, with a suitable primer and given two finish coats of exterior enamel.
- B. Prime all exposed galvanized metal, including ducts, with galvanized metal primer and paint with enamel paint to match surrounding area.
- C. Clean and prime all other unpainted ferrous metal including all pipe sleeves or equipment supports with metal primer suitable to the metal, and finish with two coats, one flat and one enamel.
- D. Clean, prime, and paint all equipment and piping, after installing the insulation with one color semi-gloss coat and with one-color enamel paint, as selected by owner.

#### 3.18 TESTS

- A. Test all materials, equipment, and systems that require testing by these specifications or by any applicable regulation or code, in the presence of owner or authority having jurisdiction.
  1. Test all items requiring pressure or leakage tests before concealing from view.
  2. Rectify all defects disclosed by tests and the repeat the tests.
    - a. Continue process until installation passes all required test.
  3. The Contractor shall provide all labor, materials, and equipment used in tests.
- B. Contractors' tests shall be scheduled and documented in accordance with the commissioning requirements.
  1. Refer to Section 01 91 00, Commissioning, for further details.
- C. Contract the services of a qualified third party testing agency or manufacturer's representative to perform the specified electrical tests and commissioning required testing.

1. The testing agency or manufacturer's representative shall provide all test calibrated test equipment.

### 3.19 COMPLETION OF WORK

- A. Prior to acceptance of the installation and final payment of the Contract, the Contractor shall provide and complete the following:
- B. CLEANING: as required by Special Conditions applicable to this Division of the work.
  1. At the conclusion of the construction, the site and structure shall be cleaned thoroughly of all debris and unused materials remaining from the mechanical construction.
    - a. Clean all areas and temporary storage spaces of all packing boxes, wood frame members and other waste materials used in the mechanical construction.
  2. Clean the entire piping system and equipment internally.
    - a. The Contractor shall open all dirt pockets and strainers, completely blowing down as required and clean strainer screens of all accumulated debris.
    - b. Clean the strainers in the presence of the Test and Balance firm.
  3. Drain all tanks fixtures and pumps and prove free of sludge and accumulated matter.
  4. Remove all temporary labels, stickers, etc. from all fixtures and equipment.
    - a. (Do not remove permanent nameplates, equipment model numbers, ratings, etc.).
  5. Thoroughly clean heating and air conditioning equipment, tanks, pumps, traps, etc., and install new filters or filter media.
- C. OPERATION AND MAINTENANCE MANUALS
  1. Refer to Section 01 91 00 – Commissioning for Operations and Maintenance Data requirements.
- D. AS-BUILT PRINTS
  1. Requirements and methods of preparing and procedure for submitting project record as-built prints shall be in accordance with Division 1.
  2. Contractor shall keep day-to-day records of all changes, and upon completion of the work, incorporate these changes on the clean copies of the original ACAD drawings.
    - a. Provide as-built drawing electronic files in both Autocad and PDF format to the Owner at the date of substantial completion.
  3. The drawings shall show:
    - a. All of the equipment and piping (including underground)
    - b. Ductwork with dimensions and reference points
    - c. All other concealed non-accessible work;
      - i) Branching arrangement and valve location for piping systems
      - ii) Locations of dampers and heaters in duct systems
      - iii) Locations of control system sensors and other control devices
      - iv) Work of change orders not shown on contract documents.
- E. WARRANTY
  1. The warranty for all mechanical equipment (whether manufacturer's or contractor's warranty) shall comply with Section 01 77 00 in the General Conditions.
  2. All equipment and systems, unless specified otherwise, shall have a manufacturer's warranty for a period of 5-years from the date of substantial completion.
    - a. This warranty shall be against defective materials, design, and workmanship.
  3. The mechanical contractor shall repair or replace any component of the Division 23 work under warranty, which proves to be defective, at no cost to the Owner.
  4. The Contractor upon receipt of notice from the Owner of a failure during the warranty period shall respond the same day and complete warranty service work in a timely manner.

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5. During warranty period, document all responses to warranty calls made by the Contractor by leaving a copy of the mechanics service ticket with the school Principal upon completion of the warranty work, prior to leaving the site.
  - a. Without proper documentation, the Owner will not acknowledge repairs are complete.
6. Required optional extended manufacturer or vendor warranties for specific items, their performance, or expected durability will be explicitly included in Division 23 Specifications.
  - a. Manufacturer or vendor shall repair or replace any defective component under extended warranty at no cost to the Owner.

### 3.20 SYSTEM FUNCTIONAL PERFORMANCE TESTING

- A. System Functional Performance Testing is part of the Commissioning Process.
- B. The Contractor shall perform all Functional Performance Testing and the Commissioning Authority shall witness and document the testing.
- C. Refer to Section 01 91 00, Commissioning, for functional performance tests and commissioning requirements.

### 3.21 DEMONSTRATION AND TRAINING

- A. Training of the Owner's operation and maintenance personnel is required in cooperation with the Owner's Representative.
- B. Provide competent, factory-authorized personnel to provide instruction to FS personnel concerning the location, operation, and troubleshooting of the installed systems.
- C. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
- D. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.

END OF SECTION