

SECTION 15000
BASIC MECHANICAL 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 15.
- B. Other Contract Documents complement the requirements and apply to the work of Division 15.
- C. Section 02310 – Earthwork.
- D. Section 09900 – Painting.

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. 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. Whenever the words "Contractor" appear in this Division, they refer to the Contractor responsible for work specified in that Section. The Contractor shall examine all Contract Documents including all drawings, all sections of the Specifications, HVAC, Plumbing and Fire Protection Design Requirements, HVAC, Plumbing and Fire Protection System Design Details, and 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. All errors, omissions, conflicts or code violations shall be reported 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 to indicate the general arrangement and locations of the work and shall be followed as closely as actual construction and as other work will permit. Because of the scale of the drawings, certain basic items such as necessary duct and pipe offsets, pipefittings, access panels and sleeves may not be shown. Contract documents show design basis equipment. 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. If equipment other than design basis is selected, the Contractor shall be responsible for the necessary design modifications and for coordination with other trades to meet all intended requirements of the original design documents. 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. Changes from the Contract Documents required to make this work conform to the building construction or other work of other trades shall be made by the Contractor with no additional cost to the Owner and shall not impact on the time schedule of the project. All changes from the Contract Documents shall be shown on shop drawings and submitted to each A/E/Owner for approval before commencing the work. Failure to follow the approval procedure may result in the forced removal of all work, performed prior to approval. 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 which may be required to produce the equipment performance specified or as required to meet the equipment design performance and warranties.

Where such items are required, they shall be included by the supplier of the equipment, whether or not specifically called for in the Contract Documents and properly installed by the Contractor.

- 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 15 of the Specifications.
- F. See Division 16905 Communications Systems for Air Conditioning requirements for Communications Rooms. Communication Rooms shall have 24 x 7 air conditioning capable of holding the room at 76°F with an additional capacity equivalent to 6000 BTU per equipment rack. Additional excess cooling is needed for communication distribution nodes. In the case of a distribution node, coordination is required with Florida Tech IT - Telecommunications and Florida Tech IT - Networks to determine exact cooling needs. DX air conditioners are required when the local AHU cannot meet the requirements of the communication rooms and for all communication distribution nodes. Air supply ducts in communication rooms shall be positioned to provide a supply of conditioned air to the front of communication racks. Air return ducts in communication rooms shall be positioned to provide for removal of heated air from the back of communication racks.
- G. Contract Documents may call for Mechanical Contractor to install specific equipment furnished by others, including Owner purchased equipment.
- H. Specifications and drawings shall be considered as complimentary one to the other. 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. Should conflicts occur between the drawings and the Division 15 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) and Plumbing work is specified in the following applicable sections of the Division 15 Specifications:

15000	Basic Mechanical Requirements
15073	Minor Mechanical Demolition
15135	Liquid and Air Flow Meters, Gages and Thermometers
15140	Supports, Bases and Anchors
15170	Motors
15190	Mechanical Identification
15242	Vibration Isolation
15260	Piping Insulation
15280	Equipment Insulation
15290	Ductwork Insulation
15411	Potable Water Systems
15412	Soil and Waste Systems
15413	Storm Water Systems
15420	Plumbing Piping
15430	Plumbing Specialties
15440	Plumbing Fixtures & Accessories
15450	Plumbing Equipment
15510	Hydronic Piping
15515	Hydronic Specialties
15535	Refrigeration Piping & Specialties
15540	HVAC Pumps
15671	Air Cooled Condensing Units

15682	Air Cooled Water Chillers
15684	Centrifugal Water Chillers
15686	Water Cooled Rotary Water Chillers
15712	Cooling Towers
15765	Variable Frequency Drive Units
15781	Packaged Roof Top Air Conditioning Units
15801	Water Treatment
15817	Electric Resistance Duct Heaters
15855	Air Handling Units
15870	Power Ventilators
15885	Air Filters
15890	Ductwork
15895	Ductwork Accessories
15900	Energy Management and Control System (Automated Logic)
15930	Variable Air Volume Terminal Units
15936	Grilles Registers, Diffusers
15990	Start-up Requirements for HVAC Systems
15991	Testing, Adjusting and Balancing of HVAC Systems
15992	Tests - Piping

B. Additional Associated Sections from Division 16

16650	Energy Management and Control System (Automated Logic)
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C. DEFINITIONS

PIPING: As used herein, is defined as pipe, fittings, valves, flanges, unions, specialties and accessories and appurtenances necessary for, or incidental to, a complete system.

DUCTWORK: As used herein, is defined as 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.

PROVIDE: As used herein is defined as to furnish and install. Where the words "furnish" "include" or "install" are used in the Specifications or on the Drawings, it shall mean 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. If an item is called for in either the Specification or on the Drawings, it shall be considered sufficient to including the same in the Work.

CONCEALED WORK: As used herein refers to piping, ductwork, and accessories above solid material ceilings and within walls, partitions, shafts, service spaces, under ground, or not normally exposed to view and enclosed on all sides by finish materials. Access to piping and ductwork would demolish finish materials.

CONCEALED BUT ACCESSIBLE: As used herein refers to piping, ductwork and accessories accessible above or through suspended ceilings, in walls at access panels or in chases with access doors.

EXPOSED WORK: Refers to ductwork, piping or equipment normally exposed to view within rooms or open areas. Ductwork, piping or equipment in mechanical or electrical equipment rooms shall be considered as "Exposed Work", unless noted otherwise in design documents.

1.4 QUALITY ASSURANCE

- A. Codes and Standards: All work shall be in compliance with, but not be limited to the requirements of all applicable Laws, Codes, Standards and Regulations of Governmental Bodies having jurisdiction over work performed for or on behalf of the Florida Institute of Technology, Brevard County, Florida, and over the applicable job site. The work shall also be performed in

accordance with current issues and revisions of the following Codes and Standards listed below and called for in other Sections of the specifications.

1. Florida Building Code
 - a. All or specific portions of Laws, Codes, Standards and Regulations cited or incorporated by reference in the Florida Building Code, including those in Chapter 35, Reference Standards.
 2. The Florida Fire Prevention Code, (Chapter 4A-60, Florida Administration Code)
 - a. All or specific portions of Laws, Codes, Standards and Regulations cited or incorporated by reference in the Florida Fire Prevention Code.
 3. City of Melbourne, Florida Municipal Codes
 - a. Design Guidelines
 - b. Master Specifications (formally known as LCCCG's)
 - c. Typical HVAC, plumbing and fire-protection details
 - d. If there should be conflicting requirements between above referenced codes than the following rules shall apply:
 1. The code that affords the greatest degree of life safety shall take precedent
 2. If life safety is not at issue the code with most stringent requirement shall apply.
- B. Contractor shall refer to the A/E any part of the contract documents which may be in conflict with the above codes and regulations. Contractor shall prepare proposed changes for review and approval by each Architect/Engineer/Owner. Base bid shall include the more stringent of the conflicting methods.

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. Existing active services: water, gas, sewer, electric, when encountered shall be protected against damage. Do not prevent or disturb operation of active services that are to remain. If active services are encountered which require temporary interruption or relocation, make request to authorities having jurisdiction for determination of procedures and coordinate work with the users of such utility services. Where existing services are to be abandoned, they shall be terminated in conformance with the Utility or Municipality having jurisdiction, and termination points shall be shown on "as-built" construction drawings.

1.7 SITE INSPECTION

- A. Contractor shall inspect and carefully examine the site to be familiar with conditions that will affect the work. Contractor shall verify points of connection of utilities, routing of outside piping to include required clearances from any existing structures, trees or other obstacles. Contractor shall verify available space in the existing structure and accessibility required for the installation of work under this contract and alert the A/E to conditions, which may be detrimental or will prevent proper execution of the work.
- B. The submittal of bid will be construed as that site inspection has been performed and extra payment will not be allowed for changes in work, resulting from observable existing conditions.
- C. Submittal of bid shall indicate that the Contractor has included all required allowances in the bid. No allowances shall be made for any code violations or errors resulting from Contractor's failure to visit job site and to review all contract documents and applicable codes and standards.

PART 2 MATERIALS

2.1 GENERAL

- A. Each system component installed by Contractor shall meet or exceed performance specification requirements listed in the Contract Documents including all drawings, all sections of the Specifications, HVAC, Plumbing and Fire Protection Design Requirements, HVAC, Plumbing and Fire Protection System Design Details. Components with a lesser degree of performance or quality as determined by Owner Representatives, Plan Reviewing Architects and Engineers, design Architects and Engineers or identified by Building Inspectors, or documented as inferior in the final Test and Balance Report will not be accepted and shall be replaced 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. 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.
- D. 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. They shall have corrosion protection suitable for atmosphere in which they are installed. Florida Tech is located in a Coastal Environment, all exterior materials shall be Stainless Steel, Hot-Dipped Galvanized, or painted in accordance with Section 09900 – Painting, unless otherwise approved. All such hardware shall be U.S. standard size.
- E. 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". Submittal data shall specifically indicate those ratings.
- F. All materials and equipment shall be fabricated in the United States of America and shall be labeled accordingly. Foreign made materials and equipment are not acceptable unless specified in Contract Documents.
- G. All equipment and piping supports shall be hot dipped galvanized except as otherwise noted in Contract Documents. Hangers for copper pipe shall be vinyl coated. Do not use copper clad hangers.
- H. Air conditioning system components shall conform to federal, state and local sound emission and vibration isolation guidelines. Objectionable noise or excessive vibration created in any part of the building by operation of any equipment under this contract will not be permitted. 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 15 equipment. If noise attenuation or vibration isolation measures do not produce satisfactory results all components which prove to be in violation shall be replaced at no additional cost to the Owner, to comply with codes and ordinances having jurisdiction at the job site.
- I. 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 Florida Institute of Technology. Florida Statutes, Chapter 489 requires all construction work to be done by licensed Contractors.

The work being performed shall be within the scope of Contractor's license. Any person who is not licensed must work under direct supervision of a person who has licenses required by the state law and by the county or municipal licensing ordinances. The job foreman must speak English and must have ten-years experience of installing the tonnage of mechanical equipment specified in the contract documents. Florida Tech may request the change of the job foreman. Workers skilled and competent in the type of work involved shall accomplish the installation. Workmanship throughout shall correspond to the standards of the best trade practices.

- B. Work other than interior work shall commence as soon as the building has sufficiently advanced in construction layout. 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.
- C. Contractor shall install all systems and equipment in accordance with the Contract Documents, and equipment or material manufacturer recommendations and instructions. Contractor shall commission, prepare and adjust HVAC and other mechanical systems prior to Owner's independent test & balancing work.
- D. Work lines and established grades shall be in strict accordance with the Contract Documents. The Contractor shall be responsible for furnishing to all trades, in ample time, any information they may require to construct all equipment bases, trenches, pits, chases, and openings in floors, walls and finishes, and to provide clearances to accommodate the work. The contractor shall set all sleeves, anchor bolts or inserts to fasten equipment before adjacent concrete work is poured.
- E. Coordinate location of all Division 15 work with Division 16. Do not run piping, ductwork and similar Division 15 work in National Electric Code (NEC) dedicated service areas for electrical equipment, including above panel boards, starters, communication panels, control panels, telephone backboards, data panels and similar electrical elements. Water piping shall not be installed directly above electrical equipment. When piping is required to be installed in electrical rooms a drain pan shall be provided to protect the electrical equipment. 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.
- F. All piping systems (chilled water, hot water, potable water, refrigerant piping, pneumatic piping,) shall be capped or plugged at the end of each workday until system is complete to prevent contamination.
- G. Provide a schematic wiring diagram for each component of HVAC system including controls. Diagrams shall be located in mechanical rooms and mounted on wall at eye level.
- H. Provide a schematic duct diagram indicating room numbers and component locations. Diagram for each air handler shall be located in mechanical room and 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. The contractor shall harmonize the work of different trades so that interference between piping, ductwork, equipment and structural work will be avoided.
- B. It is recommended that each contractor prepare shop drawings at 1/4" to 1'-0" scale clearly indicating all applicable components and coordinate the same with all trades. It is recommended that coordination shop drawings show in detail the space conditions of all concerned trades, and be reviewed and accepted by the A/E. 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. 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 changes 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 be in compliance with the General Conditions.
- B. Before ordering equipment and materials the Contractor shall submit to the Engineer for review three-copies of the manufacturer's descriptive literature for all equipment and materials he proposes to use. Submittal data shall consist of shop drawings and/or catalog cuts showing technical data necessary to evaluate the material or equipment, to include dimensions, required service and maintenance clearances, wiring diagrams, performance curves, ratings, control sequence, 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. Unless the Contractor submits a written request for a substitution to or deviation from systems, equipment or materials listed in the specifications or drawings, it will be assumed that he accepts and agrees to follow the contract drawings and specifications. Owner's representative shall review the request and either approve or deny the request in writing.
- B. All approval procedures regarding proposed substitutions as "approved equal" or "Engineer and Owner approved" shall meet the requirements of Section 01600.

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 Mechanical Work.
- B. When additional patching for unnecessary openings are required due to failure to inspect and coordinate work, than provide the patching required to properly close the openings, to include matching surface finishing and painting, at no additional cost.
- C. When cutting and patching of the structure is 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, than provide cutting and patching as required, at no additional cost.

- 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. Cutting of structural members will not be permitted without prior approval of the A/E. Extent of cutting shall be minimized; use core drills, power saws or other machines that will provide neat, minimum openings. Patching shall match adjacent materials and surfaces and shall be performed by craftsmen skilled in the respective craft required.

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. Position sleeves in formwork prior to placement of concrete. 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. When required, the 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 for free movement of pipe due to expansion and contraction. Provide for continuous insulation wrapping. Waterproof sleeves shall be of sufficient internal diameter to take pipe and waterproofing material.
- E. In finished areas where pipes are exposed, sleeves shall be terminated flush with wall, partitions and ceilings, and shall extend ½" above finished floor level. Extend sleeves 1" above finished floors in areas likely to entrap water. Caulk floor sleeves.
- F. Sleeves passing through waterproofing membrane shall be flashed as required by Division 7.
- G. Pipe penetrations through fire-rated partitions (walls, floors or ceilings) shall be protected in accordance with FBC 705.4. Protected penetration shall retain the original integrity of the fire rated partition. Unprotected penetrations through fire-rated partitions are not allowed. All materials, products and procedures used to complete the fire stopping assemblies must be tested, listed and approved by testing laboratories such as U.L. or Factory Mutual and comply with requirements of ASTM-E-119. Where sleeves are required part of the listed an approved fire-stopping assembly they shall be securely fastened to the penetrated partition. 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 air tight. Insulation and coverings shall not penetrate the fire-rated partition unless the specific material used has been tested and approved as part of the U.L or Factory Mutual fire-stopping assembly. 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. 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. Escutcheons shall fit around insulation or around pipe when not insulated; outside diameter shall cover sleeve. Where sleeve extends above finished floor, escutcheon shall be high cap type and shall clear sleeve extension. Secure escutcheons or plates to sleeve but not to insulation with setscrews or other approved devices.

3.10 PROTECTION

- A. Special care shall be taken for the protection of equipment and materials furnished. Store and completely protect all materials from damage. Materials and equipment shall be kept clean and dry, free from deterioration by weather elements, painting, plaster, etc., until the project is completed. Damaged or defective materials shall not be installed. Damage from rust, paint, etc., and finishes on equipment which have been scratched or marred shall be touched-up to match original finish or shall be completely refinished to restore equipment to original condition.
- B. Where the installation or connection of equipment requires work in areas previously finished by other Contractors, the area shall be protected and not marred, soiled or otherwise damaged during the course of such work. 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 15260.
- E. Welding will be permitted in the existing buildings as long as the contractor provides for an approved fire watch and other required safety measures. 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 MECHANICAL IDENTIFICATION

- A. Identification of mechanical systems shall be as specified in Section 15190; MECHANICAL IDENTIFICATION.

3.12 WIRING AND ELECTRICAL WORK FOR MECHANICAL EQUIPMENT

- A. All electrical work, equipment and wiring shall comply with National Electric Code.
- 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 15 equipment, complete with motors and controls. The Mechanical Contractor shall set the motors in place. 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. For special requirements for starters and disconnects in kitchen and exterior locations refer to Division 16. The entire fire alarm system including interlock wiring required for air handling unit shutdown shall be provided under Division 16.
- 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 15.
- G. Division 16 shall furnish motor starters for motors furnished by Mechanical Contractor, except where other sections call for starters to be furnished by the equipment supplier (e.g. chillers).
- H. Mechanical Contractor shall furnish variable frequency drives (VFD) and set the same in place, ready to be wired by Division 16.

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 work has been installed and tested. Care shall be taken in excavating, that walls and footings and adjacent load bearing soils are not disturbed, except where lines must cross under a wall footing. Where a line must pass under footing, the crossing shall be made by the smallest possible trench to accommodate the pipe. Excavation shall be kept free from water by pumping if necessary. No greater length of trench shall be left open, in advance of pipe or utility installation, than that which is authorized.
- B. Trenches for piping and utilities located inside foundation walls and to a point five-feet outside of the wall shall not be less than 16" nor more than 24" wider than the outside diameter of the pipe to be laid. The widths of trenches for piping and utilities located more than five-feet outside of building foundation walls, other than for sewers, shall be governed by conditions found at the site.
- C. Trenches for sewers shall be excavated so that the pipe may be laid to the alignment and depth required and the maximum trench widths up to the level of the outside top of the pipe shall be no more than 24". Other trench widths shall be governed by the conditions found at the site.
- D. Bottoms of trenches shall be so shaped that when pipe is in place the lower fourth of the circumference for the full length of the barrel will be supported on compacted fill. Bell holes shall be dug so that no part of the weight of the pipe is supported by the bell, but shall be no larger than necessary for proper jointing. All piping requiring excavation below the compacted fill required for the structure shall be excavated to at least 6" below pipe invert.
- E. Trenches shall be made true to grade by means of substantial and accurately set batter-boards.
- F. Immediately after testing and/or inspection, the trench shall be carefully backfilled with earth free from clods, brick, etc., to a depth one-half the pipe diameter and then firmly puddled and tamped in such a manner as not to disturb the alignment or joints of the pipe. Thereafter, the backfill shall be puddled and tamped every vertical foot.
- G. Burial depth of gravity drain lines shall have precedence over non-gravity systems. Chilled water and domestic water lines shall be offset 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. Routing shown on drawings is schematic in nature and shall be coordinated with field conditions, grade changes and the work of other trades, and documented in "as-built" drawings.

3.14 CONCRETE WORK

- A. Provide concrete bases and housekeeping pads for mechanical equipment unless indicated otherwise. Concrete work shall be as specified in Section; Concrete. This Contractor shall provide vibration pads and equipment base. 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 to be permanently mounted shall be securely anchored to its supporting surface in compliance with FBC, 423.14.7. A minimum of two bolts are required per each piece of equipment. Bolts shall be of sufficient size to prevent equipment from overturning or moving from original mounting position.

3.16 CORROSION

- A. Provisions shall be made to prevent corrosion due to contact of metallic pipe and equipment with moisture or dissimilar materials. When pipe is joined with another pipe, valve, fitting or

piece of equipment constructed of dissimilar metal an insulated joint shall be installed to prevent formation of galvanic couple. Pipe hangers and supports of dissimilar metal shall be isolated from contact with pipe. Metal pipe and equipment shall be isolated from direct contact with concrete or other corrosive materials and soils.

3.17 PAINTING AND FINISHING

- A. All exposed metal surfaces shall be painted, unless specified otherwise. Mechanical equipment shall have factory finish as specified; any damage to that finish shall be field primed and painted to match existing. All ferrous metal equipment and supports, not factory finished, shall be cleaned, primed with a suitable primer and given two finish coats of exterior enamel.
- B. Exposed galvanized metal, including ducts, shall be primed with galvanized metal primer and painted with enamel paint to match surrounding area.
- C. Other unpainted ferrous metal including all pipe sleeves or equipment supports shall be cleaned and primed with metal primer suitable to the metal, and shall be finished with two coats, one flat and one enamel as selected.
- D. All equipment and piping, after insulation has been installed, shall be primed and painted with one color semi-gloss coat and with one-color enamel paint. Color to be selected by the Owner.
- E. Refer to Section 09900 for paint schedule and preparation.

3.18 TESTS

- A. All materials, equipment and systems that are required to be tested by these specifications or by any applicable regulation or code, shall be tested in the presence of owner's representative or authority having jurisdiction. All items requiring pressure or leakage tests shall be tested before being concealed from view. All defects disclosed by tests shall be rectified and the tests repeated. The Contractor shall provide all labor, materials and equipment used in tests.

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. All areas and temporary storage spaces shall be cleaned of all packing boxes, wood frame members and other waste materials used in the mechanical construction.
 - 2. The entire system of piping and equipment shall be cleaned internally. The Contractor shall open all dirt pockets and strainers, completely blowing down as required and clean strainer screens of all accumulated debris. Strainers shall be cleaned in the presence of the Test and Balance firm.
 - 3. All tanks fixtures and pumps shall be drained and proven free of sludge and accumulated matter.
 - 4. All temporary labels, stickers, etc. shall be removed from all fixtures and equipment. (Do not remove permanent nameplates, equipment model numbers, ratings, etc.).
 - 5. Heating and air conditioning equipment, tanks, pumps, traps, etc., shall be thoroughly cleaned and new filters or filter media installed.
- C. OPERATION AND MAINTENANCE MANUALS
 - 1. At substantial completion the Contractor shall provide the Owner with five copies of a hardbound Operating & Maintenance manual (O & M) for all equipment furnished and

installed under his work, otherwise systems involved will not be acknowledged as complete and therefore not accepted.

2. Requirements and methods of preparing and procedures for submitting Operating and Maintenance Manuals shall be in accordance with Division One.
 3. The O & M manuals shall contain notarized cover sheet outlining the warranty commencement dates and the obligations of installing contractor responding to equipment related deficiencies, i.e. Warranty Calls.
 4. The O & M manuals shall include factory installation, maintenance and operating instructions, and repair manuals for each and every component within each system, such as but not limited to: chillers, pumps, cooling towers, air handlers, fans, controls, etc. Submittal or cut sheets shall not be acceptable as primary information on any component. The manufacturer parts list and serial numbers for all operating equipment shall also be included.
 5. The O & M manuals shall include all information on component and equipment modifications, such as required options, impeller sizes, and performance curves.
 6. The O & M manuals shall provide detailed sequence of operation for each system stating how and when each component is activated and controlled to achieve designed operation and performance.
 7. The O & M manuals shall include detailed control drawings for each system indicating components used and their respective locations within the buildings being served. Drawings shall list building and room numbers.
 8. All controls and safety devices shall be clearly and permanently embossed or have printed plates indicating their purpose or operation. Plates shall be laminated plastic (color selected by A/E) with white or black letters, attached to the equipment or device with screws, rivets or non-soluble cement (glue).
 9. Provide name, address, and phone numbers of equipment suppliers used for all system components.
 10. Upon completion of the work, the Contractor shall put the system into service. The Contractor shall be entirely responsible for the equipment during all testing operations.
 11. The Contractor shall assist the owner's Test and Balance firm in operation of equipment and providing access (in the form of ladders and scaffolding where required) to devices which require measurement and/or adjustment. The Contractor shall aid in the identification and location of equipment. The Contractor shall correct all field conditions found to be unsatisfactory by the Test and Balance firm to include, but not be limited to: reconfiguration of pipe fittings, replacement of belts and pulleys and similar tasks as may be necessary but not otherwise required under applicable specification sections or other portions of the contract documents.
- 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. Five-copies of as-built ACAD prints shall be provided to the Owner at the date of substantial completion. One of the five-sets shall be on 11" x 17" paper.
 3. The drawings shall show all equipment, piping (including underground) and ductwork with dimensions and reference points, other concealed non-accessible work, branching arrangement and valve location for piping systems, locations of damper and heaters in duct systems, locations of control system sensors and other control devices, and work of change orders not shown on contract documents.
- E. INSTRUCTIONS AND DEMONSTRATIONS

1. Systems shall be tested and placed in proper working order prior to demonstrating systems to the Owner.
2. Prior to acceptance of the mechanical installation, schedule and conduct a walk-thru instruction seminar to demonstrate to the Owner or his designated representatives all essential features and functions of all systems installed, and instruct to the Owner the proper operation and maintenance of such systems. The contract shall allow for three working days to perform the demonstrations.
3. Provide trained personnel who are fully knowledgeable and capable of answering any question raised pertaining to the mechanical systems installed to perform the demonstrations and instructions. Provide manufacturer's representatives for systems as required, to assist with the demonstrations.
4. Dates and times for performing the demonstrations shall be coordinated with owner's representative and the Architect.
5. System demonstrations shall be in accordance with operating and maintenance data. All systems shall be demonstrated including controls.
6. Upon completion of demonstrations, provide a certificate testifying that demonstrations have been completed. Certificate shall list each system demonstrated, dates demonstrations were performed, names of parties in attendance, and shall bear signatures of Contractor and Owner.

F. WARRANTY

1. The warranty for all mechanical equipment (whether manufacturer's or contractor's warranty) shall comply with Section 01700 in the General Conditions.
2. All equipment and systems, unless specified otherwise, shall have a manufacturer's warranty for a period of one year from the date of substantial completion. This warranty shall be against defective materials, design and workmanship.
3. The mechanical contractor shall repair or replace any component of the Division 15 work under warranty, which proves to be defective, at no cost to the Owner.
4. Upon receipt of notice from the Owner of failure of any part during the warranty period the Contractor shall respond the same day and shall complete warranty service work in a timely manner.
5. During warranty period, all responses to warranty calls made by the Contractor shall be documented by leaving a copy of the mechanics service ticket with the school Principal upon completion of the warranty work, prior to leaving the site. Without proper documentation the Owner shall not acknowledge repairs have been completed.
6. Required optional extended manufacturer or vendor warranties for specific items, their performance or expected durability will be explicitly included in Division 15 Specifications. Manufacturer or vendor shall repair or replace any defective component under extended warranty at no cost to the Owner.

END OF SECTION