SECTION 23 09 00

HEATING, VENTILATING AND AIR-CONDITIONING (HVAC)

PART 1 - GENERAL

1.01 DESCRIPTION:

A. This section of the specifications shall be applicable to all phases of mechanical work covered by specifications and drawings issued for this project.

B. The "General Conditions of the Contract", "Supplementary General Conditions", and all other similar general requirements issued for this project shall apply to all mechanical work and are hereby made a part of this section.

C. The Contractor and/or his representatives shall be fully acquainted with the design and operation of the systems and equipment described in these specifications and on the drawings.

D. Work included under this section shall include complete systems as shown on the plans and as specified. Provide supervision, labor, material, equipment, machinery, plant, and other items necessary to complete the mechanical systems. It is the intention of these specifications and drawings to call for finished work, tested, and ready for operation.

E. Definitions:

1. "Owner" and "Contractor" shall mean the respective parties to the prime contract governing the project. Only one contractor is recognized as a party to this contract. Where the terms "Mechanical Contractor" or "Subcontractor" are used, it is for convenience only.

2. "Architect/Engineer" shall mean the firm and authorized representatives of the firm engaged by the Owner for architectural and engineering services related to this project.

3. "Mechanical" shall mean all work related to air conditioning, heating, ventilation, plumbing, sprinkler systems, noise and vibration control, and similar work, including all related components, accessories, controls, and miscellaneous work required for a complete system.

4. "Contract Documents" shall mean and include the agreement, the drawings and specifications and all modifications thereto authorized by the Owner in writing prior to final completion of the project.

    a. The term "Agreement" shall mean the completed and signed contract form.

    b. The term "Drawings" shall mean the drawings prepared by the Architect/Engineer for specific use in bidding and execution of the work.

    c. The term "Specifications" shall include the legal and procedural documents, the general conditions, special conditions, and the technical specifications.

    d. The term "Technical Specifications" shall mean that part of the specifications which describes, outlines, and stipulates the kind and quality of the materials to be furnished, the quality of workmanship required, and the methods to be used in the construction under the contract. For convenience, the mechanical portions of the technical specifications are arranged into one general section and several detailed sections related to the various trades represented in the work. Such arrangement and references shall not operate to make the Architect/Engineer an arbiter in establishing the limits of any subcontract or trade.

5. "Work" of the Contractor shall mean labor or materials or both.

6. "As shown", "as indicated", "as detailed", or words of similar import shall mean reference to the drawings included in the contract documents, unless stated otherwise.

7. "As directed", "as required", "as permitted", "approved", or words of similar import shall mean that the direction, requirement, permission, approval, or acceptance of the Architect/Engineer is intended unless stated otherwise.

8. "As necessary" shall mean that which is necessary to achieve satisfactory completion of the work in order to provide the intended function and form of the project in compliance with the contract documents.

9. "Provide" shall mean "provide complete and in place", that is "furnish and install", ready for beneficial occupancy by the Owner. Except where stated otherwise, description of any work in the contract documents shall mean that

the work shall be provided by the Contractor, even though the words "provide" or "furnish and install" do not accompany the description.

10. "Similar" shall be interpreted in a general sense and not as meaning identical, and all related details shall be worked out in respect to their location and their connection with other parts of the work.

11. Exposed: Piping, ductwork, and equipment exposed to view in finished rooms.

12. Option or Optional: Contractor's choice of an alternate material or method.

1.02 INTENT OF CONTRACT DOCUMENTS:

A. The contract documents are complementary, and what is called for in one place shall be as binding as if called for in all places. Where variances occur between drawings and specifications or within either document itself, include in the contract price the item or arrangement of better quality, greater quantity, or higher cost. Agreement shall take precedence over the specifications and drawings. Figured dimensions shall be used in preference to scaling the drawings. In case of conflict between large and small scale drawings, the large scale drawings shall govern.

B. The mechanical drawings show the general arrangement of all piping, equipment, and appurtenances and shall be followed as closely as actual building construction and the work of other trades will permit. The mechanical work shall conform to the requirements shown on all of the drawings. Architectural and structural drawings shall take precedence over mechanical drawings. Because of the small scale of the mechanical drawings, it is not possible to indicate all offsets, fittings, and accessories which may be required. The Contractor shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings, valves, boxes, offsets, transitions, and other accessories as may be required to meet such conditions.

1.03 CODES AND STANDARDS:

A. All materials and workmanship shall comply with all applicable codes, state and federal laws, local ordinances, industry standards, utility company regulations, and all other criteria which normally apply to work of this nature.

B. In case of difference between building codes, state laws, federal laws, local ordinances, industry standards, utility company regulations, other criteria and the contract documents, the more stringent regulations will apply. The Contractor shall promptly notify the Architect/Engineer in writing of any such difference.

C. If the Contractor performs any work that does not comply with these contract documents or the requirements of the applicable building codes, state laws, local ordinances, industry standards, utility company regulations, and other applicable criteria, he shall bear all costs arising in correcting the deficiencies.

D. The standards referred to, except as modified in the specifications, shall have full force and effect as though printed in these specifications. The manufacturer and trades involved shall be familiar with the application of these standards.

E. Applicable codes and standards shall include, but are not necessarily restricted to, the most recently recognized issues of the following:

1. Building Codes:

   a. Virginia Uniform Statewide Building Code
   b. International Mechanical Code and accumulative supplements.

2. Industry Standards, Codes, and Specifications:

a.	AASHO	American Association of State Highway Officials
b.	ADA	Americans with Disabilities Act
c.	AGA	American Gas Association
d.	ARI	Air Conditioning and Refrigeration Institute
e.	AMCA	Air Moving and Conditioning Association
f.	ANSI	American National Standards Institute
g.	ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
h.	ASME	American Society of Mechanical Engineers
i.	ASSE	American Society of Sanitary Engineering
j.	ASTM	American Society of Testing and Materials
k.	AWS	American Welding Society
l.	CISPI	Cast Iron Soil Pipe Institute
m.	CSA	Canadian Standards Association
n.	AWWA	American Water Works Association
o.	FIA	Factory Insurance Association
p.	FM	Factory Mutual
q.	FS	Federal Specification
r.	IBR	Institute of Boiler and Radiator Manufacturers
s.	IRI	Industrial Risk Insurers
t.	ISO	Insurance Services Office
u.	MSS	Manufacturer's Standardization Society of the Valve and Fittings Industry, Inc.
v.	NBS	National Bureau of Standards

w.	NEC	National Electrical Code
x.	NFPA	National Fire Protection Association
y.	NSF	National Sanitation Foundation
z.	PDI	Plumbing & Drainage Institute
aa.	UL	Underwriters' Laboratories, Inc.
bb.	SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
cc.	UFAC	Uniform Federal Accessibility Standards
dd.	SCAQMD	South Coast Air Quality Management District
ee.	GS	Green Seal Standard

1.04 GOVERNMENTAL FEES, PERMITS, AND INSPECTIONS:

A. Under each applicable section of the detailed mechanical specifications, the Contractor shall obtain and pay for all required licenses, permits, charges for connections to outside services, fees and inspections. Upon completion of the work under each section of the detailed mechanical specifications, the Contractor shall furnish a certificate of final inspection to the Architect/Engineer from the governmental inspection department having jurisdiction.

1.05 VISITING THE SITE:

A. Each Contractor shall be responsible for visiting the site before bidding the job to familiarize himself with all existing conditions to be met in the execution of the work under this contract. No additional compensation will be allowed for any changes which may be required to make because of site conditions.

1.06 QUALITY ASSURANCE:

A. Product Criteria:

1. All materials shall be new and shall bear the manufacturer's name, trade name, and the UL label in every case where a standard has been established for this particular material. The equipment to be furnished shall be essentially the standard product of a manufacturer regularly engaged in the production of the required type of equipment, and shall be the manufacturer's latest approved design. All equipment shall bear a permanent and legible factory-applied nameplate to permit identification of manufacturer, model number and type of unit.

2. Equipment Service: Products shall be supported by a service organization which maintains an adequate inventory of repair parts and is located, in the opinion of the Architect/Engineer, reasonably close to the site.

3. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer to provide for uniform appearance, operation, and maintenance.

4. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.

B. Manufacturers' directions shall be followed in the delivery, storage, protection, and installation of all equipment and materials. The Contractor shall promptly notify the Architect/Engineer in writing of any conflict between any requirements of the contract documents and the written instructions before proceeding with the work. If the Contractor performs any work that does not comply with the manufacturers' directions or such written instructions from the Architect/Engineer, he shall bear all costs arising in correcting the deficiencies.

C. Factory Start-up by the manufacturer's Factory Certified Representative shall be provided for each Boiler. Letters signed by the Representative stating that their equipment has been started, tested, and is operating safely shall be submitted to the Owner as part of the bound Operations and Maintenance Instructions manual specified in section 2.10 CATALOG DATA FOR OWNER of this specification.

1.07 BIDDING INSTRUCTIONS:

A. Products are generally specified by a performance specification and/or by manufacturer's name and model number or trade name.

B. When specified only by a performance specification, the Contractor may use any manufacturer who meets the performance specification and applicable codes.

C. When several products/manufacturers are specified together and the system design is based on one of the listed products by specific model number(s) or catalog number(s), then the Contractor has the option of using the one specific product or any other product/manufacturer listed. In either case, the Contractor shall be subject to the requirements of 1.09 - SHOP DRAWINGS. However, when the other listed product/manufacturer is used, the Contractor shall be responsible for determining that the product(s) will be compatible with building design, electrical design, mechanical design, and the product(s) will not necessitate design modifications by the Architect/Engineer. The Contractors bid shall be compiled on the use of the listed products without exception. Substitutions will only be considered after the Contract has been executed and shall be subject to the requirements of 1.08 - SUBSTITUTIONS. If the products/manufacturer are listed to be "only", then substitutions will not be considered.

1.08 SUBSTITUTIONS:

A. Substitutions will not be considered during the bid.

B. After the Contract has been executed, the Architect/Engineer will consider a formal request for a review of substituted products in place of those specified, under the following conditions:

1. Not later than 30 days from the Contract Date, the Contractor shall provide a list of products proposed as substitutions, including the name, manufacturer, and section of the specifications governing the product.

2. The request shall be accompanied by accurate cost data on the proposed substitutions indicating whether or not a modification of the Contract Sum is to be considered.

C. Substitutions are understood to mean that the installing Contractor:

1. Has personally investigated the proposed substitute and has determined that it is equal or superior in all respects to the item specified;

2. Will provide the same guarantee for the substitution that he would for the item or equipment specified;

3. Certifies that the cost data is complete and includes all related costs under this Contract, and waives all claims for additional cost related to the installation of the accepted substitute;

4. Has coordinated the installation of the substitute, providing design modifications and changes as required for the work to be complete in all respects;

5. Has coordinated the installation of the substitute with the General Contractor pertaining to changes required for the work to be complete with all trades and all changes shall be provided without additional cost to the Owner.

D. The acceptance by the Architect/Engineer of any or all of those substitute items listed by the Contractor for review shall not constitute an approval of the substitute but shall mean that the Contractor may then submit detailed shop drawings for review. When a request for substitution is granted, shop drawings will be reviewed by the Architect/Engineer. Shop drawings not complete with proper review information will not be reviewed and will be returned unchecked. If after two submittals, the substitute equipment is not approved, the specified equipment shall be provided.

1.09 SHOP DRAWINGS:

A. Shop Drawings are required for all material and equipment that is specified by a manufacturer's name or as indicated in the technical specifications. Furnish the number of copies required by the General and Special Conditions of the Contract, but in no case less than six (6) copies. Submittal data for related equipment shall be submitted at one time.

B. Substitutions will not be considered if:

1. They are indicated or implied on shop drawing submissions without information specified in 1.08 - SUBSTITUTIONS.

2. They require a substantial revision of the Contract Documents in order to accommodate their use.

C. Identify submittals with PROJECT NAME and NUMBER, CONTRACTOR'S NAME, SECTION NUMBER & NAME, and PARAGRAPH NUMBER of SPECIFICATION GOVERNING, MANUFACTURER, MODEL or STYLE, and CONTRACTOR's REVIEW STAMP. Submittals shall be detailed, dimensioned drawings showing construction, size and arrangement, service clearances, performance characteristics, and capacity. Submittals not properly identified or containing information of a general nature will not be reviewed and will be returned unchecked.

D. Acceptance of shop drawings shall not be considered as a guarantee of measurements or building conditions. Acceptance shall not relieve the Contractor from the responsibility or necessity of furnishing material or performing work required by the drawings and specifications. Submittal data on any one item shall not be reviewed more than three (3) times. If not accepted after the third review, the Contractor shall provide the equipment upon which the design was based.

E. Failure to submit shop drawings in ample time for checking shall not entitle an extension of contract time, and no claim for extension by reason of such default will be allowed.

F. No material or equipment, for which submittals are required, may be delivered to or installed at the job site until submittals have been accepted.

G. Unless a specific finish is indicated in the contract documents, wherever a choice of finish is available for the specified item, submit accurate color chips or charts to the Architect for review and selection.

PART 2 - PRODUCTS

2.01 DRIVE GUARDS:

A. For machinery and equipment, provide guards as shown in AMCA 410 for belts, chains, couplings, pulleys, sheaves, shafts, gears and other moving parts regardless of height above the floor. Drive guards may be excluded where motors and drives are inside factory fabricated unit casings.

B. Materials: Sheet steel, cast iron, expanded metal or wire mesh rigidly secured so as to be removable without disassembling pipe, duct, or electrical connections to equipment.

C. Access for Speed Measurement: One inch diameter hole at each shaft center.

D. Lubrication: Guards shall not interfere with lubrication of equipment.

2.02 PAINTING:

A. General - Paint mechanical and electrical equipment and material in Equipment Rooms and utility type areas and located outside of the building or on the roof. Painting in concealed spaces shall be limited to equipment and materials not otherwise protected from rusting such as hangers and supports. Paint shall be products of Sherwin-Williams, Pittsburgh, or Pratt-Lambert. All paints, finishes and coatings shall comply with Green Seal Standard GS-11, GS-03, and SCAQMD Rule #1113 VOC limits for paints and coatings

B. Workmanship - The work shall be accomplished by workmen skilled in the painting trade after testing is complete and systems are ready for operation. Surfaces to be painted shall be completely dry before applying paint. Surfaces shall not be painted when the temperature is below 50 Deg. F or above 120 Deg. F, or when they are exposed to hot sun. Materials shall be evenly spread and smoothly flowed on without runs or sags. Each coat shall be thoroughly dry before application of succeeding coat. The painters shall protect adjacent surfaces with drip covers during the process of painting. Upon completion, paint spots, if any, shall be removed from adjacent surfaces.

C. Preparation of surface - Metal surfaces shall be cleaned with solvent before applying materials. Rust and scale shall be removed by wire brushing or sanding. Galvanized surfaces shall be pretreated with a phosphoric acid cleaning solution and primed with Sherwin-Williams "Galvanized Iron Primer".

D. Painting - After preparation as described above, each item shall be painted as follows, except color of paint for equipment and material located outside of the building or on the roof shall be as selected by the Architect.

1. Painting is not required of equipment, equipment supports, and hangers with a factory-finish coat. Patch painting is required of any damaged areas to match factory-finish coat. Painting is required where equipment or equipment supports do not have factory-finish paint. Painting for other equipment and associated hangers and supports shall be primed with one coat of alkyd, zinc potassium chromate metal primer, except insulated surfaces shall be primed with one coat Sherwin-Williams "Wall Primer and Sealer." Finish with two coats of Sherwin-Williams Steel Gray Enamel. Exterior of belt guards and other protective guards shall be finished with two coats of machinery enamel in OSHA yellow color. Interior of items covered by belt guards and other protective guards shall be finished with two coats of machinery enamel in OSHA orange color. Nameplates on equipment shall not be painted.

2. Pipes and conduits - Exposed pipes, conduits, and associated hangers exposed in equipment rooms and other unfinished areas such as storage areas shall have two finish coats of paint of the same color as existing piping, conduit, and associated hangers. Bare copper pipe shall not be painted. Canvas or paper jacket insulation of pipes exposed in unfinished areas shall be primed and sealed before final two coats of paint. Hangers and supports in concealed areas not protected by factory-finish paint shall have one coat of metal primer.

E. Identification of pipes and equipment

1. Equipment - Each piece of equipment shall be identified by stenciled marking that will read the same as the identification shown on mechanical or electrical drawings. Stencil letters shall be 2 inches high upper case painted with white enamel.

2. Pipe shall be identified with stencil letters (as indicated on the plans) and flow arrows as shown below.

NOTES:
1. Arrows shall be stencil type.
2. Arrows shall be readable from floor.
3. Arrows shall be installed every 15'-0".
4. Arrows shall be painted on pipes.

F. Identification of Valves: Properly mark service and control valves. Valve markers shall be metal tags with designations stamped thereon or laminated engraved plastic chained to their respective valves. Identification symbols or designations shall be the same as shown on the Contract Documents.

2.03 MOTORS, CONTROL, AND ELECTRICAL WIRING:

A. Provide motors in accordance with NEMA Standards and suitably designed to match the starting and running characteristics of the driven equipment. Unless indicated otherwise, motors less than 1/2 horsepower shall be wound for 120 volt, single phase, 60 hertz. Motors 1/2 horsepower and above, unless indicated otherwise, shall be wound for three phase, 60 hertz, 200 volt, 230 volt, or 460 volt as required by the system voltage. Select motors coordinated with the utilization voltage and phase. Motors for equipment with VFD shall be matched to the VFD.

B. All starters and safety switches, except for those specified to be furnished with the mechanical equipment, shall be furnished as part of the Electrical Work - Division 16.

C. Starters and safety switches furnished with the mechanical equipment shall comply with the specifications of Sections 16482 and 16170. Starters furnished as an integral part of the mechanical equipment shall be complete with properly sized overload heaters. Integral 3-phase motor starters and VFD's shall be provided with phase loss relay as specified in Section 16482.

D. Temperature control wiring shall be furnished as part of the Mechanical Work, Section 15971 - INSTRUMENTATION AND CONTROL FOR HVAC. Temperature control wiring is any wiring, regardless of voltage, related to mechanical equipment that is not the equipment power circuit from the circuit breaker in the panelboard to the motor starter or safety disconnect switch and to the motor or equipment junction box. Temperature control wiring shall include, regardless of voltage, power for control panels, power for actuators, signal for input and outputs, interlocks, and line voltage as herein specified to provide the proper operation and sequence of control for all heating, ventilating, and air conditioning equipment. All wiring shall conform to applicable sections of Division 16.

1. Power for control panels shall be provided by the Controls Contractor and shall be obtained from nearest receptacle or unswitched 120 volt lighting circuit. Control Contractor shall coordinate with Electrical Contractor when connecting to these circuits. Circuit directories in panelboards shall indicate where control panels are connected. When control panels require voltage other than 120 VAC, Control Contractor shall provide transformer to reduce voltage. All wiring shall conform to applicable sections of Division 16 of the specifications.

2. Power for damper actuators and valves which are an integral part of mechanical equipment shall be provided by the Contractor and shall be obtained from the power source to the equipment or the nearest receptacle circuit. Where power requirement for the actuator or valve is different from that supplied to the equipment, the Contractor shall provide a transformer or tap the nearest receptacle circuit or unswitched 120 volt lighting circuit. Dampers located at fans shall be considered an integral part of the mechanical equipment and shall be factory wired to the equipment power source.

3. Where equipment is controlled by a line voltage control device (thermostat, On-Off switch, Speed Switch, etc.) the Contractor shall wire from the control device to the equipment, unless specifically indicated otherwise on the drawings.

4. Where control devices that are intended to interrupt the motor or equipment power circuit are provided by the Contractor and are mounted other than on or directly adjacent to the controlled equipment, the Control System Contractor shall provide wiring through these devices regardless of voltage or phases.

5. All low voltage control wiring in inaccessible areas or in exposed areas shall be in metal conduit and shall comply with the specifications of Divisions 16, 27 and 28. All low voltage control wiring in unexposed, accessible areas shall be wire in conduit or U.L. approved plenum rated cable supported from the structure with ties spaced 4'-0" on center. Cable shall not be supported on ceiling, lights, or pipes. All low voltage control wiring penetrating walls or floors shall be in conduits. All 120 volt wiring shall be wire in conduit and shall comply with the specifications of Division 16. All wall-mounted thermostats, sensors, and switches shall be mounted in recessed metal rough-in box.

6. The Controls Contractor shall coordinate with the Electrical Contractor all 120 volt power source, connections required for the controls system. The Contractor shall verify that wiring of motors and controls provides the correct sequence of operation.

7. All equipment that has electrical connections shall have wiring terminals/connectors rated for not less than 75 deg. C. If terminals/connectors are provided and are rated for less than 75 deg. C., the mechanical contractor shall incur all costs associated with upsizing wire and conduit as required by the National Electrical Code.

2.04 FIRE-STOPPING:

A. Pipe penetrations of rated walls, floors, and floor-ceiling assemblies shall be constructed in accordance with Underwriter's Laboratories, Inc., Fire Resistance Directory, Volume II, Hourly Ratings for Through Firestop Penetrations. The Contractor shall provide U.L. firestop penetrations according to the particular wall, floor, or floor-ceiling assembly rating, construction type, pipe material, pipe size, insulation requirements, sleeve requirements, and the contractor's choice of firestop products as listed by U.L. Refer to the architectural drawings for the wall, floor, or floor-ceiling assembly construction types and ratings.

2.05 PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS:

A. Under each applicable section of the detailed mechanical specifications, the Contractor shall furnish and install all accessories, connections, bases, guards, supports, and incidental items necessary to fully complete the work, ready for use, occupancy, and operation by the Owner.

B. Type Numbers Specified: MSS SP-58; for selection and application, MSS SP-69. Refer to Section METAL FABRICATIONS, for miscellaneous metal support materials and prime coat painting.

C. For Attachment to Concrete Construction

1. Concrete Insert: MSS SP-69, Type 18

2. Self-Drilling Expansion Shields and Machine Bolt Expansion Anchors: Fed. Spec. FF-S-325, permitted in concrete not less than four inches thick. Applied load shall not exceed one-fourth the proof test load listed in Fed. Spec. FF-S-235.

3. Power-Driven Fasteners: Permitted in existing concrete or masonry not less than four inches thick when approved by the Architect/ Engineer for each job condition. Use fasteners capable of supporting a 1000 pound test load, with the actual load not exceeding 50 pounds.

D. For Attachment to Steel Construction; MSS SP-69:

1. Welded Attachment: Type 22.

2. Beam Clamps: Types 20, 21, 23, 28 or 29.

E. Attachment to Metal Pan or Deck: As required for materials specified in Section METAL DECKING.

F. Hanger Rods: Hot-rolled steel, ASTM A 36 or A 575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turnbuckles shall provide 1-1/2 inches minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.

G. Multiple (Trapeze) Hangers: Galvanized, cold formed, lipped steel channel horizontal member, not less than 1-1/2 inches by 1-1/2 inches, No. 12 gage, designed to accept special spring held, hardened steel nuts. Not permitted for steam supply and condensate piping, fire and sprinkler piping, or chemical waste drain piping.

1. Allowable Hanger Load: Manufacturers rating less 200 pounds.

2. Guide individual pipes on the horizontal member of every other trapeze hanger with 1/4-inch U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 2-inch galvanized steel bands, for insulated piping at each hanger.

H. Pipe Hangers and Supports: Use hangers sized to encircle insulation on insulated piping. Refer to Section 15250, HVAC INSULATION, for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports. Provide Type 40 insulation shields at all other types of supports and hangers including those for pre-insulated piping.

1. General Types (MSS SP-69):

a. Standard Clevis Hanger: Type 1; provide locknut.
b. Riser Clamps: Type 8 or 42.
c. Wall Brackets: Types 31, 32, or 33.
d. Roller Supports: Type 41, 43 and 46.
e. Saddle Support: Type 36, 37, or 38.
f. Turnbuckle: Types 13 or 15.
g. U-Bolt Clamp: Type 24.
h. For Uninsulated Copper Tube: Material compatible for use with copper to prevent electrolysis.
i. Supports for Plastic or Glass Piping: As recommended by the pipe manufacturer.

2. HVAC Piping:

a. Spring Supports (Expansion and Contraction of Vertical Piping):

(1) Movement up to 3/4-Inch: Type 51 or 52 variable spring unit with integral turnbuckle and load indicator.

(2) Movement more than 3/4-Inch: Type 54 or 55 constant support unit with integral adjusting nut, turnbuckle, and travel position indicator.

3. Plumbing Piping:

a. Sprinkler System: NFPA or Factory Mutual approved types.
b. Horizontal Piping: Types 1, 5, 7, 9, and 10.
c. Chrome Plated Piping: Chrome plated supports.
d. Hangers and Supports in Pipe Chase: Prefabricated system ABS self-extinguishing material, not subject to electrolytic action, to hold piping, prevent vibration, and compensate for all static and operational conditions.
e. Blocking, Stays and Bracing: Angle iron or preformed metal channel shapes, 18 gage minimum.

2.06 PIPE SLEEVES:

A. Locate sleeves during normal course of work. Provide sleeves for piping and conduit passing through concrete floor slabs and concrete, masonry, tile, and gypsum wall construction. Sleeves shall not be provided for piping and conduit running embedded in concrete or slab on grade, except that copper piping shall require sleeves through slabs on grade. Sleeves through structural members shall be only as directed by Architect. In interior wall, provide 1/4 inch space all around between sleeve and conduit, piping, or insulation of piping.

B. Sleeves placed in exterior walls below grade shall be O.Z. Gedney Type 'FSK' or equal, Thunderline 'LINK SEAL', or equal sleeve assemblies sized for the pipe or conduit encountered, except for cast iron piping. Sleeve assembly shall provide watertight seal and electrical insulation to reduce cathodic reaction. When a sleeve passes through a wall below a concrete slab on grade, the sealing assembly shall be on the outside of the wall. When a sleeve passes through a wall into a crawl space or the building interior, the sealing assembly shall be in the crawl space or interior of the building. Provide sleeve assembly for copper piping through slab on grade, with sealing assembly located on interior side of floor slab. Where cast iron pipes pass through an exterior wall below grade, provide an iron-pipe sleeve two (2) pipe sizes greater than pipe passing through. Caulk between pipe and sleeve with a rubber-based compound.

C. Where sleeves are located through fire-rated walls and floor/ceiling assemblies, provide sleeves and protect the penetration in accordance with Underwriter's Laboratories, Inc., Fire Resistance Directory, Volume II, Ratings for Through Firestop Penetrations.

D. Sleeves in mechanical rooms with floor drains or hose bibbs shall extend 4 inches above floor. Provide flanges or flashing rings with sleeves in floors with waterproof membrane and clamp or flash into the membrane. Provide sleeves flush with floor in other rooms.

E. Sleeves shall be constructed of 20 gage galvanized sheet steel with lock seam joints for all sleeves set in concrete floor slabs terminating flush with the floor. All other sleeves shall be constructed of galvanized steel pipe unless otherwise indicated.

F. Fasten sleeves securely in floors or walls so that they will not become displaced when concrete is poured or when other construction is built around them. Take precautions to prevent concrete, plaster, or other materials from being forced into the space between pipe and sleeve during construction.

2.08 ACCESS PANELS:

A. Under each applicable section of the detailed mechanical specifications, the Contractor shall provide access panels in all locations where required for access to concealed valves, traps, air cushions, controls, dampers, damper operators, junction boxes, and any other equipment or materials requiring inspection or maintenance. Access panels shall be of adequate size and properly located so that concealed items will be readily accessible for servicing or for removing and replacing if necessary, except as indicated or specified otherwise. Access panels are not required in ceilings formed of removable acoustical panels.

B. Access panels that are not fire-rated shall be Milcor or equal. Provide modular-sized access panels in inaccessible acoustic tile ceilings sized according to the tile size. Provide Milcor metal access panels with cam lock and mounting trim to match finish encountered. Provide natural anodized aluminum finish for panels in kitchens and toilets. Provide prime finished steel for panels in other areas. Paint panels in finished areas to match finish surface.

C. Where indicated and where access panels are installed in walls of shafts that are not sealed at each floor, access panels shall be Milcor or equal "Fire-Rated" and shall bear the Underwriters' Laboratories, Inc. Class B, 1-1/2 hour label. Openings shall be framed in accordance with the access panel manufacturer's recommendations. Frames shall be not lighter than 16-gage steel. Panels shall be not lighter than 20-gage steel and shall be insulated sandwich type. Panels shall have a continuous hinge, self-lubricating lock, a direct action-knurled knob, and an interior latch release mechanism.

2.07 CHARTS, DIAGRAMS, AND SCHEMES:

A. Charts, diagrams, and schemes listed below shall be provided under each applicable section of the detailed mechanical specifications by the Contractor, framed under glass, and installed where shown on the drawings or directed in the field. All charts, diagrams, and schemes shall be complete, neat, clear, legible, and permanent.

B. Electric sequence control diagrams of all mechanical system components.

C. Automatic temperature control diagrams identified as to name, sequence of operation, location, function, temperature setting, spring range, and manufacturer's part number.

D. Valve identification chart with typewritten schedule of all valves giving their tag number, description, system served, and normal operation position.

E. Piping schemes where required by the detailed specifications.

2.08 CATALOG DATA FOR OWNER:

A. Furnish one (1) bound copy of Catalog Data on each manufactured item of equipment used in the mechanical work, complete with index listing the products alphabetically by name, together with the names and addresses of manufacturers, sales, and service representatives. Furnish two (2) bound copies of Operating and Maintenance Instructions of each item of equipment. Catalog Data and Operating and Maintenance Instructions shall be submitted to the Engineer for review prior to transmittal to the Owner.

2.09 RECORD OF AS-BUILTS AND CONDITIONS:

A. Provide a complete set of prints of mechanical plans marked to indicate as-built conditions which are different from those shown on the original construction documents. Site as-built conditions which are different from the construction documents shall be dimensioned from building or identifiable marker. Accurate locations of all concealed utility lines, both interior and exterior shall be recorded. These drawings shall be delivered to the Architect/Engineer before being turned over to the Owner.

2.10 ASBESTOS:

A. It is the intention of these Drawings and Specifications that there be no asbestos containing materials installed on this project.

B. Existing Conditions:

1. The Contractor shall review the Owners asbestos management plan prior to demolition and construction to identify the location of existing asbestos containing materials under surveillance.

2. Any suspect material encountered during demolition or construction shall result in stop work and immediate notification of the Owner's representative. The Owner is responsible for any asbestos removal.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Coordination of Work:

1. The Contractor shall compare the mechanical drawings and specifications with the drawings and specifications of other trades, and shall report any discrepancies between them to the Architect/Engineer, and shall obtain from him written instructions for changes necessary in the mechanical work. The mechanical work shall be installed in cooperation with other trades installing interrelated work. Before installation, the Contractor shall make proper provision to avoid interferences in a manner approved by the Architect/Engineer. All changes required in the work of the Contractor caused by his neglect to do so shall be made by him at his own expense.

2. Anchor bolts, sleeves, inserts, and supports that may be required for the work shall be fully coordinated and compatible with the related equipment or materials. Locations shall be determined by the trade installing the related equipment or materials.

3. Slots, chases, openings, and recesses through floors, walls, ceilings, roofs, and partitions shall be located by the trades requiring them.

4. Locations of pipes, ducts, equipment, fixtures, etc., shall be adjusted to accommodate the work to interferences anticipated and encountered. The installing Contractors shall coordinate their work to the building structure and to other trades as directed by the General Contractor. No additional compensation or extension of completion time will be granted for extra work caused by a lack of coordination. The installing Contractor shall provide dimensions and locations of all openings, shafts, and similar items to the General Contractor for his coordination and execution. Work shall be installed as required so as not to interfere with or delay the building construction. Pipes, ducts, etc., shall be concealed above ceilings, in walls, or

in floors as applicable in all areas of the building except in equipment rooms, unfinished storage rooms, or other areas specifically noted to the contrary.

a. Right-of-Way: Lines which pitch shall have right-of-way over those which do not pitch. For example, plumbing drains shall normally have right-of-way. Lines whose elevations cannot be changed shall have the right-of-way over lines whose elevations can be changed.

b. Offsets, transitions, and changes in direction of pipes and ducts shall be made as required to maintain proper head room and pitch of sloping lines whether or not indicated on the drawings. The Contractor shall furnish and install all traps, drains, air vents, sanitary vents, etc., as required to affect these offsets, transitions, and changes in direction.

5. Exact locations of items such as diffusers, grilles, thermostats, hose bibbs, wall hydrants, and other similar items in finished areas of the building and on the exterior of the building shall be coordinated with each other, the building structure, and architectural features thereof so as to be aligned with or centered on other items as applicable. Locations indicated on the drawings are approximate. Trades shall coordinate their work with door swings, block coursing, tile arrangement, and other similar features before establishing the location of any components. Before any related work has begun, the Architect/Engineer may direct reasonable minor changes in equipment locations with no increase in contract price to the Owner. Thermostats shall be mounted so that the top of the thermostat is 48" above the floor and aligned with the top of the light switch plates and 8" from the light switch if shown on the drawings adjacent to a light switch. Room thermostat locations shall be coordinated with door swings, light switches and other wall mounted items. Corridor thermostats shall be mounted 60" above finished floor. Before roughing in conduit or pipe, verify the location of equipment to be connected.

6. Installation and Arrangement: The Contractor shall install all mechanical work to permit removal of coils, heat exchanger bundles, boiler tubes, sheaves and drives, and all other parts requiring periodic replacement or maintenance. The Contractor shall arrange pipes and equipment to permit ready access to valves, cocks, traps, motors, control components, and to clear the openings of swinging and overhead doors and of access panels.

7. Ductwork: The Contractor shall change the cross-sectional dimensions of ductwork when required to meet job conditions but shall maintain at least the same equivalent cross-sectional area. The Contractor shall secure the approval of the Architect/Engineer prior to fabrication of ductwork requiring

substantial changes. Ductwork shall not be fabricated until coordination with available space.

8. Drawings by Contractor: When directed by the Architect/Engineer, the Contractor shall submit for review by Architect/Engineer drawings clearly showing certain portions of the mechanical work and its relation to the work of other trades before beginning shop fabrication or erection in the field.

9. Dimensions: The Contractor shall ensure that items to be furnished fit the space available. He shall make necessary field measurements to ascertain space requirements, including those for connections, and shall furnish and install such sizes and shapes of equipment that the final installation shall suite the true intent and meaning of the drawings and specifications. If he concludes that there is insufficient space for installation or specified materials, he shall immediately notify the Architect/Engineer of the conflict and shall stop affected work until he receives instructions as to how to proceed from the Architect/Engineer.

10. Damage to Work: The Contractor is responsible for damage caused by his work or workmen. Repairing of damaged work shall be done by the Contractor as directed by the Engineer at no additional cost.

11. The Contractor shall be responsible for any interruptions to existing services and shall repair any damages to existing systems caused by his operations.

B. Protection and Cleaning:

1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations. Damaged or defective items, in the opinion of the Architect/Engineer, shall be replaced.

2. All items subject to moisture damage (such as controls and electrical equipment) shall be stored in dry, heated spaces.

3. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water, chemical or mechanical injury. Clean mechanical equipment to remove dust, oil, dirt, plaster, mortar, trash, or paint. Piping, conduit, and ductwork shall be blown out or flushed of all foreign matter before wires are pulled in or before connections are made to equipment or systems. Clean each boiler in accordance with manufacturer's instructions before connecting to the system.

Provide temporary filters for air units that are operated during construction. After all construction dirt has been removed from the building, install new filters in air units.

C. Install gages, thermometers, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gages to be easily read by operator standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.

D. Work in Existing Buildings:

1. Cut required openings through existing masonry and reinforced concrete using diamond core drills. Use of pneumatic hammer type drills, impact type electric drills, and hand or manual hammer type drills will be permitted only with approval of the Architect/Engineer. Locate openings that will least effect structural slabs, columns, ribs or beams. Refer to the Architect/Engineer for determination of proper design for openings through structural sections and opening layouts approval, prior to cutting or drilling into structure. After Architect/Engineer's approval, carefully cut opening through construction not larger than is absolutely necessary for the required installation.

2. Remove existing work as necessary to install new work. Except as otherwise shown or specified, do not cut, alter or remove any structural work or any plumbing, gas or electric work without approval of Architect/Engineer. Existing work (walls, ceilings, partitions, floors, mechanical, and electrical work) disturbed or removed as a result of performing required new work shall be patched, repaired, reinstalled, replaced with new work, and refinished and left in as good condition as existed before commencing work. Existing work to be altered or extended that is found to be defective in any way shall be reported to the Architect/Engineer before it is disturbed. Materials and workmanship used in restoring work shall conform in type and quality to that of original existing construction, except as otherwise shown or specified.

3. Continuity of service shall be maintained to all existing systems, except for designated short intervals during which connections are to be made. Interruptions shall be coordinated with the Owner as to the time and duration.

4. Upon completion of contract, deliver work complete and undamaged. Damage that is caused by Contractor or Contractor's workmen to existing structures, grounds, or utilities or to work done by others shall be repaired by Contractor and left in as good condition as existed prior to damaging.

a. At Contractor's own expense, Contractor shall immediately restore to service and repair any damage caused by Contractor's workmen to existing piping and conduits, wires, cable, etc., of utility services or of fire protection system and communications systems (except telephone) which are not scheduled for discontinuance or abandonment.

b. Restoration work required by damage to telephone systems shall be done by telephone company at Contractor's expense.

3.02 PIPING:

A. Under each applicable section of the detailed mechanical specifications, the Contractor shall furnish and install as shown on the drawings or as necessary to complete the working system in accordance with the intent of the drawings and specifications, a complete system of piping, valves, supports, anchors, sleeves, and all other 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 of responsibility for the proper erection of systems of piping in every respect suitable for the work intended as described in the specifications and as approved by the Architect/Engineer. Wherever two dissimilar metals join in any piping system, install a dielectric fitting at their intersection.

B. Installation: Piping shall be properly supported and adequate provisions shall be made for expansion, contraction, slope, and anchorage without damage to joints or hangers. All piping shall be cut accurately for fabrication to measurements established at the construction site. Pipe shall be worked into place without springing and/or forcing, properly clearing all windows, doors, and other openings and equipment. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted without written approval. Pipe extending through the roof shall be properly flashed. All changes in direction shall be made with fittings. Wherever pipe hanger bears directly on the pipe being supported, the hanger shall be of the same material as the pipe.

C. Arrangement: All piping shall be arranged so as not to interfere with removal of other equipment or devices nor to block access to doors, windows, manholes, or other access openings. Piping shall be arranged so as to facilitate removal of tube bundles. Flanges or unions, as applicable for the type of piping specified, shall be provided in the piping at connections to all items of equipment. Piping shall be placed and installed so that there will be no interference with the installation of the equipment, ducts, etc. All piping shall be installed to ensure noiseless circulation. All piping shall be erected and pitched to ensure proper drainage. Piping shall be installed so as to avoid liquid or air pockets throughout the work. Pipe in finished areas shall be

concealed. Exposed piping shall be installed in practical alignment with the building. All valves and specialties shall be placed to permit easy operation and access, and all valves shall be regulated, packed, and glands adjusted at the completion of the work before final acceptance. Water pipes shall not be installed in attic spaces, crawl spaces or similar areas which are subject to freezing, unless indicated to be heat traced.

3.03 PIPE AND EQUIPMENT SUPPORTS:

A. Supports: The Contractor shall support plumb, rigid, and true to line all work and equipment furnished under each section of these specifications. The Contractor shall study thoroughly all general, structural, and mechanical drawings, shop drawings, and catalog data to determine how equipment, fixtures, piping, ductwork, etc., are to be supported, mounted, or suspended, and shall provide extra steel bolts, inserts, pipe stands, brackets and accessories for proper support, whether or not shown on the drawings. When directed, the Contractor shall submit drawings showing supports for review by the Architect/Engineer.

B. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Drill or burn holes in structural steel only with the prior approval of the Architect/Engineer.

C. Use of chain, wire or strap hangers; wood for blocking stays or bracing; or hangers suspended from piping above will not be permitted. If products are rusty, replace or thoroughly clean and coat with prime paint.

D. Use hanger rods that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. Provide a minimum of 2-inch clearance between pipe or pipe covering and adjacent work.

E. Horizontal Pipe Support Spacing:

1. Cast Iron: Five feet on centers maximum spacing. At least one hanger on each full length of pipe, close to hub where possible and at least one within 24 inches of each fitting, and wherever else required to prevent tendency toward deflection due to load. Provide a hanger at upper angle at each drop. Locate hangers adjacent to hubs on multiple fittings not more than four feet on centers.

2. Plastic and Glass Pipe: Support in accordance with manufacturer's recommendations.

3. For support spacing of all other horizontal piping, refer to MSS SP-69 and provide additional supports at valves, strainers, inline pumps and other heavy components. Provide a support within one foot of each elbow.

F. Vertical Pipe Supports:

1. Plumbing

a. Cast Iron Stacks: Base of stacks shall be supported on concrete, brick in cement mortar, or metal brackets permanently attached to building structure. Support stacks on each building floor structure, but not to exceed 15 feet spacing.

2. HVAC

a. Vertical runs less than 15 feet long may be supported by the hangers on the connecting horizontal runs.

b. Up to 6-Inch Pipe, 60 Feet Long or Not Over 12-Inch Pipe Up to 30 Feet Long: Riser clamps bolted to pipe below couplings, or welded to pipe and resting securely on the building structure.

c. Vertical pipe larger than the foregoing, support on base elbows or tees, or substantial pipe legs extending to the building structure.

G. Connections: All piping connecting to pumps and other equipment shall be installed without strain at the piping connection. The Contractor shall be required as directed to remove the bolts in flanged connections or to disconnect piping to demonstrate that piping has been so connected.

3.04 MOTOR AND DRIVE ALIGNMENT:

A. Belt Drive: Set driving and driven shafts parallel and align so that the corresponding grooves are in the same plane.

B. Direct-Connect Drive: Securely mount motor in accurate alignment so that shafts are free from both angular and parallel misalignment when both motor and driven machine are operating at normal temperatures.

3.05 CUTTING AND PATCHING:

A. The Contractor shall be responsible for all required digging, cutting, etc., incident to the work, and shall thereafter make all required repairs necessary to restore the cut structure or material to the condition existing prior to the cutting. In no case shall the

Contractor cut into any major structural element, beam, or column without the written approval of the Architect/Engineer. All cutting, patching, repairing, or replacing of work required because of fault, error, tardiness, or damage by any trade shall be performed with no increase in the contract price to the Owner.

3.06 LUBRICATION:

A. Under each applicable section of the detailed mechanical specifications, the Contractor shall provide all oil and grease required for the operation of all equipment until acceptance by the Owner. The type and application of all lubricants shall conform to the recommendations of the manufacturer of the equipment involved. The Contractor shall be held responsible for all damage to bearings while the equipment is being operated by him up to the date of acceptance of the project. This Contractor shall be required to protect all bearings during installation and shall thoroughly grease or otherwise protect steel shafts and other bare ferrous parts to prevent corrosion. All equipment shall be provided with covers as necessary for proper protection against damage or deterioration during construction.

3.07 OPERATING AND PERFORMANCE TESTS:

A. Prior to the final inspection, perform required tests as specified in Section 15990, TESTING, ADJUSTING AND BALANCING FOR HVAC, and submit the test reports and records to the Architect/Engineer.

B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Owner.

C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests for heating systems and for cooling systems respectively during first actual seasonal use of respective systems following completion of the work.

3.08 QUIET OPERATION AND VIBRATION:

A. Systems shall operate under conditions of load without unusual or excessive noise or vibration. Unusual or excessive noise or vibration shall be corrected.

3.09 INSTRUCTIONS TO OWNER'S PERSONNEL:

A. Under each applicable section of the detailed mechanical specifications, the Contractor shall instruct the representative of the Owner in the proper operation and maintenance of all elements of the mechanical systems. A competent representative

of the Contractor shall spend not less than two days in such formal instruction and shall spend such additional time as directed by the Architect/Engineer to fully prepare the Owner to operate and maintain the mechanical systems. The Contractor shall provide letter of instruction upon completion to the Architect/Engineer stating the date of instruction and the names of those in attendance.

3.10 GUARANTEE:

A. All mechanical equipment, materials, and labor required by the contract documents for this project shall be guaranteed to be free of defective materials or workmanship for a period of one year after final acceptance of the project. Defects in equipment, materials, or workmanship occurring during this period shall be corrected with new equipment and materials or additional labor at no cost to the Owner.

3.11 SITE VISIT REPORT:

A. Answer in writing each item of discrepancy noted on all site visit reports.

3.12 DEMOLITION:

A. Contractor shall visit the site before bidding to determine the extent and location of demolition to be performed.

B. Contractor to remove all pipes, ducts, equipment, controls, etc. not required, reused or needed for reconnecting to the new systems. All items not required for the new system shall be removed.

C. The Owner shall select and retain such existing items indicated or required to be removed as he desires. Items selected by the Owner to be retained shall be removed and relocated to an Owner designated location by the Contractor. The existing Electric and Gas Fired Boilers indicated to be removed shall become the property of the Contractor (including salvage value) and shall be removed from the premises.

D. All equipment, piping, ductwork, conduit, etc. to remain and be reused shall be protected from damage. Any damage to existing material shall be repaired to original condition.

E. Coordinate all demolition activities with the phasing of construction. Demolition shall not affect operations of the building.

3.13 PHASING OF WORK:

A. The mechanical contractor is required to fully understand the phasing of work and to coordinate his work according to phasing plan drawings and related sections of the specifications.

B. Sections of the existing building will continue to be occupied during renovation. The contractor shall be responsible for retaining existing HVAC systems to serve the occupied sections of the building. Otherwise, the contractor shall provide interim HVAC systems for the occupied sections of the building.

C. The contractor is cautioned to fully understand the need to operate HVAC systems during construction and to block off ductwork serving areas under construction. Protect return ductwork with temporary filters at air inlet grilles, etc.

D. Provide temporary HVAC to protect the owner's property from freeze damage and from high humidity. For new construction, provide HVAC for proper drying and application of finishes.

E. Portions of the renovated building will be reoccupied as sections of renovation become complete. The contractor shall be responsible for providing HVAC for the reoccupied sections of building.

END OF SECTION