

SECTION 23 00 00

HEATING, VENTILATING AND AIR CONDITIONING

PART 1 – GENERAL

1.1 GENERAL

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. All work shall be in accordance with state and local codes and SED regulations.
- C. HC shall be a firm regularly engaged in the installation of heating, ventilating and air conditioning systems for a period of at least five (5) years and shall have the licenses and certificates required by local, county and state regulations. License/Certificate holder shall be an officer of the firm and have a minimum of five (5) years employment with the firm.
- D. HC shall apply for, obtain and pay for any required permits.
- E. Refer to Section 23 50 00 for Supplementary Conditions for Mechanical and Electrical Work, the requirement of which are part of the Work.
- F. All materials shall be new and without blemish or defects.
- G. Cutting and patching shall be in accord with Section 23 50 00.
- H. Refer to Section 23 50 00 for Coordination Drawing requirements.
- I. HC shall become familiar with drawings of other trades to understand work of other trades and its impact/effect on the HVAC work.
- J. All electrical components shall bear a UL label.
- K. HC shall provide Owner with invoices and other data required for utility rebates.
- L. HC shall fire-stop openings around pipes and ducts passing through floors and walls. Refer to Penetration Firestop System section of the specifications for materials and methods.
- M. The following abbreviations shall apply:

GC - Contractor for General Construction
PC - Plumbing Contractor
FPC - Fire Protection Contractor
HC - Heating (HVAC) Contractor
EC - Electrical Contractor
KEC – Kitchen Equipment Contractor

1.2 QUALITY ASSURANCE

- A. Requirements given herein may be affected by other related requirements of the project specifications. Correlation of contract re-counted is the responsibility of the Contractor.
- B. All HVAC Work on this project shall be governed by this Specification.

1.3 SCOPE OF WORK

- A. HC shall provide all labor, material and appliances required for a complete heating and ventilating installation as shown on Drawings and hereinafter specified, including but not limited to the following principal items:
 - 1. Piping, Fittings, Valves
 - 2. Miscellaneous Water Specialties
 - 3. Sheet Metal Work
 - 4. Insulation and Covering
 - 5. Foundations, Supports, Sleeves and Plates
 - 6. Shop Drawings
 - 7. Start-up, Tests and Adjustments
 - 8. Heat Pump Systems
 - 9. Condensing Boilers
 - 10. Circulating Pump
 - 11. Wall Heaters
 - 12. Unit Heater
 - 13. Exhaust Fans
 - 14. Diffusers, Registers and Grilles
 - 15. Electric Motors, Motor Controllers and Wiring
 - 16. Automatic Temperature Controls
 - 17. Alternate Building Management System (BMS)
 - 18. Guarantee

1.4 WORK IN CONNECTION WITH OTHER TRADES

- A. The following principal items of work will be done under other Sections of these Specifications.
 - 1. Electric Wiring: HC shall furnish motor starters, controls and other electrical equipment as specified and deliver same to EC at job site for installation. EC shall provide all disconnect switches, fuses and wiring. All equipment, trim and controls furnished by others required to be mounted by HC shall be furnished to him for mounting.
 - 2. Responsibility: HC shall be held responsible for correct installation and operating of all material furnished by him under this contract whether or not equipment is installed by him.

1.5 MISCELLANEOUS WATER SPECIALTIES

- A. Expansion Tank: Provide diaphragm expansion tank of size and capacity as shown on drawings. Tank to be constructed for (125 psig) working pressure and to be guaranteed leak proof by manufacturer. Tank to be stamped with "U" symbol and Form U-1 furnished denoting compliance with paragraph U-69 for Construction of Unfired Pressure Vessels Section VIII ASME.
- B. Airtrol Fittings: Provide Airtrol fittings as indicated on drawings. Fittings shall be manufactured by Bell & Gossett or equivalent.
- C. Air Vents: Provide at all high points to eliminate air binding. Use automatic air vents in Boiler Rooms and Equipment Rooms. All automatic air vents shall be approved heavy duty type equipped with tubing and pet cocks for manual venting. All other vents shall be of the manual key operated type. All vents concealed from view shall be accessible through access doors. Vents shall be by Hoffman, Anderson or Bell & Gossett, and unless otherwise noted shall be designed for 125 psig working pressure.
- D. Pressure Relief Valves: Provide pressure relief valves on all systems as shown and/or required by code. Relief valves shall be 125 lb. cast iron body with bronze trim. Drains shall be piped from valves to sump pit or floor drains in Boiler Room. Pressure relief valves shall be Bell & Gossett, Cash or Mueller.
- E. Pressure Reducing Valves: Provide pressure reducing valves on each system when connecting to service water line. Provide check valves and shut off gate valves ahead of reducing valves. Reducing valves shall be Bell & Gossett, Cash or Mueller.
- F. Pressure Gauges: Provide pressure gauges on suction and discharge sides of each pump and as required to check the operation of equipment; pressure gauges shall have 4 ½" diameter dials. Ashton, Ashcroft or approved equal.
- G. Thermometers: Provide thermometers at all locations in piping system as noted on plans and as required to check system performance. Thermometers shall be installed before and after each coil, for each air conditioning unit and on each supply, return fresh air ducts. Mueller, Taylor or Tagliabue, with 9" face 6" well, mercury filled. Provide separable sockets for all thermometers.
- H. Expansion Joints and Flexible Connections: Except as noted, flexible connections shall be provided at the suction and discharge of each circulating pump. Expansion joints shall be provided on each long run of pipe in the amount of approximately one per 40 feet of run; additional joints may be required depending upon the particular conditions to provide adequate piping support. Expansion loops may be used in lieu of joints but are subject to approval as to length and width. Joints shall be of the corrugated compensator type as manufactured by Flexonics Corporation, Maywood, Illinois or approved equal.

1.6 PIPING, FITTINGS, VALVES

- A. Piping:

1. Circulating Hot Water, and Cold-Water Make-Up Piping: Copper tubing, Type "L" hard temper for 2 ½" and smaller, soldered joints.
2. As an alternating for piping 2" and smaller Uponor straight length PEX-A joined with Uponor Pro Pex expansion fitting maybe used for mains and listed Uponor Pex-a tubing joined with Pro Pex expansion fitting may be used for branches. Piping connection to equipment to be Type A Copper except in Mezzanine.
3. Piping run under slabs shall be PEX tubing installed with Armaflex insulation. Runs shall be continuous without joints or fittings below the slab.
4. Condensate Drain Piping: Copper tubing, Type "M", hard temper with soldered joints using DWV fittings.
5. Refrigerant Piping: Type ACR copper tubing with brazed joints, up to branch box and line sets from branch box to heat pump unit. Piping to comply with ASTM B 280. All joints to be brazed.
6. Piping for VRF system to have brazed joints.
7. Line set piping to be labeled to identify unit served and neatly bundled.
8. All solder shall be Silverbrite, lead-free.

B. Fittings

1. All fittings for copper tube shall be wrought copper joined using Silverbrite lead-free solder. Unions of brass pattern shall be used as required to facilitate the removal of equipment or accessories in connection with copper tube. Flanges shall be used on connections greater than 2". Fittings to be in accordance with ASME B16.18

C. Valves

1. Provide shut-off valve to isolate each item of equipment for maintenance service and replacement, provide balancing valve or cock to adjust flow.
2. Valves for pipe sizes of 2 ½" or less shall be Apollo 70-200 or Milwaukee Series 150, for sizes 3" and larger Milwaukee Series C, lug type butterfly valves shall be provided.
3. Balancing valves shall be of Victaulic, Model 78K head cock type. Provide custodian with at least two operators use with balancing valves. Balancing valves shall be the same size as the adjacent piping.
4. Check valves shall be of the horizontal swing check type with brass or bronze working parts and removable disc except where lift check valves shall be used on the discharge side of circulating pumps.;
5. Where combination shut off and balancing valves noted on plans, provide a shut-off valve and a Bell & Gossett circuit setter.
6. Valves for chilled piping to have extended stems to permit installation of full thickness insulation.

D. Dielectric Fittings:

1. Piping connections between dissimilar metals shall be made with dielectric fittings or insulating fittings to prevent electrolytic corrosion. Dielectric fittings shall be of the screwed union type as manufactured by EPCO.

E. General Piping

1. Run, arrangement, position, connections, etc., of equipment and materials shown on the Drawings shall be taken as a close approximation to a true position and, while they shall be followed as closely as possible, right is reserved to change locations, etc., to accommodate any condition which might arise during progress of the work without additional compensation to Contractor for such changes.
2. Runs shall be straight and direct, forming right angles or parallel lines with building walls and other pipes, and be neatly and evenly spaced. Offsets will be permitted only where necessary to allow pipes to follow walls.
3. Responsibility for accurately laying out work rests with Contractor. Should interference occur, the Engineer's decision shall be final. Where so shown or required, piping shall be concealed in building walls or above ceilings.
4. Horizontal runs, except where concealed in partitions shall be kept as high as possible and close to walls. Cooperate with other trades that grouped lines will not interfere with each other.
5. Contractor shall take special care in supporting pipe to provide for expansion and venting. Pockets and traps shall be avoided but where required, shall be provided with drains. Provide air vents at all high points.

1.7 PIPING IDENTIFICATION, CODING AND PAINTING

- A. All piping in Boiler, Fan, Storage and Equipment Rooms and all piping above accessible ceiling shall be coded and identified as herein specified.
- B. Apply color-coded polyvinyl chloride pipe bands identifying pipe contents and direction of flow.
- C. Apply bands on 15' centers on piping in Equipment Rooms and 25' elsewhere on straight runs; at valve locations at point where piping enters and leaves a partition, wall, floor or ceiling.
- D. Apply bands at exit and entrance points to each vessel, tank or piece of equipment.
- E. Bands width shall be 8" for pipes up to 10" diameter and 16" wide for larger diameter piping. Letter heights stating service shall be preprinted on band, 3/4" high for 16" bands.
- F. For insulated pipes, apply bands after insulation and painting work has been completed.
- G. Provide 4 additional bands of each type for future use by Owner's personnel.
- H. Follow manufacturer's instructions for application procedures using noncombustible materials and contact adhesives.
- I. All piping shall be color coded in full accordance with ANSI 13.1, 1981 Standards. Pipe markers shall be as manufactured by Seton Name Plate Corp., or equivalent.
- J. All piping which is not insulated, tanks and equipment in Boiler Rooms shall be painted. Equipment provided with a factory finished coating shall be cleaned and touched up as necessary. Equipment provided with a factory primer shall be given two (2) coats of enamel paint after installation. Pipes, hangers, support and equipment shall be primed

and given two (2) coats of enamel paint. Color for piping and tanks shall be in accordance with ANSI 13.1, 1975 Standard, color of equipment and supports shall be as directed by Architect.

1.8 SHEET METAL WORK

- A. Provide all sheet metal work for all systems shown on Drawings, including all required register boxes, diffuser collars, balancing dampers, fire dampers, and auxiliary work necessary to make the various system complete and ready for satisfactory operations.
- B. Except as noted, all sheet metal for systems shall be fabricated of galvanized steel. Galvanized sheet metal shall be of the best grade. Ducts shall be constructed, braced and reinforced and of a gauge thickness in accordance with SMACNA Duct Manual, latest Edition.
- C. Duct sealant to be UL181 A-M B-M listed
- D. Galvanizing must not peel or crack and surfaces must be smooth and free of foreign matter.
- E. Round and flat oval ductwork shall be factory fabricated, spiral galvanized, Semco or equivalent. Thickness shall be one gauge heavier than standard. Fittings shall be factory fabricated continuous weld galvanized steel; Semco, Accuflange or equivalent, thickness to be 20 gauge minimum. Duct and fittings to include SEMCO Powder coating. Color as per Architect include matching screws and accessories. Gymnasium: single wall ductwork and fitting.
- F. Outside air ductwork shall be of aluminum construction.
- G. Boiler and water heater vent and intake to be sized and installed pursuant to manufacturer's installation instructions
- H. Any duct connections made with holes or open corners shall be opened and redone or soldered tight at the discretion of the Architect. No caulking compound shall be used to cover imperfect workmanship. Panels shall be cross-creased for stiffness and supported with braces, ties and angles to prevent buckling.
- I. All Ductwork: Provide suitable balancing dampers as shown on Drawings or as required for proper distribution and balancing of airflow.
- J. Dampers shall be of the multiblade type unless otherwise indicated, with quadrants and locking devices. Furnish and install a splitter damper or butterfly damper at each branch takeoff.
- K. Outside air and shutoff dampers shall be Class 1 motorized dampers with an air leakage rate not greater than 4 cfm/ft² of damper surface area at 1.0-inch water gauge and shall be labeled by an approved agency when tested in accordance with AMCA 500D for such purpose. Outdoor air intake and exhaust dampers shall be installed with automatic controls configured to close when the systems or spaces served are not in use or during unoccupied periods except when used for economizer cooling.

- L. Double radius turning vanes shall be provided in all square elbows.
 - M. Flexible ductwork shall be insulated, UL181 listed Class 1, length of runs shall not exceed 4'-0", and runs shall not pass-through walls or partitions. Connections to rigid ductwork and diffusers shall be double banded. Thermaflex flex flow elbows shall be provided at all diffuser connections. Flexible ductwork shall not be used for return or exhaust service.
 - N. Access doors shall be provided in all casings and ductwork for access to coils, and filters, dampers, fresh air intakes and all other such equipment and locations requiring maintenance or periodic inspection. Where doors are installed in insulated casings, or ducts, these doors shall be double thick steel with an insulated core. Access doors shall have continuous piano hinges and slide bar bolt locks with gasketed edges. Furnish ceilings and wall access doors for access to heating and ventilating equipment as specified.
 - O. Acoustic Lining:
 - 1. Acoustic liner shall be fiber free, Armaflex sheets.
 - 2. Installation shall be in accord with manufacturer recommendations.
 - P. Dishwasher exhaust duct shall be aluminum. Provide drains at low point and at fans. Extend drains to floor drain with PVC pipe and fittings.
 - Q. Louvers will be provided by HC.
 - R. Clothes dryer exhaust duct to be aluminum. Provide cleanouts at each side of booster fans and at changes in direction.
 - S. Boiler and water heater vents and intakes to be factory fabricated stainless steel, listed system.
 - T. Kitchen hood exhaust duct shall be 16 gauge black iron with all welded construction. As an alternate, UL listed double wall insulated stainless steel ducts maybe used.
- 1.9 UNDER FLOOR DUCTWORK
- A. Under floor ductwork shall be Blue Duct, HDPE duct as manufactured by AQC industries.
 - B. Under Floor Duct System
 - 1. Complete duct system (including: plenums, round duct, run-out, diffusers boots, etc) must be from one manufacturer and be the same material, construction and connection method throughout. Field made duct components are NOT acceptable.
 - 2. Include the complete underground duct system including plenums.
 - 3. Unless otherwise noted, all duct and fittings shall be constructed per SMACNA's Duct Construction Standards (+10= w.g.).
 - 4. Provide elbows, duct, diffusers, plenum, clamp & gasket, boots, saddle registers and caulk as required for underground installation.

5. Ductwork shall be closed cell plastic material that is recyclable, does not emit volatile organic compounds, and conforms to ASTM-D2412. Ductwork shall be resistant to mildew, mold (UL 181B), and radon gas (BSS 7239-88). Ductwork shall not rust or crack under external stress or strain. Ductwork shall have integral R-10 equivalent thermal insulation value, without the use of external insulation, per NSF's P374 Protocol and verified by a NSF Thermal Testing Report.
6. All joints shall be sealed via gasket or bolts and sealant. Clamps and gasket shall be used on ductwork without flanges. Clamps shall be polyethylene with stainless steel plates and stainless steel screws. Gasket shall comprise of 1/4" thick butyl rubber sealant tape that is water and UV resistant and shall not stain. Gaskets shall comply with ASTM-E84 for flame and smoke spread.
7. Flanged joints and duct branches shall use a co-polymer adhesive caulking sealant that is water and UV resistant. Flanges shall be connected with stainless steel bolts.
8. Duct system shall be installed by an AQC Industries trained installer.
9. Duct system performance shall exceed SMACNA's Leakage Class 3 requirements at the system design static pressure.
10. Duct system shall carry a 10 year Limited Warranty.

C. Installation

1. Follow the Blue Duct Installation Instruction provided by AQC Industries. It is strongly recommended to complete installation training provided by AQC Industries prior to installation.
2. Excavate a trench evenly as per The Blue Duct Installation Instructions. No bedding is required except for cases of bedrock or clay where sand or light aggregate may be used.
3. Ducts shall be pressured tested prior to backfill.
4. Backfill material must consist of pea gravel or dry silica sand, placed and compacted in lifts of 12" or less.
5. The sealant and gasket material provided by AQC Industries must be used as directed. The use of non-approved sealant or gasket will void warranty.

D. Testing

1. The complete underground duct system shall be tested for leakage after final assembly.
2. Follow SMACNA air duct leakage test standard.
3. Allow 24 hours for The Blue Duct sealant to cure after final assembly before testing the duct system. Additional curing time may be required in high ambient conditions.

E. Cleaning

1. Remove dust and debris from ductwork prior to occupancy.

1.10 INSULATION AND COVERING

A. General:

1. Insulate all piping, ductwork and equipment as herein noted.

2. All insulation work shall be performed under this Section.
3. All joints shall be butted firmly together. All insulation shall be installed in accordance with best practice of the trade and in accordance with manufacturer's recommendations. All workmanship shall be done so as to leave a smooth finish with no raveled edges.
4. Fittings shall be insulated with preformed sections and covered with Zeston fittings.
5. Provide high density insulation inserts under pipe supports and hangers.
6. For all piping, end joint strips and overlap seams shall be adhered with a vapor barrier mastic and stapled with outward clinch staples on 4" centers.
7. High density inserts and galvanized sheet metal shield shall be provided to maintain continuous insulation valve.
8. All insulation materials, adhesives, mastics and jackets assemblies shall be UL rated and classified. Ratings shall not exceed:

Flame	25
Fuel Contributed	50
Smoke Developed	50

9. Circulating Hot Water, and Cold-Water Make-up: Insulate piping with 4 lb. per cubic feet density glass fiber with maximum "K" factor of 0.24 at 75°F. mean temperature, with factory applied ASJ vapor barrier jacket. Joints and ends of well water piping shall be vapor sealed.

Thickness:	2" for pipe sizes 1½" and larger
	1" for pipe sizes 1 1/4" and smaller

10. Condensate Drain Piping: Same as for cold water piping, thickness, ½".
11. Refrigerant Piping: 1" Armaflex, coat exterior piping with approved UV protective paint.
12. Air Separator for circulating hot water
 - a. Air separator including flanges to be wrapped with 2" thick fiberglass blanket having a foil skim vapor barrier, with all joints taped and sealed.
 - b. An ASJ cover shall be provided.

B. Ductwork:

1. Air conditioning supply, return and outside air ductwork shall be insulated as herein noted. Insulation shall be omitted from ductwork exposed in air-conditioned spaces and from underground ductwork.
2. External Insulation: Exposed to view indoors, all outdoor ductwork in fan and Mechanical Rooms; 6 lbs. density fiberglass board with reinforced ASJ jacket and corner beads. Insulation shall be wired on, impaled and all joints sealed with tape.
3. Not exposed to view (e.g., above hung ceiling) fiberglass blanket with FRJ aluminum jacket. Blanket shall be wired on, with all joints overlapped, pasted and sealed.
4. Thickness: All air conditioning ducts shall be insulated. Ductwork exposed in conditioned spaces shall not be insulated. Unless otherwise noted, thickness as follows:

Indoor Supply	2" thick
Indoor Return	2" thick
Outside Air	3" thick

1.11 KITCHEN HOOD EXHAUST DUCT

- A. Insulate with two (2) layers of 1 ½" thick listed fire wrap.
- B. Fire wrap insulation may be omitted if listed double wall, insulated duct is installed.
- C. Insulate Dishwasher exhaust duct and fan with 1" thick fiberglass blanket with all joints and seams taped.

1.12 FOUNDATIONS, SUPPORTS, SLEEVES AND PLATES

- A. Unless otherwise noted, HC shall provide all foundations, hangers, and supports for his equipment including piping, air conditioning units, fans, fin pipe radiation and covers, ductwork, etc.
- B. All ductwork, piping, wiring, and equipment shall be hung or supported from structural members only.
- C. Ductwork shall be supported in accord with SMACNA Standards.
- D. Piping:
 - 1. All pipe shall be supported from building structure in a neat and workmanlike manner wherever possible, parallel runs of horizontal piping shall be grouped together on trapeze hangers.
 - 2. Piping shall be supported by adjustable wrought iron, steel or malleable iron hangers. Pipe hangers, supports, etc., shall be primed with a coat of rust inhibitor primer. Hangers shall be of the clevis type selected to conform to the maximum recommended loads. Do not hang piping or equipment from work of other trades. Attachment to beams or joists shall be made with top beam or I-beam clamps that attach to both sides of the flange.
 - 3. Hanger rods shall be steel threaded with nuts and lock nuts, size in accordance with the following schedule:

Pipe Size	Rod Size (diam)	Spacing
Up to 1 ½"	3/8"	6'-0"
1 ½" to 3"	3/8"	8'-0"
4" to 5"	5/8"	10'-0"
6" and over	¾"	12'-0"

- 4. Hanger spacing as above, but not over 18" from each change in direction of piping.
- 5. Vertical Pipe: Vertical piping shall also be supported on every floor with riser clamps.

6. Hangers: Hangers used to hang galvanized-coated pipe shall be galvanized. Hangers used to hang ungalvanized steel, pipe shall be steel. Hangers used to hang brass or copper pipe shall be brass or copperized steel or iron. Groups of pipes may be supported on a common trapeze, but pipe shall individually be permitted freedom of motion by roller or other approved support. Trapeze shall be made of angle iron with adjustable threaded steel rod supports.
7. Spacers: Groups of risers and horizontal running lines shall be provided with temporary spacers to maintain spacing and allow for separate pipe covering and maintenance.
8. Perforated Strap: Perforated strap iron and temporary wire supports are not permitted.
9. Hangers shall support piping from building structure to maintain required grade and pitch of pipelines, prevent vibration, secure piping in place, and provide for expansion and contraction. Hangers shall be secured to inserts wherever practical. Pipe supports shall give neat appearance. Provide clad shield where copper tubing is utilized.
10. Approved bolts and inserts shall be used for connecting supports, fixtures or equipment to masonry, wood plugs shall not be used.
11. Provide approved sheet metal shields to protect insulation at areas of contact with hangers and supports. Provide protective saddles as required, installed in approved manner. Shields to be "Insul-Shield" Insul-Coustic Corp.
12. Piping on side walls shall be supported from approved roller type brackets in sizes larger than 2" and "J" type for smaller sizes or from metal channels with adjustable brackets secured to wall.
13. All supports shall be fastened to structural members or additional steel supports provided by HC. Supports shall be attached to joist panel points.
14. Where pipes pass through masonry, concrete walls, foundations, or floors, HC shall set such sleeves as are necessary for passage of pipes. These sleeves shall be of sufficient size to permit 1" of insulation to be provided around pipe passing through. HC shall be responsible for exact location of these sleeves.
15. Sleeves shall not be used in any portion of building where use of same would impair strength or construction features of the building. Insert for supporting lateral pipes and equipment shall be placed and secured to form work, and all sleeve insert locations shall be thoroughly checked with Architect so as not to conflict with other trades.
16. Where pipes pass through floor or walls, they shall be provided with chromium plated escutcheons.
17. Unless otherwise noted, auxiliary steel supports for support of piping, ducts and mechanical equipment as required for particular applications or as directed and indicated on Drawings shall be by HC. All equipment hung from overhead construction shall have weight or equipment distributed by use of angle or channel iron beams as necessary and approved or substantially fastened to beams used for building structural support.
18. All operating equipment shall be supported so as to produce the minimum amount of noise transmission.
19. Provide vibration isolation devices for equipment having moving parts.
20. Floor mounted equipment shall be installed on 6" high reinforced concrete pads, provided by HC.
21. Hydronic and refrigerant piping to be installed and supported per Section 305 of the 2015 International Mechanical Code and be supported at distances not to exceed spacing in Table 305.4 or in accordance with ANSI/MSS SP-58.

22. Vibration rails and spring pipe hangers shall be provided for base mounted circulating pump.

1.13 SHOP DRAWINGS

- A. All manufactured items shall be submitted for review before installation of same. Submission shall be in form of manufacturer's standard printed sheets, pamphlets or bulletins and shall be clearly indicated thereon as to size, type, etc.
- B. Before fabricating any work, HC shall prepare and submit drawings of all ductwork and complicated piping including coordination of lighting, ceiling grid, structural steel and connections to related equipment showing all dimensions and details of construction and installation. No work is to be fabricated until shop drawings are reviewed. Shop drawings shall be 1/4" equal to 1'-0" minimum scale.
- C. Review of submission shall mean review of equipment and/or fabrications as to design and performance only. Contractor shall be responsible for scheduling quantities, physical size to suit allowable space, electrical characteristics, etc.
- D. Any additional costs incurred due to substitution of equipment (e.g., electrical, structural, etc.) shall be borne by HC.
- E. The following items require a submission of shop drawings:
 1. Piping Material
 2. Ductwork
 3. Insulation
 4. Pipe and Equipment Identification Material
 5. Heating Hot Water
 6. Water specialties
 7. Supports and Hangers
 8. Exhaust Fans
 9. Circulating Pumps
 10. Wall Heaters
 11. Unit Heater
 12. Air Handling Units
 13. Heat Pump Systems
 14. Diffusers, Registers and Grilles
 15. Motor Controls
 16. Variable Frequency Drives
 17. Louvers
 18. Automatic Temperature Controls
 19. Building Management System (BMS)-Alternate

1.14 START-UP, TESTS AND ADJUSTMENTS

- A. Unless otherwise specified, all new water piping systems shall be hydrostatically tested to 100 psig. Test shall be four (4) hour duration, during which time piping shall show no leaks and during time no sealing of leaks will be permitted.

- B. HC shall balance out all air and water systems and submit test reports showing operational data to include the following:
1. Motor power consumption for fans and pumps
 2. Air quantities at each outlet
 3. Fan RPM, air quantities, motor amperages
 4. Pump suction and discharge pressure and motor amperages
 5. Water flow quantities at all equipment, circuit setter locations and at pumps
- C. Balancing shall be done by a certified balancing firm, NEBB, AABC, TABB.
- D. An allowance of six (6) additional four (4) hour periods shall be made to rebalance air and/or waterflows, if found necessary.
- E. HC shall furnish services of a qualified person, thoroughly familiar with job, to operate and make all adjustments so that system and control equipment shall operate as intended. This person shall make adjustments including balancing of water and air systems in cooperation with qualified representative of mechanical equipment manufacturers and temperature control manufacturer. Architect is to be notified when this balancing is to be performed.
- F. When all work is in an acceptable operating condition, Owner shall be furnished with trade literature, parts lists, and operating instructions for all equipment furnished. Contractor shall furnish one glass framed set and two sets not framed of operating and maintenance instructions, control circuits, and charts with the number of all critical valves corresponding to 2" brass numbered valve discs chained to these valves to Architect.
- G. Final inspection and review shall be made only after proper completion of all of the above requirements.
- H. As part of the operating and maintenance manual HC shall provide a detailed listing (in a bound book) of the equipment installed.
- I. As a minimum the listing shall include:
1. Unit type
 2. Unit designation
 3. Unit location
 4. Area or areas served by unit
 5. Starter location
 6. Unit manufacturer
 7. Model number
 8. Scheduled Capacity
 9. Electrical, Volts, Phase, Amps
 10. Motor HP
 11. Filter type, quantity and sizes
 12. Belt quantity and model

1.15 HEAT PUMP SYSTEMS

- A. Provide Mitsubishi Trane as specified and scheduled on drawings.
- B. Provide 10-year extended warranty.

1.16 GAS FIRED CONDENSING BOILER

- A. Provide one (1) gas-fired condensing boilers describe on drawings and specified herein.
- B. Reference standards

- 1. American Society of Mechanical Engineers
 - ASME Boiler & Pressure Vessel Code, Section IV – Rules for construction of heating boilers
 - ASME CSD-1 – Controls and safety devices for automatically fired boilers
- 2. American National Standards Institute
 - ANSI Z21.13/CSA 4.9 – Standard for gas-fired low-pressure steam and hot water boilers
- 3. Air Conditioning, Heating and Refrigeration Institute
 - BTS 2000 Testing Standard – Method to determine efficiency of commercial space heating boilers
- 4. National Fire Protection Association
 - NFPA 54- National fuel gas code

C. Submittals:

- 1. Product submittal sheet: Provide submittal data sheet which lists performance, features, standard equipment and optional equipment.
- 2. Capacities and pressure drop: Provide total water capacity, expected pressure drop, gas pressure range, maximum length of vent/air intake piping and shipping weight.
- 3. Dimensional drawings: Provide detailed dimensional drawing that shows overall length, width and height along with locations of all water, exhaust, air inlet, gas inlet and condensate drain connections.
- 4. Manufacturer's instructions: Provide installation, operating and maintenance instruction, including detailed wiring diagrams showing all required electrical connections.
- 5. Electrical ratings: Provide electrical supply specification including current draw of the appliance and maximum rated draw of circulating pumps.

D. Regulatory Requirements:

- 1. Boiler pressure vessel to be designed, constructed and tested in accordance with Section IV of the ASME boiler and pressure vessel code entitled, "Rules for construction of heating boilers"

2. ETL listed in the United States and Canada. Certified in accordance with ANSI Z21.13/CSA 4.9 by Intertek Testing Services NA Inc.
3. Each boiler shall be listed in the AHRI Certification Directory and shall bear the AHRI Certified Logo.
4. Designed to meet ASME CSD-1 requirements for Controls & Safety Devices without additional separate equipment.
5. Tested by Gas Consultants, Inc. in accordance with Rule 1146.2 Administration Certification Program for California's South Coast Air Quality Management District (SCAQMD) for NOx compliance (14 ng/J or 20 PPM corrected to 3% O₂).

E. Quality Assurance:

1. Each boiler is supplied with a manufacturers data report for Watertube boilers, Form H-3, which provides full traceability for all pressure vessel parts to their raw materials.
2. Each boiler is factory tested by the manufacturer to assure proper operation of the heating system.
 - a. The factory testing includes testing of each burner individually and both burners together at low fire and high fire.
 - b. A factory test report showing the satisfactory results of all combustion and controls tests is supplied with each boiler.

F. Warranty:

1. 10-year limited Heat Exchanger warranty.
2. 1 year parts warranty
3. 1 year labor warranty (registered providers)
4. Available extended service plans

G. Manufacturers:

1. Navien.
2. Equivalent conforming to these specifications.

H. Performance:

1. Full Load Thermal Efficiency 96% minimum as tested in accordance with BTS-2000, Method to Determine Efficiency of Commercial Space Heating Boilers by AHRI.
2. Fully Modulating boiler(s) with 10:1 input turndown ratio capability.

I. Construction:

1. Fully assembled, packaged, water tube, condensing boiler design certified for zero clearance to combustible construction and approved for installation on combustible floors.
2. Pressure vessel to be designed, constructed and tested in accordance with Section IV of the ASME Boiler and Pressure Vessel Code for a maximum allowable working pressure of 160 psig and a maximum temperature of 210°F.

3. All heat exchangers surfaces must be constructed of high-grade stainless steel to prevent corrosion due to acidic condensation.
4. The heavy gauge jacket and support structure shall be factory designed to allow stacking of identical units up to two high.
5. The boiler shall have removable jacket panels to allow access for cleaning, inspection and service.
6. The heat exchanger shall be designed with dual combustion chambers to facilitate dual combustion system.
7. Leveling legs shall be provided to assure level installation of the boiler on uneven floors allowing for proper condensate drainage.
8. The exhaust connection shall be 6" stainless steel with a factory supplied adapter to 6" PVC.
9. The air inlet connection, if required, shall be suitable 6" diameter plastic or metal pipe.
10. The water connections shall be 2" NPT supply (outlet) and return (inlet).
11. The gas inlet connection shall be 1-1/4" NPT.
12. Connection for the condensate drain shall be a 3/4" hose barb fitting.
13. Maximum dimensions: 46" high x 27" wide x 40" long.

J. Combustion System:

1. A dual, tandem, fully modulating, combustion system shall be provided to provide a maximum boiler turndown ratio of 10:1.
2. Pneumatic gas valves shall be used to provide a consistent fuel/air ratio throughout the modulation range. The valve is to be mounted on the inlet to the combustion air fan to provide a thorough fuel/air mixture.
3. Combustion air fans shall be powered by an electronically commutated brushless DC motor controlled with a pulse width modulated input with tachometer feedback to the control system.
4. Combustion air fans shall have integral venturi mixers to maximize fuel input capability with minimum electrical energy input.
5. Ported, cylindrical, premix burner heads with a metal mesh sleeve shall be used in each combustion chamber.
6. Flame supervision on each burner shall be through both the flame sensor and the ignition electrode for reliable operation.
7. Ignition of the main flame shall be achieved by a direct spark from a high energy ignition system.
8. Each combustion system shall incorporate a "flapper" valve to prevent back flow of combustion gases through an inactive burner while the other burner is operating.

K. Electrical:

1. Electrical control cabinet with removable terminal strips for easy connection of power supply wiring, circulating pumps, outdoor sensor and central heating and/or domestic hot water demand signal wires.
2. Electrical knockouts on the rear jacket support panel for all required component connections.
3. Two service switches for interrupting power to individual control circuits.

L. Control:

1. Dual integrated control systems to provide primary safety functions, temperature operating control and burner sequencing.
2. Integrated manual reset high limit and low water cutoff inputs to meet CSD-1 requirements.
3. Factory installed high and low gas pressure switches.
4. Factory installed vent temperature limit switch.
5. Plain English display interface to explain burner operation and current status of each burner.
6. Front pixel display shows status, current supply temperature, target temperature, modulation rate of each burner, outdoor temperature, boiler demand type.
7. Easy access to status of all connected boilers through the master boiler pixel display.
8. Dual temperature operation to allow one boiler reset temperature target and one setpoint target for domestic hot water input. Configurable for two fixed setpoints if required.
9. Factory equipped to allow control and sequencing of up to 16 boilers.
10. Factory equipped for connection to serial communication (Modbus) from building management systems.
11. Factory equipped with alarm contacts for remote annunciation of fault conditions.
12. Installer/Service Menu allows flame signal status, logging of flame signal during the last ignition sequence, fault history, service notification, presets for reset calculation parameters.
13. Control features for efficient operation:
 - Warm Weather Shutdown
 - Anti-Cycling Logic
 - Temperature Boost
14. Central Heating Modes: Multiple central heating modes.

M. Exhaust/Air Inlet:

1. Boiler(s) shall be suitable for direct, positive pressure exhaust operation with outside or indoor air.
2. Boiler(s) shall include a stainless-steel drain tee (shipped loose) with condensate connection to the neutralization system.
3. Boiler(s) shall be designed to allow a single vent connection from a standalone boiler and common venting from multiple boilers.
4. Boiler(s) shall incorporate a vent temperature sensor with control logic to limit the boiler input to regulate vent temperature if a problem should occur.

N. Condensate System:

1. Boiler(s) are to include built-in condensate trap with neutralization.
2. The condensate collector shall allow visual inspection of neutralizer charge.
3. Boiler(s) shall incorporate a blocked condensate switch to prevent operation condensate to back up into the combustion area.

O. Additional Components (Loose):

1. ASME Rated pressure relief valve rated for the full input of the boiler at 30 psig relief pressure.
2. Hardware required to mount ASME relief valve to supply connection.
3. Temperature/Pressure Gauge – 0-200°F & 0-75 psig, 2 ½” Diameter.
4. Outdoor Sensor
5. Auxiliary low water cut-off.

1.17 UNIT HEATERS

- A. Provide where shown on the drawing's unit heaters of the type and capacity noted, as manufactured by Sterling or equivalent.
- B. Casings: Shall be heavy gauge steel, phosphatized for rust and corrosion prevention and painted with a baked enamel. Casings shall be equipped with weld nuts for threaded hanger rods. All hardware shall be plated for rust resistance.
- C. Motors: Shall be rubber mounted to safety wire guards of solid brass. Motors shall be built to NEMA Standards and shall be selected and tested for each unit heater.
- D. Coils: Shall be constructed with steel headers, seamless copper tubes hydraulically expanded into die formed aluminum fin collars. All copper to steel joints shall be made with high temperature brazing material. Coils shall be tested at 150 psi hydrostatic pressure.
- E. Fans: Shall be constructed of aluminum and shall be factor balanced.
- F. Air Diffusers: Provide with individually adjustable four-way discharge louvers.

1.18 WALL HEATERS

- A. Provide where shown on the Drawings, wall heater as manufactured by Smiths.
- B. Units shall be designed to fit between wall studs or surface mounted.
- C. Motor shall be shaded four-pole type, two speed, 1400 and 900 RPM.
- D. Air vent and reverse acting Aquastat shall be provided with unit.

1.19 CIRULATING PUMPS-IN-LINE

- A. Pumps shall be of size and capacity indicated on plans and shall be Grundfos Magna Series 3 series or equivalent.
- B. Pumps shall be In-Line type, close-coupled, single stage design, for installation in vertical or horizontal position, and capable of being serviced without disturbing piping connections.

- C. Pumps shall be rated for minimum of 175 psi working pressure. The pump case shall have gauge tapping's at the suction and discharge nozzles and will include vent and drain ports.
- D. Motor high efficiency type and shall meet NEMA specifications and shall be the size, voltage and enclosure called for on the plans. It shall have heavy duty grease lubricated ball bearings, completely adequate for the maximum load for which the pump is designed.
- E. Each pump shall be factory tested, it shall then be thoroughly cleaned and painted with high-grade machinery enamel prior to shipment. A set of installation instructions shall be included with the pump at the time of shipment.

1.20 EXHASUT FANS

- A. Provide exhaust fans as scheduled on drawings.

1.21 LOUVERS

- A. Provide louvers as scheduled on drawings.

1.22 AIR HANDLING UNITS

- A. Provide air handling units as scheduled on drawings.

1.23 DIFFUSERS, REGISTERS AND GRILLES

- A. Provide where shown on Plans, diffusers, registers and grilles of sizes and types indicated on Drawings. Unless otherwise noted on Plans, units shall be by Price or equivalent.
- B. Catalog numbers and performance data are based on Models scheduled on Drawings. Noise levels of all air terminals shall not exceed those of units specified.
- C. Velocity of air in the breathing zone shall not exceed 40' per minute.
- D. A complete schedule of diffusers, registers and grilles shall be prepared and submitted for review.
- E. Finish and color selected by the Architect.
- F. All air terminals shall be furnished by the manufacturer with sponge rubber gaskets around the frame periphery to provide an air tight seal against the wall or ceiling into which the air terminal is set. Gaskets shall be no less than 1/4" thick and shall be securely glued to the inside surface of the frame.

1.24 ELECTRIC MOTORS

- A. High efficiently motors shall be provided with all of the equipment furnished under this section.

1.25 ELECTRIC MOTORS, MOTOR CONTROLLERS AND WIRING

- A. HC shall furnish all necessary electrical controls, motor starter, switches, etc., for proper operation of equipment furnished by him under this Contract, and as herein noted.
- B. Separate magnetic starter with phase protection and thermal overload protection shall be used for all motors 1/2 HP and over. For motors 20 HP and above, provide reduced voltage starters.
- C. Separate manual starter with thermal overload protection for all motors 1/3 HP and under.
- D. Provide non-fused disconnect switches at exhaust fans.
- E. Electric service is 120/208 volt, 3 phase, 4 wire, 60 cycle. All motors 1/2" and under ½ HP shall be wired for 120-volt, single phase; motors 1/2 HP and over shall be 208 volts, 3 phase, exceptions as specified.
- F. All starters shall have Hand-Off-Auto push buttons and pilot lights.
- G. Provide all auxiliary contacts and controls required for interlocks and automatic operation of HVAC equipment as noted under temperature control specifications. Control circuit voltage shall not exceed 120 volts. Provide fused control transformers where required.
- H. HC shall be responsible for the proper electrical connections which will be done by EC and shall supply said EC with all necessary wiring diagrams to complete this installation.

1.26 AUTOMATIC TEMPERATURE CONTROL

- A. Provide all labor and material for a complete electric/electronic low voltage system of temperature controls.
- B. Work shall be complete in all respects, including labor, transformers, materials and necessary services, and shall be installed by competent mechanics regularly employed by the control manufacturer.
- C. The Sub-Contractor performing this work shall be a prime manufacturer presently engaged in the manufacture of direct digital temperature control systems. Installation shall be by factory-trained personnel regularly employed by the control's manufacturer.
- D. Control manufacturer shall maintain an adequate stock of spare parts and necessary service personnel locally to maintain and service the systems being installed and/or refurbished.

- E. Service personnel shall be equipped with the control manufacturer's approved tools, testing and calibrating apparatus necessary to perform the work specified herein.
- F. Complete control drawings shall be submitted for approval before field installation is started. The drawings shall give a complete description of all control elements complete air and water flow diagrams locating instruments, valves, etc. and show all schematic piping and wiring. In addition, the submittal shall include manufacturer's data sheets on each control component and a sequence of operation.
- G. All electrical wiring, including but not limited to line voltage, low voltage and miscellaneous conduit, connections, etc., required for the installation and operation of the ATCS, is to be provided by the H.C. Wiring methods and materials to be as specified in section.
- H. Installation of Valves and Wells: Automatic temperature control valves, separable wells, duct mounted devices and other pipe mounted control devices furnished shall be installed by the H.C.
- I. Installation, Service and Adjustment:
 - 1. On completion of job, complete adjust the control system. Instruct Owner's representative on the operation of control system and supply three (3) copies of control operating and instruction and maintenance manuals. Obtain from the Owner's representative a signed receipt that he has received the instruction manuals and complete instruction of the operation of the system.
 - 2. The control manufacturer shall guarantee the system and provide full-service contract (normal and emergency) for a period of one year from the date of substantial completion, at no additional cost to the Owner.
 - 3. Full-service contract shall include emergency service with a response time of four (4) hours during the normal workday and eight (8) hours nights and weekends.
 - 4. Normal service shall include a minimum of four (4) visits to check systems, calibrate controls, replace any parts and perform preventive maintenance.
 - 5. A written report of work performed shall be provided to the Owner after each visit.
 - 6. Service contract shall include all labor, parts and material required to maintain systems in top conditions.
- J. Material Requirements:
 - 1. General: All components shall be of the latest type produced by the control manufacturer.
 - 2. Thermostats and/or sensors shall be mounted 54" above finished floor.
- K. Valves
 - 1. All valves shall be full modulating with spring return, unless otherwise specified. In addition, valves shall be quiet in operation, fail-safe, be equipped with throttling plugs and renewable composition discs, and be capable of operating at varying rates of speed to correspond with the exact dictates of the controller. Valves shall be sized by the Contract Contractor and guaranteed to meet the heating

requirements. All valves 2" and smaller shall have flanged connections. Valve body rating shall match service requirements.

2. Valves shall be suitable for hot water with pressure drop not to exceed 3 psi for water.
- L. Dampers: Control dampers shall be substantially built-in steel frames fabricated from 2" channel or equivalent. Frames shall be equipped with brass trunnions and bearings and blade end stops. All damper blades shall be galvanized steel. The maximum blade width shall be 6". For the relief air dampers with blade, shall be sized to fit in wall, 3"-4" maximum. Furnish corner braces for all damper frames exceeding a 4 square foot area. Maximum width of any section shall be 48" and the maximum section height shall be 96". Furnish horizontal stiffening for any section exceeding 48" in height. Dampers for outdoor air and exhaust air applications shall be low leakage type and provided with neoprene seals on blade edges and end stops.
- M. Damper Motors: Damper motors shall be gear train type with adjustable stroke, spring return and shall be of proper size to meet the power requirements, as determined by control manufacturer. Damper motor for relief air shall be of size able to fit in allowable space between relief louver and wall grille.
- N. Sequence of Operation
1. VRF Heat Pump Units
 - a. Units to be controlled by controller furnished with system.
 - b. Room sensor to maintain space conditions.
 - c. Central controller to be installed in Mezzanine Mechanical Room.
 - d. Provide simplified room thermostat.
 - e. Units with outside air damper to close damper during unoccupied hours.
 - f. Central controller to schedule occupied and unoccupied hours.
 2. Air Handling Units
 - a. Air handling units shall be controlled by a 7-day programmable thermostat.
 - b. Individual control shall be provided for each unit serving the Dining Hall.
 - c. Subject to the heating or cooling load, one unit shall start and if unable to reach set point, the second unit shall start.
 - d. During heating occupied cycle, unit shall run continuously, outside air damper shall open to minimal position, and first stage of heating shall be from heat pump unit, and if required, second stage of heating. Heating coil shall operate with motorized valve modulating to meet the load.
 - e. Heating Unoccupied: Similar to heating occupied cycle except outside air damper shall remain closed and unit shall be modulating.
 - f. Cooling Occupied Cycle: Unit shall run continuously. Heat pump shall be activated and operate to maintain cooling set point. Outside air damper shall open to minimal position.
 - g. Cooling Unoccupied Cycle: Air handling and heat pump unit shall be off.
 - h. Position of outside air damper shall be controlled by a CO2 sensor located in the return plenum of each unit.

- i. Economizer Cycle: Dual enthalpy sensor shall switch the units to economizer operation when outside air temperature permits. During economizer operation, heat pump and heating coil shall be inactive and outside air shall be modulated to meet load conditions.
 - j. Pressure sensor in Dining Hall shall operate to modulate opening and closing of motorized relief damper.
3. Lobby Heat Pump Unit
 - a. Operation shall be similar to that of the air handling units except the outside air damper shall operate at constant minimum position during occupied cycle for heating and cooling.
4. Kitchen Heat Pump Unit
 - a. Kitchen heat pump unit shall be controlled by 7-day programmable heating/cooling thermostat.
 - b. Occupied cooling cycle: Unit shall run continuously and outdoor heat pump shall be modulated to maintain space temperature. Outside air damper shall open to minimal position.
 - c. Unoccupied Cooling Cycle: Units and heat pump shall be off. Outside air damper shall remain closed.
 - d. Heating Occupied: Room thermostat shall cycle heat pump for first stage of heating, and modulate motorized heating coil valve for second stage, to maintain space conditions. Outside air damper shall open to minimal position.
5. Wall and Unit Heaters
 - a. Units shall be controlled by a single setting wall sensor which shall cycle unit fan through a 120 volt relay.
 - b. Aquastat furnished with unit shall prevent fan operation if heat is not available.
6. Exhaust Fans
 - a. Toilet room exhaust fan programmable timeclock shall activate fan during occupied hours and turn off during unoccupied hours.
 - b. Singular toilet room shall be controlled by room motion sensor.
 - c. Dryer exhaust fans: Pressure sensor switch shall start fan whenever dryer operates.
 - d. Dishwasher exhaust fan shall be interlocked whenever dishwasher operates.
 - e. Kitchen hood exhaust fan to operate under control of kitchen hood operating panel, which shall start fan and vary speed of fan based on conditions at the hood.

7. Boilers

- a. Boilers shall start whenever there is a call for heating from units served by the boiler.
- b. Circulating pumps shall start whenever there is a call for heating from units served by the boiler.

8. Electric Cove Heater

- a. Shall be controlled by integral thermostat furnished with heater.

1.27 BUILDING MANAGEMENT SYSTEM (ALTERNATE #2)

- A. Provide a direct digital control Building Management System (BMS). System to be by Schneider Electric EcoStruxure or equivalent. System to tie all new equipment scheduled in HVAC drawings and water heaters, mixing valve and recirculating pumps from plumbing drawings. BMS shall provide for the sequences under base bid and shall include graphics, internet access, trending, alarms and status indication for equipment.

1.28 GUARANTEE AND SERVICE

- A. Refer to Section 23 50 00.

END OF SECTION 23 00 00

SECTION 23 50 00

SUPPLEMENTARY CONDITIONS
MECHANICAL AND ELECTRICAL WORK

PART 1 – GENERAL

1.1 GENERAL

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. It is intent of Drawings and Specifications to call for finished work, tested and ready for operation. All materials, equipment and apparatus shall be new, of highest grade and quality and free from imperfections.
- C. Any apparatus, appliance, material or work not shown on Drawings, but mentioned in Specifications, or vice versa, or any incidental accessories or minor details now shown but necessary to make work complete and perfect in all respects and ready for operation, even if not particularly specified, shall be provided by Contractor without additional cost to Owner.
- D. With submission of Bid, Contractor shall give written notice to Architect of any materials, apparatus or omissions believed to be in violation of laws, ordinances, rules or regulations or authorities having jurisdiction. In absence of such written notice, it is mutually agreed that Contractor shall include cost of providing all systems in accordance with applicable regulations without additional cost to Owner.

1.2 ABBREVIATIONS

- A. The following abbreviations shall apply:
 - GC - Contractor for General Construction
 - PC - Plumbing Contractor
 - FPC - Fire Protection Contractor
 - HC - Heating (HVAC) Contractor
 - EC - Electrical Contractor
 - KEC - Kitchen Equipment Contractor

1.3 EXAMINATION

- A. Contractor, before submitting Bid, shall examine site, building and existing facilities, Drawings and Specifications, inform himself as to State and local codes and laws having jurisdiction, allow for licenses and fees to be paid as directed under his Contract and/or as required by law.

- B. Claims made for extra payment for the following reasons will not be allowed:
Unfamiliarity with work to be performed by other trades, existing conditions at job site, local or State laws and codes and minor alterations due to field conditions.

1.4 CONTRACT DRAWINGS

- A. Drawings and Specifications: Drawings accompanying these Specifications are intended to show general arrangement and extent of work to be done. Work in all its details is subject to approval of Architect, whose decision on all points of difference shall be final and binding on Contractor. Any work or materials, which are rejected, must be immediately replaced by Contractor.
- B. Drawings and Specifications together mutually explain each other and indicate work to be done, and anything appearing in one and not in other shall be as if appearing in both. In case of disagreement between Drawings and Specifications or within either document itself as to better quality, greater quantity or more costly work shall be included in contract price and matter referred to Engineer's attention for decision or adjustment.

1.5 EQUIPMENT LOCATIONS

- A. Location of equipment, outlets, etc., as indicated on Drawings shall be considered as reasonably correct, but it shall be understood that they are subject to modifications as may be found necessary or desirable at time of installation in order to meet any unforeseen or design conditions. Such changes shall be made by Contractor without additional cost to Owner.
- B. Location of devices, fixtures, diffusers, registers, panels, sprinkler heads, equipment, etc., which are exposed in finished spaces, shall be coordinated and aligned with Architectural elements. Where on exposed masonry, they shall be coordinated with block or brick courses.
- C. Locations of pipes, ducts, electrical raceways, switches, panels, equipment, fixtures, etc., shall be adjusted to accommodate the work to interferences anticipated and encountered. The Contractor shall determine the exact route location of each pipe, duct and electrical raceway prior to fabrication.
- D. Offsets, transitions and changes in direction in pipes, ducts and electrical raceways shall be made as required to maintain proper headroom and pitch of sloping lines, whether or not indicated on the Drawings. The Contractor shall provide for all trades, air vents, pull boxes, etc. as required to effect these offsets, transitions and changes in direction.
- E. Architect reserves right to relocate any outlet or equipment to a distance of five feet in either direction from that indicated or described; said changes, if any, will be requested prior to installation and shall be made without additional cost to Owner.

1.6 COOPERATION

- A. The Contractor shall compare the mechanical and electrical Drawings and Specifications with those for other trades and shall report any discrepancies between them to the Engineer and shall obtain from him written instructions for changes necessary in the mechanical and electrical work. The mechanical and electrical work shall be installed in cooperation with other trades installing interrelated work. Before installation, the Contractor shall make proper provision to avoid interference in a manner approved by the Architect. 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.
- B. Every effort shall be made not to damage, soil or scratch the work of other Contractors.
- C. In case of damage to work or materials of other Contractors, he shall be required to pay for such damage as may be incurred. Architect shall be sole arbitrator in this matter.

1.7 SPACE CONDITIONS

- A. Work shall be confined to space allowed for it. If space is not sufficient, Architect shall be notified. More space shall not be used unless authorized by Architect.

1.8 ACCESSIBILITY

- A. Contractor shall install all work so that all parts required are readily accessible for inspection, operation, maintenance and repair. Minor deviations from Drawings may be made to accomplish this, but changes of magnitude shall not be made without prior written approval from Architect.
- B. The Contractor shall install all mechanical and electrical work to permit removal (without damage to other parts) of coils, heat exchanger bundles, fan shafts and wheel, draw-out circuit breakers, filters, belt guards, sheaves and drives and all other parts requiring periodic replacement or maintenance. The Contractor shall arrange pipes, ducts, raceways, traps, starters, motors, control components to clear the openings of swinging doors and of access panels.

1.9 ACCESS DOORS

- A. Location: Access doors in building construction through which a man must pass to repair or operate valves and other apparatus will be provided by others. All other required access doors, panels, cabinets, etc. shall be furnished by Contractor requiring same, for access to equipment provided under his Contract. Access doors shall be provided for valves, cleanouts, air vents, dampers, and for adjustments of apparatus where necessary and required. Access doors shall be installed by Contract No. 2. Doors must be made at job site so as not to cause delay to other trades.
- B. Type: Access doors shall have angle frame, cold rolled steel, shaped to provide a rabbet on all sides to house door and confine wall. Frames shall be 16-gauge steel, doors 14 gauge to 29" dimension vertical or horizontal and 12 gauge for larger sizes.

Hinges shall be concealed type permitting a door swing of 175°. Panels shall have prime coat of gray rust inhibitive paint. Access panels shall be similar to "Milcor" as manufactured by Inland Steel Products Company, Style "K" for plastered surfaces and Style "M" for masonry and tile surfaces. Panels must be available at job site, not to cause delay to other trades.

- C. Size: Access door shall be of adequate size to permit ready servicing of intended equipment. Unless otherwise noted, the minimum size shall be 12" x 12".

1.10 DRIP PANS

- A. Examine the drawings, and in cooperation with the Electrical Trade, confirm the final location of all electrical equipment to be installed in the vicinity of piping. Plan and arrange all overhead piping no closer than 2 feet from a vertical line to electric motors and controllers, switchboards, panelboards or similar equipment.
- B. Where the installation of piping does not comply with the requirements of foregoing paragraph, where feasible, the piping shall be relocated.
- C. Furnish galvanized steel gutters as follows:
 - 1. Provide and erect a gutter of 18 gauge galvanized steel under every pipe which is within 2'-0" of being vertically over any motor, electrical controllers, switchboards, panelboards, or the like.
 - 2. Each gutter shall be welded and made watertight, properly suspended and carefully pitched to a convenient point for draining. Provide a 3/4" drain, with valve as directed, to nearest floor drain or slop sink.
 - 3. In lieu of such separate gutters, a continuous, adequately supported and braced, properly rimmed, pitched and drained, may be provided over any such motor, and extending 2'-0" in all directions beyond the motor, over which such piping has to run.

1.11 DAMAGE

- A. Each Contractor shall protect and leave in perfect condition materials, apparatus, fittings, fixtures and trim in scope of his Contract. Should any items be damaged or broken or workmanship molested, no matter by whom such damage is caused, work must be corrected and damaged items replaced with new units by Contractor at no additional cost to Owner. Work, which needs redoing because of damage, shall be done by skilled trade which originally performed such work.
- B. Any adjustments between Contractors relative to damage to work or materials shall not be responsibility of Owner, Architect or their representatives.

1.12 LAW, ORDINANCES, PERMITS AND FEES

- A. The Contractor shall give all necessary notices, obtain all permits, pay all governmental taxes, fees and other costs in connection with his work, file for necessary approvals with the Town or Village and all other State governmental departments having jurisdiction, obtain all required certificates of inspection for his work and deliver same to the Architect before request for acceptance and final payment for the work.

1.13 CODES AND STANDARDS

- A. Contractor shall include in his Contract any labor, materials, services, apparatus, Drawings (in addition to Contract Documents), necessary to comply with all applicable codes, specifications, local ordinances, industry standards and utility company regulations.
- B. In case of difference between building codes, specifications, State laws, local ordinances, industry standards and utility company regulations and Contract Documents, most stringent shall govern. Contractor shall promptly notify Engineer in writing of any such difference.
- C. Noncompliance: Should Contractor perform any work that does not comply with requirements of applicable building codes, State local ordinances, industry standards and utility company regulations, he shall bear all costs arising in correcting deficiencies.
- D. Applicable codes and standards for material furnished and work installed shall include all State laws, local ordinances, utility company regulations, special requirements of Owner's insurance underwriters, requirements of governmental agencies having jurisdiction, and applicable requirements of following nationally accepted codes and standards:
- E. Codes:
1. International Building Code.
 2. International Plumbing Code.
 3. International Fuel Gas Code.
 4. International Fire Code.
 5. International Energy Conservation and Construction Code.
 6. National Electrical Code.
- F. Industry Standards, Codes and Specifications:
1. AIEE American Institute of Electrical Engineers
 2. ANSI American National Standards Institute
 3. ASHRAE American Society of Heating, Refrigeration & Air Conditioning Engineers
 4. ASME American Society of Mechanical Engineers
 5. ASTM American Society of Testing Materials
 6. AWWA American Water Works Association
 7. IPCEA Insulated Power Cable Engineers Association
 8. NBS National Bureau of Standards

9.	NEMA	National Electrical Manufacturers Association
10.	NFPA	National Fire Protection Association
11.	NEC	National Electrical Code
12.	UL	Underwriters' Laboratories
13.	AGA	American Gas Association

1.14 DEFINITIONS

- A. The term "Contractor" or "this Contractor" shall be interpreted to mean individual, partnership, or corporation to whom Contract has been awarded.
- B. Whenever the terms "provide" or "provided" are used in the specifications, they shall mean "furnish & install" or "furnished & Installed," "connect" or "connected", "apply" or "applied", "erect" or "erected," "construct" or "constructed," or similar terms, unless otherwise indicated in the specifications.
- C. Words in the singular shall also mean and include the plural wherever the context so indicates, and words in the plural mean the singular wherever the context so indicates.
- D. Wherever the terms "shown on drawings" are used in the specifications, they shall mean, "noted", "indicated," "scheduled," "detailed," or any other diagrammatic or written reference made on the drawings.
- E. Wherever the terms "material" or "materials" are used in the specifications, they shall mean any "product," "equipment," "device," "assembly" or "item" required under the contract, as indicated by trade or brand name, manufacturer's name, standard specification reference or other description.
- F. The terms "approved" or "approval" shall mean the written approval of the Engineer.
- G. The terms "specification" or "specifications" shall mean all information contained in the bound or unbound volume, including all "Contract Documents" defined therein, except for the drawings.
- H. The terms "directed," "required," "permitted," "ordered," "designated," "prescribed" and similar words shall mean the direction, requirement, permission, order, designation or prescription of the Engineer; the terms "approved," "acceptable," "satisfactory" and similar words shall mean approved by, acceptable or satisfactory to the Engineer; the terms "necessary," "reasonable," "proper," "correct" and similar words shall mean necessary, reasonable, proper or correct in the judgment of the Engineer.
- I. "Piping" includes, in addition to pipe or tubing, all fittings, flanges, unions, valves, strainers, drains, hangers and other accessories relative to such piping.
- J. "Concealed" means hidden from sight in chases, furred spaces, shafts, hung ceiling, embedded in construction or in crawl spaces.
- K. "Exposed" means not installed underground or "concealed" as defined above.
- L. "Invert Elevations" means the inside bottom of pipe.

- M. "Wiring" includes, in addition to wire, all conductors, raceways, boxes, devices, supports, hangers and other accessories relative to such wiring.
- N. Trade Contractors for this project shall be the PC, FPC, HC and the EC.

1.15 REMOVALS AND RELOCATIONS

- A. Removal and/or relocate all existing equipment, fixtures, wiring, piping and ductwork not being incorporated into the new design or as required to accommodate Architectural changes. Removals shall be carefully phased so that existing portions of the building continue to be served while the first phase of the new construction take place. All existing equipment, fixtures, piping, ductwork, wiring not being reused in the new design shall be removed. Protect existing equipment, fixtures piping, ductwork, and wiring which is to remain. Existing equipment which is reused shall be checked for proper operation and cleaned.
- B. Extreme care shall be taken during removal of Mechanical/Electrical facilities so as not to damage architectural facilities.
- C. Where light fixtures are removed, lighting controls and switches not being reused shall also be removed.
- D. Coordinate removals work with that of other trades. Any existing equipment fixtures, piping, ductwork, etc., which is to be reused, shall be identified to the other Contractors. Should it be damaged or removed, it shall be repaired or replaced. Responsibility for protecting, identifying, storing, repairing and replacing shall e by the Contractor who would normally provide the item.
- E. Removals shall be complete and include all trim, supports and accessories.
- F. Where raceways, piping or ductwork cannot be removed, cap and make safe behind finished construction.
- G. No disruption of existing service will be permitted without prior approval of the Owner.
- H. Wiring and piping for equipment which is to be relocated shall be disconnected, relocated and reconnected.
- I. During the course of removing existing and installation of all new service, equipment, fixtures, piping, ductwork and wiring, no interruption of existing facilities will be permitted without the consent of the Owner. All new wiring, piping, ductwork and equipment shall be installed, connected and made ready for final connections to existing systems before disrupting services. These final connections shall be made with such force as may be required to minimize time of shutdown or discontinuance of existing services. Prior to making final connections to existing services, schedule with Owner exact time and duration of discontinuance of service. A minimum of one (1) week notice shall be given to the Owner and other Contractors of any shutdown of services.

- J. Provide all piping, ductwork, wiring, raceways, equipment, appliances and labor required for temporary connections and bypasses necessary to permit continuous operating with minimum interruption of service.
- K. Disposition on equipment and fixtures being removed shall be reviewed with Owner. Equipment or fixtures which the Owner wishes to retain shall be carefully removed and set aside at a location designated by Owner. All other equipment, fixtures and trim shall be removed from site and properly disposed of.

1.16 CUTTING AND PATCHING

- A. Contractor must lay out the work in advance to minimize unnecessary cutting and patching.
- B. Cutting and patching of holes in walls, partitions, ceilings and floors and building in of chases, recesses or other openings that may be required shall be done by Contractor requiring same. All such patching and chases shall be finished to match existing adjacent finishes. Provide all new acoustic tile ceilings in areas where such ceilings are disturbed. All final patching shall be done by Contractor normally employed for such work at expense of Contractor requiring same.
- C. Drilling and patching for expansion bolts, hangers and other supports shall be done by Contractor requiring same, subject to review by Architect.
- D. Pavements, sidewalks, roads and curbs, planted areas, fences and all other site structures shall be cut, patched, repaired and/or replaced as required to permit installation of work of various trades and such cutting, patching, repairing and replacing shall be responsibility of, and paid for by, Contractor under Section of Specifications for trade requiring work. Work shall be done by Contractor normally employed for such work at expense of Contractor requiring same.
- E. Each Contractor shall bear expense of all cutting, patching, repairing or replacing of work of other trades required because of negligence or tardiness or because of any damage caused by him.

1.17 USE OF PREMISES

- A. Each Contractor shall perform all work necessary to deliver, store, and protect his material and equipment and shall provide a locker for safe and orderly storing of materials and tools. Location of such locker shall be with approval of Architect. Contractor shall change location thereof when so directed by Architect.
- B. The Contractor shall confine his apparatus, storage of materials and construction operations to the limits indicated by ordinances or permits or as may be directed by the Architect. He shall not unreasonably encumber the premises with his materials.
- C. In the utilization of ground area, the protection of pavement, curbs, walks, structures, and other permanent improvements shall be installed and maintained.

- D. In storing materials within any structure, or when using structure as a shop, the Contractor shall consult with the Architect and shall restrict his storage to spaces designated for such purposes. The Contractor will be held responsible for repairs, patching or cleaning arising from such use.
- E. Ground storage shall be similarly restricted.
- F. The Contractor shall not trespass or enter upon areas that are noted as being restricted.
- G. Plumbing fixtures shall not be used for emptying water from buckets, pails or other containers. Notwithstanding any approvals or instructions which must be obtained by the Contractor from the Owner in connection with use of premises, the responsibility for the safe working conditions at the site shall be the Contractor's and the or Owner shall not be deemed to have any responsibility or liability in connection therewith.

1.18 CLEANING

- A. Each Contractor shall, while engaged in work, maintain everything used in conjunction therewith in an orderly and clean condition and shall periodically during progress of work, or when directed by Architect, clean up and remove from building rubbish accumulated from his work.
- B. Work areas shall be cleaned on a daily basis. Areas occupied by Owner shall be kept clean at all times.
- C. Before reporting for final inspection, preceding acceptance by Architect, Contractor shall thoroughly clean fixtures, and apparatus of dust, stains, grease, oil, etc., and touch up with enamel or paint any scratched or marred surfaces. Finish of all trim and equipment shall be in perfect condition.

1.19 MANUFACTURER'S REPRESENTATIVE

- A. Each Trade Contractor shall provide, at appropriate time or as directed by Architect, the services of a competent factory-trained Engineer of particular manufacturer of equipment or item involved so as to inspect, adjust, and place in proper operating condition any and all items of manufacturer. No additional compensation will be allowed Contractor for such services.

1.20 SUPERVISION AND LAYOUT

- A. The work called for under this Contract shall be carried on simultaneously with the work of other trades in a manner such as not to delay the overall progress of the work. Be prepared to furnish promptly to other trades involved at the project all information and measurements relating to the work which they may require. Cooperate with them in order to secure the harmony necessary in the interest of the project as a whole.

- B. Keep a competent Superintendent in charge of the work. Such Superintendent shall be replaced if unsatisfactory to the Owner or Architect. Dealings at the site will be made only with this person.
- C. Maintain a complete file of Contract shop drawings at the site available for inspection by Owner's representatives. Installation and equipment shop drawings shall be initialed and dated upon installation.
- D. Every facility shall be provided to permit inspection of the work by Owner's representative during the course of construction.
- E. Be responsible for work until its completion and final acceptance; replace any of the same, which may be damaged, lost or stolen, without additional cost to the Owner.
- F. Contractor shall not employ on job unfit persons or anyone not skilled in work assigned nor anyone considered detrimental to best interests of job.
- G. Contractor to provide supervision, layout the work, do necessary leveling and measuring or employ a competent person satisfactory to Architect.
- H. All work shall be executed at and from as many different points at such times and with such force as to meet completion schedules and/or as may be deemed necessary by Architect.

1.21 COORDINATION OF THE WORK

- A. Each Trade Contractor shall coordinate their work with that of the Contractor for General Construction's and with the other Trade Contractors. Work of the respective trades shall be scheduled in accordance with the Contractor for General Construction's schedule so that all of the work will be installed at the proper time without delaying completion of the project.
- B. Contractor shall check the Contract Drawings and Specifications for all of the other trades so as to become familiar with the various items of apparatus and equipment, which will be furnished or set under the different Contractors, that require connections or other coordination.
- C. Trade Contractor shall furnish to the Contractor for General Construction, detailed advance information regarding all the requirements related to work under other Divisions and/or Sections. Each Contractor shall furnish sizes, accurate data, and location of any and all pads, chases, sleeves, and slots through floor slabs, walls, foundations, ceilings, roof, and other special openings required.
- D. Trade Contractor shall carefully check space requirements with other Contractors to ensure that the equipment, fixtures, piping, conduits, ducts, etc. can be installed in the spaces allotted for same.
- E. Wherever the work of the various Trade Contractors interconnects each Contractor shall provide all information, as required for the equipment, to the connecting Contractor so that the connecting Contractor will be able to properly furnish and install all water and

drain connections, gas connections, electrical connections or general construction provisions.

- F. Each Contractor shall check the Architectural Drawings for all ceiling height requirements.
- G. The HC shall provide reproducible drawings or electronic drawing files for trade coordination. These drawings shall show the duct layout and major piping layout for the HVAC work. This coordination drawing shall be circulated in timely fashion to the other contractors for them to add their work to provide a fully coordinated drawing for the work of all trade. Coordination meetings shall be held in locations and at frequencies as required to develop full coordinated drawings. All coordinating Contractors shall “sign-off” the coordination drawings when coordination is complete.
- H. Final coordination drawing in electronic file format shall be provided to the Construction Manager, the Architect and the Engineer.

1.22 MATERIALS AND WORKMANSHIP - GENERAL REQUIREMENTS

- A. Guarantees of Performance: Contractor shall be held to have carefully examined and checked Drawings and Specifications before acceptance of Contract, starting any work, or purchasing any materials. Contractor shall inform Engineer of any changes or additions necessary to make possible fulfillment of any guarantees called for by this Specification, failing which, he shall be deemed to have accepted such guarantees and be bound thereby.
- B. Wherever hereinafter guarantees of durability, operating capacity, proper functioning or like are called for, or whenever it is specified that manufacturer shall furnish detail drawings, test certificates or performance curves, supervise installation of his apparatus, test or adjust it after installation, keep it in repair for a stated period, or render other similar services,
- C. Contractor will be held responsible for thorough performance or specific services under actual conditions of installation. Same shall apply in cases where special adjustment or other services are necessary to insure proper and efficient functioning of apparatus, even though not specifically called for. It is intended that entire plant be ready for satisfactory operation, and Contractor is hereby made responsible for this result.
- D. In every case where Contractor's own employees cannot adequately perform above described services, he shall stipulate such performance in his Contract with sub-contractors, manufacturers, etc., or else subsequently pay them any additional fees required therefor so that a satisfactory and ready plant will be secured without additional cost to Owner.

1.23 JURISDICTIONAL DISPUTES

- A. Contractor shall assume responsibility for resolving jurisdictional disputes and resolving all claims arising from factory vs. field installation, etc.

- B. Wherever factory mounting, piping or wiring of controls and accessories, etc., are called for, Contractor shall ascertain at time of Bid that all work is in accord with local jurisdiction and shall allow for all costs to comply with same. Extras arising out of jurisdictional disputes will not be permitted.

1.24 FOUNDATIONS AND SUPPORTS

- A. All piers, supports, shelving, foundations, anchor bolts, hangers, auxiliary steel, etc., unless specified under other Sections, required by Mechanical or Electrical Contractors for support or hanging of their equipment shall be provided by Contractor requiring same. All such work shall be done by Contractor requiring same. All such work shall be done in a manner approved by Architect.
- B. The anchoring of all equipment to the structure shall comply with all applicable requirements of the local governing codes.
- C. Support and fastening of all mechanical and electrical equipment shall be by the Trade Contractors. All equipment hung from overhead construction shall have weight of equipment distributed by use of structural iron supports, as necessary and approved, substantially fastened to structural support system. Any wall-mounted equipment, which cannot be supported from architectural or structural materials shall have its own independent support system furnished by the Contractor. Proposed installation method shall be reviewed by the Architect.
- D. Refer to trade sections of the specification for equipment requirements.

1.25 ESCUTCHEONS

- A. Contractor shall provide escutcheons on pipes wherever they pass through floors, ceilings, walls or partitions.
- B. Escutcheons for pipes passing through outside walls shall be Ritter Pattern and Casting Company No. 1 solid, cast brass, flat type, secured to pipe with a set screw.
- C. Escutcheons for pipes passing through floors shall be Ritter Pattern and Casting Company No. 3A split-hinged, cast brass chromium plated type. Piping passing through exterior walls, floors below grade, etc., shall be made watertight with caulking compound and pipe sleeves with wall collar located at the center of the wall extending 8" all around the pipe. Collar to be 1/8" thick steel welded to sleeve.

1.26 PAINTING

- A. Painting and touching up shall be responsibility of Contractor installing equipment and/or materials as hereinafter described, including but not limited to following principal items:
 - 1. Prime Coat: Suitable rust inhibiting metal primer.
 - 2. Final Coat: Enamel of colors to be selected by Architect.

3. Galvanized and Copper Pipe: Uncovered piping shall be cleaned and left unpainted.
 4. Materials Not Accessible: Hangers, metal supports, pipe, conduit and miscellaneous equipment, except copper and galvanized, which is above hung ceilings, in chases or areas not accessible when job is completed shall be given a prime coat of paint to prevent rusting or corroding of material.
 5. Exposed Material: Hangers, metal supports, pipe and conduit, air handling units, tanks, electric fixture stems and canopies, and all material with exposed metal surfaces shall be finished as described above with prime and final coats of paint.
 6. Equipment, which has factory enamel finished surfaces, and which has been slightly scratched or chipped shall be carefully cleaned and at discretion of the Architect, shall be touched up with factory paint. Equipment, which is more than slightly rusted, scratched or chipped, shall at discretion of the Architect be repainted in its entirety with a factory finish.
 7. Natatorium and Pool Equipment Room: Any painting or touch equipment in these spaces shall be done with an epoxy coating suitable for a chlorine environment.
- B. Underground metallic conduit shall be coated with Asphaltum.
- C. Finish painting of patched architectural finishes will be provided by others.

1.27 MANUFACTURER'S IDENTIFICATION

- A. Manufacturer's nameplate, name or trademark shall be permanently affixed to all equipment and material furnished under this Specification. Nameplates of a contractor or distributor will not be acceptable.

1.28 NAMEPLATES

- A. Contractor shall provide for each item of equipment, including controls, a permanently attached nameplate made of black surface, white core, laminated bakelite with incised. Nameplates shall be a minimum of 3" long by 1-1/2" wide and shall bear equipment names and item numbers as designated in equipment schedule.

1.29 TAGS AND CHARTS

- A. Charts and diagrams listed below shall be provided by Contractor, mounted in separate glazed hardwood frames.
1. Valve Charts: Furnish to Owner's representative three (3) complete framed plastic laminated valve tag schedules. Schedule shall indicate tag number, valve location by floor, and nearest column number, valve size and service control. Include reproducible Mylar copy with as-built drawings.

- B. Valves

1. Attach a 2" round brass tag stamped with designating numbers 1" high filled in with black enamel to each valve.
2. Securely fasten valve tag to valve spindle or handle with a brass chain.
3. Appropriate ceiling tile markers, in areas where removable ceilings occur to indicate location of valves or other devices, shall be provided under the general construction division of these Specifications.

1.30 EXCAVATION AND BACKFILL

- A. Work for interior will be provided by Contractor requiring same.
- B. Excavation and Backfil shall be provided by Contractor as noted on drawing.
- C. Trade Contractors shall layout routing and confirm depths with respective Utility Companies.
- D. Trade Contractors shall be present during backfilling to assure that no damage is done to their material by improper backfill operations.
- E. Trade contractors shall furnish all special backfill materials, sand, pea gravel or concrete as specified under Trade Sections or called for on the drawings.
- F. Trade contractors shall provide marker tapes to be incorporated into the backfill.
- G. Refer to applicable specification sections for site work, further requirements.

1.31 TEMPORARY OPENINGS

- A. Contractor shall ascertain from his examination of existing facilities and Drawings whether any special temporary openings in building will be required for admission of apparatus provided under his Contract, and he shall notify Engineer accordingly. In event of Contractor to give sufficient notice to Architect in time to arrange for these openings during construction, Contractor shall assume all costs of providing such openings thereafter.

1.32 WORK IN CONNECTION WITH BUILDING SERVICES

- A. Mechanical and Electrical Contractors shall include in Bid all work, labor, material, fees and costs, including charges imposed and work charged by any utility company or governmental agency, for introduction of building services from street terminal to building, unless another terminal location is specifically noted. Work shall be complete and in accordance with intent of Drawings and Specifications. Contractor shall take special note to contact all agencies and utility company to account for and include in his Bid ALL charges.

1.33 EQUIPMENT START-UP AND TESTING

- A. Each Contractor shall furnish services of qualified person thoroughly familiar with job and installed work to operate and make adjustments so that equipment and work furnished under this Contract operates as required.
- B. Contractor shall instruct Owner's operating personnel during start up and separate operating tests of each major item of equipment. During operating tests, Contractor shall prove operation of each item of equipment to satisfaction of Architect.
- C. At least seven (7) days' note of equipment start-up and operating tests shall be given to Architect. See technical sections of these specifications for additional field tests, factory tests and certifications required.

1.34 INSTRUCTIONS AND LITERATURE

- A. Contractor is to thoroughly instruct building custodian or person/persons designated by Owner in proper care and operation of work furnished and installed by him. Contractor shall prepare for use by Owner a detailed brochure of instructions in non-technical terms describing maintenance and operation of all apparatus, valves, controls, switches, fixtures, etc. provided.
- B. A preliminary copy shall be submitted for review, after which four (4) bound copies of corrected material along with an electronic copy shall be delivered to the Owner.
- C. Furnish required number of manuals in bound form containing data covering capacities, maintenance of operation of all equipment and apparatus. Operating instructions shall cover all phases of control and include the following:
 - 1. Performance Curves: For pumps, and similar equipment at the operating conditions.
 - 2. Lubrication Schedule: Indicating type and frequency of lubrication required.
 - 3. List of Spare Parts: Recommended for normal service requirements.
 - 4. Parts List: For identifying the various parts of the equipment for repair and replacement purposes.
 - 5. Instruction Books: May be standard booklets but shall be clearly marked to indicate applicable equipment.
 - 6. Wiring Diagrams: Generalize diagrams are not acceptable, submittal shall be specifically prepared for this project.
 - 7. Automatic Controls: Diagrams and functional descriptions.
 - 8. List of Equipment: Furnish list including manufacturer's representative, address, phone number and e-mail for future use in obtaining replacement parts.
- D. Where applicable, one set of operating and maintenance instructions shall be neatly framed behind glass and hung adjacent to the equipment concerned.

- E. Tools: All special tools as are required for proper operation and maintenance of the equipment provided under this Specification shall be delivered to the Owner's representative and a receipt obtained as evidence of delivery.
- F. In addition to above, and to various other instructions called for under individual Specifications, Contractor shall make arrangements for formal "classroom" lecture type instruction seminar where Owner's maintenance and administrative personnel will receive detailed verbal and written instructions from Contractor and the various subcontractors and material and equipment suppliers and when instruction brochures will be turned over to the Owner. A video of these instruction sessions shall be provided to the Owner.
- G. At completion of instruction period, when Contractor and Owner are satisfied of Owner's knowledge to operate equipment, Contractor shall obtain in writing Owner's acceptance of instructions.

1.35 RECORD DRAWINGS

- A. Each Trade Contractor shall prepare a set of drawings on which shall be recorded any changes made so that at completion of work a complete record will be shown thereon of actual installation. At completion of work all of the information added to these drawings shall be transferred to the AutoCAD files which will be furnished to the Contractors. Drawings shall be certified to be complete and accurate. Contractor shall furnish two print copies and discs of this AutoCad files.

1.36 SHOP DRAWINGS

- A. See individual Sections for items requiring submission of shop drawings. Contractor shall submit the shop drawings electronically.
- B. Ductwork, piping, wiring diagrams and other drawings prepared for this project shall be prepared using AutoCad.
- C. The name of the manufacturer, model, accessories, size, etc. shall be clearly noted.
- D. Contractor shall review shop drawings prior to submission and all shop drawings shall be stamped by the Contractor. Any deviations or changes to Contract Documents shall be clearly noted.
- E. Review of shop drawings by the Architect/Engineer shall not relieve the Contractor of the responsibility of furnishing materials in accordance with the Contract Documents.
- F. Contractor shall be responsible for quantities, physical sizes, electrical characteristics, etc. Any additional costs incurred due to the substitution of equipment (e.g. electrical, structural, etc.) shall be borne by the Contractor.
- G. Project specific drawings for Ductwork piping, Fire Protection, Electrical Feeders, etc. shall be prepared using AutoCad.

1.37 GUARANTEE AND SERVICE

- A. Guarantee and service the entire installation for a period of one year from the date of final completion.
- B. The final acceptance will be made after Contractor has adjusted his equipment, balanced the various systems, demonstrated that it fulfills the requirement of the drawings and specifications, and has furnished all the required certificates of inspection, drawings, instructions and approvals.
- C. Contractor shall, during the period of the guarantee, replace or repair at his/her own expense any piece of equipment and/or material which is found to be defective. The replacement or repair shall be performed the same day of notification in an emergency fashion when notified by the Owner or authorized representative. Contractor shall also repair all damage to surrounding work caused by the failure, repair or replacement of defective equipment.
- D. During guarantee period, Contractor shall provide full service and maintenance for all equipment and systems, including all necessary inspections, cleaning, servicing, lubrication, adjustments, belts, filters, refrigerant, replacements and cleaning necessary to maintain equipment and systems in top working efficiency. Service shall include preventive, normal and emergency.
- E. Response time for emergency service shall be four (4) hours during business hours and six (6) hours on nights, weekends or holidays, and two (2) days for routine servicing.
- F. Refer to technical sections for additional guarantee and servicing requirements for specific equipment and systems.

END OF SECTION 23 50 00