PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections:
   1. Section 15050 "Basic Mechanical Materials and Methods".
   2. Section 15055 "Motors".
   3. Section 15060 "Hangers and Supports".
   4. Section 15074 "Vibration and Seismic Controls for HVAC Piping and Equipment".
   5. Section 15181 "Hydronic Piping".
   6. Section 15671 "Condensing Units".
   7. Section 15672 "Air-Cooled Condensers".
   8. Section 15900 "HVAC Instrumentation and Controls".
   9. Section 15950 "Testing, Adjusting and Balancing".
  10. Section 15995 "Commissioning of Mechanical Systems"

1.2 SUMMARY

A. This Section includes air-conditioning units and their accessories intended specifically for
   computer-room applications, in the following arrangements:
   1. Split-system air cooled air conditioning systems (Example of System: Liebert Deluxe System 3-7 to 25 tons).
   2. Water cooled air conditioning systems (Example of System: Liebert Deluxe System 3-7 to 25 tons).
   3. Packaged air conditioning units
   4. Air cooled condenser
   5. Propeller type drycoolers
   6. Centrifugal drycoolers
   7. Air cooled air conditioning unit (Example of System: Mini-Mate - 1-1.2 tons)
   8. Water cooled air conditioning unit (Example of System: Mini-Mate - 1-1/2 tons)
   9. Humidifier (Nortec - 10 TO 180 lb/hr)

1.3 SUBMITTALS

A. Product Data: Include rated capacities; shipping, installed, and operating weights;
   furnished specialties; and accessories for each model indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights,
   loadings, required clearances, method of field assembly, components, and location and
   size of each field connection.
   1. Wiring Diagrams: Detail wiring for power, signal, and control systems and
      differentiate between manufacturer-installed and field-installed wiring.

C. Maintenance Data: For equipment to include in the maintenance manuals.
D. Warranties: Special warranties specified in this Section.

1.4 QUALITY CONTROL

A. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."


C. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

D. Listing and Labeling: Provide electrically operated components specified in this Section that are listed and labeled.
   1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.

E. ASME Compliance: Fabricate and label water-cooled condenser shells to comply with ASME Boiler and Pressure Vessel Code, Section VIII.

F. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate layout and installation of units and suspension components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations with roof construction. Roof specialties are specified in Division 7 Sections.

C. Coordinate installation of computer-room air-conditioning units with computer-room raised floor Installer.

1.6 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: A written warranty, executed by the manufacturer and signed by the Contractor, agreeing to replace components that fail in materials or workmanship within the specified warranty period, provided manufacturer's written instructions for installation, operation, and maintenance have been followed.
   1. Warranty Period, Compressors: Manufacturer's standard, but not less than 5 years after date of Substantial Completion.
1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
1. Fan Belts: One set for each belt-drive fan.
2. Filters: One set of filters for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Computer Room Air Conditioning Equipment:
   a. Liebert Corporation
   b. Data Aire, Inc.
   c. Stulz Investment Corp. of America

2.2 SPLIT-SYSTEM AIR COOLED AIR CONDITIONING SYSTEMS BASIS OF DESIGN (LIEBERT DELUXE SYSTEM 3-7 TO 25 TONS)

A. Description: Split-system air cooled air conditioning systems shall consist of packaged air conditioning units, air cooled condenser, and controls. Each system shall be a complete package by one manufacturer.

2.3 WATER COOLED AIR CONDITIONING SYSTEMS BASIS OF DESIGN (Liebert Deluxe System 3-7 to 25 tons)

A. Description: Water cooled air conditioning systems shall consist of packaged air conditioning units and controls. Each system shall be a complete package by a single manufacturer.

B. The condenser water side of the system shall be rated for 150 psig working pressure.

2.4 PACKAGED AIR CONDITIONING UNITS

A. Description: Factory assembled environmental control unit with down-flow (up-flow) air delivery.

B. Refrigeration System: Two completely pre-piped assemblies including semi-hermetic compressors with vibration isolation, dual circuited evaporator coils, water or glycol-water cooled condensers (as applicable), expansion valves with external equalizers, liquid line
solenoid valves, (hot gas bypass valves), hot gas mufflers, liquid line filter dryers and refrigerant sight glasses with moisture indicators.

C. Evaporator Coil: Dual circuited A-frame direct expansion coils with refrigerant from each system distributed equally throughout the entire coil face area. Coils shall be constructed with seamless copper tubing and aluminum fins. The entire coil shall be mounted in a stainless steel drain pan.

D. Chilled Water Coils: Water coils with a water circuit designed to distribute the chilled water evenly over the entire coil area. The coils shall be constructed with seamless copper tubing and aluminum fins. The entire coil shall be mounted in a stainless steel condensate drain pan. The coils shall be rated for a minimum of 250 psig.

E. Water or Glycol-Water Cooled Condensers: Cleanable, shell and tube type heat exchangers with removable heads. Condensers shall be ASME stamped for a maximum refrigerant pressure of 400 psi at 300°F.

F. Evaporator (Cooling Coil) Fans: Double width double inlet, statically and dynamically balanced blowers. The fan wheels shall be supported by ball bearing pillow blocks from a single shaft which is driven with a two-belt variable speed V-belt drive, selected for 200% of the fan motor horsepower. The fan motor shall be mounted on slide base. Fan shall be mounted for uniform air flow across the evaporator coil.

1. Refer to Section 15055 “Motors” for fan motor requirements.

G. Electric Reheat: Multiple stage, thermally protected, low watt density fin-tubular constructed elements.

H. Hot Gas Reheat System: Provided with each unit. the system shall consist of refrigerant coil, three-way solenoid valve, and a refrigerant check valve. The refrigerant coil shall be constructed with seamless copper tubing and aluminum fins.

I. Hot Water Reheat System: Provided with each unit. The system shall consist of hot water heating coil and prepiped two-way modulating control valve, Y-strainer and F & T trap. The heating coil shall be constructed with seamless copper tubing and aluminum fins and shall be rated for 250 psig.

J. Humidifier: Electric steam generating canister unit with self contained electrode steam humidifier. Humidifier assembly shall include 20 gauge steel cabinet which houses the replaceable canister with integral fill cup, fill and drain valves and associated piping. The microprocessor shall operate the unit to maintain required humidity conditions and shall initiate fill and drain cycles based on water conductivity. Overflow and loss of flow protection shall be provided along with a manual drain switch. A capacity adjustment potentiometer shall be provided. A high water alarm with time delay shall provide audible and visual indication to change canister.

K. Humidifier: Infrared type consisting of high intensity quartz lamps mounted above and out of the water supply. The evaporator pan shall be stainless steel and arranged to be serviceable without disconnecting the water supply lines, draw lines or electrical connections. The complete humidifier section shall be prepiped and ready for final connection. The primary water supply for the humidifier shall be condensate water from the cooling coil. The infrared humidification system shall bypass air to prevent over humidification of the conditioned space.
1. The equipment manufacturer shall provide one additional stainless steel evaporator pan of each size unit for the entire installation and shall provide two (2) replacement infrared bulbs for each unit.

L. Cabinet and Frame: Welded steel and fully acoustically and thermally insulated with 1" thick 1-1/2 pound density insulation. Cabinet shall be designed for full access to air handling components and shall have a completely separate compartment for servicing the refrigeration system and controls while the unit is in operation. The cabinet shall be complete with manufacturers baked enamel finish in a color selected by the Owner.

M. Filter Chamber: Integral part of the unit located within the cabinet and serviceable from either end of the unit. Provide one set of clean filters at start-up.

N. Controls and Sensors: Include an integral solid state temperature and humidity controller with sensors, (space temperature/glycol comparative temperature monitor), a compressor lead/lag controller, manual reset high refrigerant head pressure switches, low refrigerant suction pressure switches, air flow switches, (water flow switches), solid state water and moisture sensor, smoke detector, (hot gas bypass valves), three (two)-way condenser head pressure regulating valves, three (two)-way chilled water valve and three-way glycol regulating valve for the economizer coil.

O. The solid state controller shall operate all internal functions of the unit and shall be capable of displaying the following items:
   1. Space temperature
   2. Space humidity
   3. Unit temperature setpoint
   4. Unit temperature sensitivity
   5. Unit humidity setpoint
   6. Unit humidity sensitivity
   7. Heating mode (in operation)
   8. Cooling mode (in operation)
   9. Humidification mode (in operation)
  10. Dehumidification mode (in operation)

P. The control system shall monitor the unit operation and activate an audible and visual alarm in the event of the following factory set conditions or failures:
   1. High temperature as specified in °F
   2. Low temperature as specified in °F
   3. High humidity as specified in % RH
   4. Low humidity as specified in % RH
   5. High head pressure
   6. Change filters
   7. Loss of air
   8. Local alarm (for smoke detected and water on floor)

Q. The unit operation shall be started through the action of a remotely located normally open dry contact.

R. Disconnect Switch: Factory mounted non-locking (locking) type disconnect switch.

S. Accessories: Provide the following:
   1. Floor stand height as scheduled or specified
   2. Factory mounted coil condensate pump
3. Extended discharge plenum with double deflection grilles
4. Extended return air plenum with grille
5. Temperature and humidity recorder
6. Smoke detector
7. Liqui-tect water deflector

2.5 AIR COOLED CONDENSER

A. Air Cooled Condenser: Low profile, slow speed, multiple direct drive propeller fan type. The condenser shall be arranged for vertical discharge. The condenser shall have two separate refrigeration circuits to balance the heat rejection of each compressor under all specified ambient conditions. The condenser shall be constructed of aluminum support casing and shall contain a copper tube, aluminum fin coil.

B. Condenser Fans: Direct drive, heavy gauge aluminum blades securely riveted to zinc plated chromate treated steel hubs. All fans shall be statically and dynamically balanced before shipment and shall operate with low top speeds for minimum noise and vibration.

C. Fans shall be provided with PVC coated, heavy gauge, close meshed steel, wire guard.

D. Control System: Fan Speed Control. The drip proof variable speed motors shall operate at scheduled rpm. They shall be designed with ball bearings, permanent lubrication, internal overload protection, 40°C rise at full speed, 65°C rise at 10 rpm, with a minimum 10-year life. Motors shall be installed within the condenser casing protected from the weather. The control system shall be complete with transducers, thermostats, line voltage/24 volt control transformer, and electrical control circuit. The control system shall be factory prepackaged in a fan speed control box which shall be mounted to the air cooled condenser in the field. The transducer shall automatically sense the highest head pressure of either operating compressor and control the variable speed fan on the air cooled condenser to properly maintain the head pressure. The fan speed control system shall provide positive start-up and operation in ambient temperature as low as 20°F or lower. Included with the fan speed control system shall be a solid state winter start kit as an integral feature of the electronic control panel.

E. Lee Temp Winter Control System: The winter control system for the air cooled condenser shall be "Lee-Temp". The Lee-Temp system shall allow start-up and positive head pressure control with ambient temperatures as low as 20°F or lower. The Lee-Temp package shall include the insulated receivers, pressure relief valves for each circuit, head pressure three-way control valves, and roto-loc valves for isolating the refrigerant charge. The Lee-Temp receivers shall be factory insulated and mounted ready for the field connection to the air cooled condenser.

F. The unit's self-contained control system shall be energized and operated in response to the closure of a normally open contact in the packaged air conditioning unit.

G. Disconnect Switch: Nonfused.

2.6 PROPELLER TYPE DRYCOOLERS

A. Description: The drycoolers shall be the low profile, slow speed, multiple direct drive propeller fan type. The drycoolers shall be arranged for vertical or horizontal (as
designed for application) discharge. The drycooler shall have sufficient capacity to reject the heat from its associated packaged air conditioning unit under all specified ambient conditions. The condenser shall be constructed of aluminum support casing and contain a copper tubing aluminum fin coil.

B. Drycooler Fans: Direct drive, heavy gauge aluminum blades securely riveted to zinc plated chromate treated steel hubs. All fans shall be statically and dynamically balanced before shipment and shall operate with low top speeds for minimum noise and vibration.

C. Fan Guard: PVC coated, heavy gauge, close meshed, steel wire guard.

D. Fan Motors: Single speed permanently lubricated, thermally protected, single phase, drip proof, motors, each controlled by a single contactor. Motors shall be installed within the drycooler cabins, protected from the weather.

E. Control Package: Include contactors for the fan motors, starters for the glycol pumps, step down transformers for operating fan motors and for control purposes, and two remote bulb aquastats. All shall be factory wired and mounted in a weather proof enclosure.

F. The individual fans shall be controlled in sequence by (two) glycol supply water aquastats. The aquastats shall monitor the supply temperature from the drycooler.

G. Sequence of Operation:
   1. On closure of the normally open contact in the packaged air conditioning unit, the glycol pump and the drycooler fans shall be energized.
   2. On rise of supply temperature above 80°F as detected by the first aquastat, the first fan will be energized, the fan will continue to operate until the supply temperature falls below 68°F.
   3. On rise of supply temperature above 90°F as detected by the second aquastat, the other fan(s) will be energized; the other fan(s) shall operate until the supply temperature falls below 78°F.

2.7 CENTRIFUGAL DRYCOOLERS

A. Description: Centrifugal drycoolers shall be central station type air handling units complete with cabinet fan, filter box, draw-through coils and controls.

B. Unit casings: Sectionalized construction with all sheet metal parts of galvanized sheet steel, rigidly braced and bolted. Casing panels shall be easily removable for access to the interior. Cabinet panels shall be insulated with 1/2" thick, 3/4 pound density glass fibre insulation with neoprene coating.

C. Fans and shafts shall be selected to operate well below the first critical speed and each shaft shall be factory coated after assembly with anticorrosion coating.

D. Fan Bearings: Average life of at least 200,000 hours, factory lubricated and equipped with standard hydraulic grease fittings. Extended lube lines, as necessary shall terminate on the outside of drive end of each unit including extension to allow greasing without removal of belt guard. Multiple sheave fan drives shall be selected for 200 percent of motor horsepower and anti-static belts shall be furnished.
E. Fan Wheel: Forward curved blade. All scrolls, bracing, and fan wheels shall be galvanized steel. The fan assembly shall be statically and dynamically balanced after installation in the air handling unit casing.

F. Refer to Section 15055 "Motors" for motor requirements.

G. Fluid Cooling Coil: Meet the performance requirements of the air conditioning units. Coil shall be the cartridge type removable from either the coil connection side or the opposite side of the air handling unit and supported in tracks over the entire length of the coil. Coil shall be suitable for a maximum working pressure of 250 psig at 120°F. Coil shall be fabricated of 5/8" O.D. copper tubes with 0.024" nominal wall thickness with aluminum plate fins. Fins shall have belted collars and be bonded to tubes by mechanical expansion. Coil shall have 20 gauge galvanized steel casing and cast iron or copper headers. Coils shall be drainable and have non-trapping circuit.

H. Filter Box: Manufacturer's standard, low velocity, complete with 2" thick replaceable filters equal to Farr 30/30. Filter box construction shall be similar to drycoolers construction complete with hinged and latched side access doors for filter changing.

I. Controls: Include a starter package for the drycooler and associated pump, a three-way valve, a proportioning aquastat, and a duct mounted differential pressure type air proving switch.

J. Starter Package: Include magnetic contactors, fuse protection, and overload protection for the drycooler motor and for the glycol pump motor(s). Starter package shall also be furnished with a step-down transformer for control purposes. Refer to Section 15055 "Motors" for starter requirements.

K. Sequence of Operation:
   1. On closure of the normally open contact in the packaged air conditioning unit, the glycol pump, the drycooler and the three-way valve control circuit shall be energized.
   2. Under the control of the proportioning aquastat, the leaving glycol-water temperature, through the action of the three-way valve, shall be maintained at the lowest possible temperature down to 40°F.

2.8 AIR COOLED AIR CONDITIONING UNIT BASIS OF DESIGN (MINI-MATE - 1-1.2 TONS)

A. Description: Basic air cooled air conditioning unit shall be packaged environmental control unit for spot cooling as manufactured by Liebert.

B. Configuration: Horizontal for ceiling mounting and sized to fit the 2' x 4' opening of a standard "T-bar" ceiling. Unit shall be fully accessible from below and shall include a permanently mounted insulated cabinet with removable refrigeration/blower section.

C. Refrigeration system shall be a completely prepiped assembly including hermetic compressor with vibration isolation, evaporator coil, condenser coil, expansion valve with external equalizers, filter-dehydrator and access fittings on suction and discharge lines.
D. Evaporator and Condenser Coils: Multiple circuit/low pressure drop coils constructed with seamless copper tubing and aluminum fins.

E. Evaporator and Condenser Fans: Direct drive, double inlet, dynamically balanced, forward curved blade blowers. Motor for the condenser fan shall be a three-speed motor.

F. Reheat: Multiple stage, thermally protected, low watt density, tubular constructed elements.

G. Humidifier: Evaporative pan humidifier consisting of a stainless steel water preheating chamber with a low watt density stainless steel heating element, Y-strainer, needle valve, solenoid valve, and controls.

H. The removable refrigeration/blower section shall include the prepiped refrigeration system, the evaporator fan and the reheat section. All permanently mounted on a light weight rigid metal chassis.

I. Cabinet: Galvanized steel construction with baked enamel finish. Cabinet shall be fully insulated with /12" thick 2 pound density fiberglass insulation. The condenser fan, complete with enclosure, shall be mounted to the cabinet. The cabinet shall be complete with double deflection supply air grille, return air grille, filter, vibration isolation for refrigeration/blower section and a rigging device for servicing the refrigeration/blower section of the unit.

J. Controls: Solid state wall mounted thermostat/humidistat to maintain temperature and humidity, a condenser air thermostat to control condenser fan in order to maintain head pressure, a liquid sensing device to prevent condensate drain pan overflow, and all other controls, contactors, relays, transformers and capacitors required for a complete operating system. All controls, etc., shall be prewired and mounted on the refrigerator/blower section to the furthest extent possible. All control and power connections shall be made by means of terminal blocks.

K. Provide an outdoor air louver for condenser air ductwork, a factory mounted condensate pump, and a nonfused disconnect switch with each unit as required.

2.9 WATER COOLED AIR CONDITIONING UNIT BASIS OF DESIGN (MINI-MATE - 1-1/2 TONS)

A. Description: Basic water cooled air conditioning unit shall be a packaged environmental control unit for spot cooling as manufactured by Liebert.

B. Configuration: Horizontal for ceiling mounting and sized to fit the 2' x 4' opening of a standard "T-bar" ceiling. Unit shall be fully accessible from below and shall include a permanently mounted insulated cabinet with removable refrigeration/blower section.

C. Refrigeration system shall be a completely prepiped assembly including hermetic compressor with vibration isolation, evaporator coil, condenser, expansion valve with external equalizers, filter-dehydrator and access fittings on suction and discharge lines.

D. Evaporator Coil: Multiple circuit/low pressure drop coils constructed with seamless copper tubing and aluminum fins.
E. Condenser: Coaxial type for complete counterflow performance and efficient use of water and heat transfer surfaces. The condenser shall be furnished complete with adjustable water regulating valve and controls. Condenser water and valve shall be selected for 150 psig working pressure.

F. Evaporator Fan: Direct drive, double inlet, dynamically balanced, forward curved blade blowers. Motor for evaporator fan shall be single-speed type.

G. Reheat: Multiple stage, thermally protected, low watt density, tubular constructed elements.

H. Humidifiers: Evaporative pan humidifier consisting of a stainless steel water preheating chamber with a low watt density stainless steel heating element, Y-strainer, needle valve, solenoid valve, and controls.

I. The removable refrigeration/blower section shall include, the prepiped refrigeration system, the evaporator fan and the reheat section. All permanently mounted on a lightweight rigid metal chassis.

J. Cabinet: Galvanized steel construction with baked enamel finish. Cabinet shall be fully insulated with 1/2" thick, 2 pound density fiberglass insulation. The cabinet shall be complete with double deflection supply air grille, return air grille, filter, vibration isolation for refrigeration/blower section and a rigging device for servicing the refrigeration/blower section of the unit.

K. Controls: Solid state wall mounted thermostat/humidistat to maintain temperature and humidity, condenser water regulator operator to maintain head pressure, a liquid sensing device to prevent condensate drain pan overflow, and all other controls, contactors, relays, transformers and capacitors required for a complete operating system. All controls, etc., shall be prewired and mounted on the refrigerator/blower section to the furthest extent possible. All control and power connections shall be made by means of terminal blocks.

L. Provide a factory mounted condensate pump and a nonfused disconnect switch with each unit as required.

2.10 HUMIDIFIER (NORTEC - 10 TO 180 LB/HR)

A. Description: Humidifier shall be self-contained disposable cylinder electronic electrode steam generating Condair humidifiers as manufactured by Nortec Industries, Inc.

B. Humidifier shall be furnished with the following:
   1. Fused disconnect switch.
   2. (Two) spare replacement cylinders.
   3. Duct insertion type steam distributor(s) each with condensate separator and return leg.
   4. Steam supply hose.
   5. Condensate return hose.
   6. Built-on blower pack with factory mounted steam distributor ON/OFF (pressure differential) air proving switch.
   7. Wall-mounted or Duct-mounted on/off humidistat as scheduled or specified.
8. Duct-mounted on/off air proving switch (pressure differential).
9. Wall-mounted continuous control humidistat to operate unit between 20% and 100% capacity to match load.
10. Duct mounted high limit humidistat.
11. Continuous control adapter to accept a varying (2) 3-wire output signal of (specify signal) from a pneumatic transducer furnished under Section 15900 “HVAC Instrumentation and Controls”; which shall automatically control unit to operate between 20% and 100% capacity to match load.

C. Humidifier control shall be as follows:
   1. Air proving switch in supply air duct closes with duct airflow.
   2. On fall in space humidity to 35% R.H. wall mounted on/off humidistat will close and will start steam generator.
   3. Under the control of wall mounted continuous control humidistat, steam generator will produce from 20% to 100% of its rated capacity in response to the space load requirement.
   4. On rise in humidity above 95% RH duct-mounted high limit humidistat shall de-energize the steam generator.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine area for compliance with requirements for installation tolerances and other conditions affecting performance of units. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Verify that flooring system is ready to receive work and opening dimensions are as indicated on Shop Drawings.

C. Verify that ceiling system is ready to receive work and opening dimensions are as indicated on Shop Drawings.

D. Verify that power supply is available and of the correct characteristics.

3.2 INSTALLATION

A. Install units according to manufacturer's written instructions.

B. Install units level and plumb.

C. Install air-cooled condenser on vibration isolation.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
   1. Install piping to allow service and maintenance.
   2. Water and Drainage Connections: Conform to applicable requirements of Section 15140 "Plumbing Piping." Provide adequate connections for water-cooled units, condensate, and humidifier flushing system.
3. Hot-Water Heating Piping: Conform to applicable requirements of Section 15181 "Hydronic Piping." Provide shutoff valves in inlet and outlet piping to reheat coils.

4. Condenser Water Piping: Conform to applicable requirements of Section 15181 "Hydronic Piping." Provide shutoff valves in water inlet and outlet piping on water-cooled units.

5. Refrigerant Piping: Conform to applicable requirements of Section 15183 "Refrigerant Piping." Provide shutoff valves and piping.

B. Electrical: Conform to applicable requirements in Division 16 Sections.

C. Ground equipment.
   1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 ADJUSTING

A. Set initial temperature and humidity set points.

3.5 CLEANING AND INITIAL CHARGING OF REFRIGERATION SYSTEM

A. The Contractor shall clean and charge all air cooled refrigeration equipment under the supervision of the equipment manufacturer's authorized factory-trained service representative.

B. Thoroughly clean all refrigerant piping with refrigerant, then test with carbon dioxide or nitrogen at 250 psig. Then evacuate lines vacuum of 29.75" of mercury. Repair leaks and replace faulty materials and repeat tests until specified vacuum is maintained and held without loss over 48-hour period. Charge system with proper refrigerant in sufficient quantity. Final inspection will not be made until system is properly adjusted and operated for at least 72 hours.

C. The equipment manufacturer's authorized service representative shall provide three (3) certified copies to Owner stating that the system has been properly cleaned and charged with refrigerant and an inspection report outlining the refrigerant suction and hot gas pressures with system under full load. Alternate testing procedures may be submitted for approval.

3.6 START UP SERVICE

A. After installation, check the following:
   1. General:
      a. Check all piping and electrical connections.
   2. For all Fans and Pumps:
      a. Check alignment.
      b. Check lubrication.
      c. Tabulate voltage and amperage readings.
      d. Check electrical connections.
      e. Check rotation.
      f. Check balance.
      g. Tabulate discharge and suction gauge readings.
h. Check pH and condition of system water (pumps).

3. Refrigeration Systems
   a. Check refrigerant charge.
   b. Tabulate refrigerant discharge and suction gauge readings.
   c. Tabulate entering and leaving air and water (glycol) temperatures.
   d. Check control sequence.

B. Start unit according to manufacturer's written instructions.
   1. Complete manufacturer's startup checks.

C. After starting and performance test, change filters and flush humidifier.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:

   1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
   2. Review data in the maintenance manuals. Refer to Section "Contract Closeout."
   3. Review data in the maintenance manuals. Refer to Section "Operation and Maintenance Data."
   4. Schedule training with Owner, with at least 7 days' advance notice.

END OF SECTION