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**PART 1 GENERAL****1.1 RELATED DOCUMENTS**

- A. The requirements of the General Conditions, Supplementary Conditions and the following Specification sections apply to all Work herein:
1. Section 23 00 10 - General Requirements
  2. Section 23 00 20 - HVAC Scope of Work
  3. Section 23 05 07 - Design Conditions
  4. Section 23 05 13 - Motor Requirements for HVAC Equipment
  5. Section 23 05 30 - Miscellaneous Equipment
  6. Section 23 05 48 - Vibration Isolation
  7. Section 23 05 93 - Testing, Balancing, and Adjusting
  8. Section 23 31 00 - Ductwork and Sheet Metal
  9. Section 23 40 00 - Air Filtering

**1.2 SUMMARY**

- A. Furnish and install all factory-built computer room air handling units herein specified and as indicated on the Drawings.

**1.3 REFERENCE STANDARDS**

- A. All computer room air handling units, humidifier, electronic DDC control system and accessories shall be designed, manufactured and tested in accordance with the latest applicable industry standards including the following:
1. ASTM B-88-72 H23.1-59, E84, C423-90a and E795-83
  2. NFPA 90A, 90B and 255
  3. UL 723
  4. ARI Standard 440
  5. Mechanical Power Transmission Association and the Rubber Manufacturers Association, Inc. – “Engineering Standards for Multiple V-Belt Drives - 1972”
  6. AMCA 210-85, 211, 300 and 311
  7. ISO BS-848-1980 and 1940 G6.3
  8. IEEE 444 and 519-1992
  9. NEMA ICS-3-303
- B. All equipment and material to be furnished and installed on this Project shall be UL or ETL listed, in accordance with the requirements of the authorities having jurisdiction and suitable for its intended use on this Project.

**1.4 SUBMITTALS**

- A. The following submittal data shall be furnished according to the General Conditions and Section 23 00 10 and shall include, but not be limited to:
1. Computer Room Air Handling Units\* complete with fan and DX coil selection data, calculations, DX compressor data physical dimensions, horsepower and starting requirements, humidifiers, motor details, DDC control system, etc. Shop Drawings shall indicate specifically that the construction, fabrication, etc., of the units to be furnished complies with these Specifications.
  2. Prior to execution of factory testing and field testing, submit test procedures, recording forms, and test equipment cut sheets to Engineer for review. Refer to Section 23 00 20 titled “Scope of Work” for “Scheduling Procedures”.
  3. Factory Test Schedule.
  4. Factory Test Reports.
  5. Field Test Schedule.
  6. Field Test Reports.
- B. Training Schedule including extent of scope and estimated time duration.

- C. All items or equipment listed above with asterisks (\*) shall be certified by the manufacturer using Manufacturer Certification "MCA" as set forth in Section 23 00 10. See Section 23 00 10 for certification requirements.

## 1.5 WARRANTY

- A. Comply with the requirements of the General Conditions and Section 23 00 10.

## PART 2 PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- A. If it complies with these Specifications, factory-built computer room DX air handling units manufactured by one of the following manufacturers will be acceptable:
1. APC Network Air
  2. Data-Aire
  3. Liebert
  4. Stulz
- B. If it complies with these Specifications, steam humidifiers manufactured by one of the following manufacturers will be acceptable:
1. Armstrong
  2. Dri-Steam
  3. Nortec

### 2.2 FACTORY-BUILT COMPUTER ROOM AIR HANDLING UNITS

- A. General:
1. Furnish factory assembled packaged direct expansion self-contained air conditioning unit and controls with discharge airflow pattern and refrigerant side connections as indicated on the Contract Documents and capacities as listed in the schedules by the Contract Documents.
  2. Unless otherwise noted, each computer room air handling unit shall be complete with casings, fans, insulation, stainless steel drain pans, electric heating coils, humidifier, direct expansion cooling coils, galvanized or painted filter retainer frames and filter media as specified in Section 23 40 00 titled "Air Filtering", factory mounted fan motors with adjustable bases, and belt drives.
  3. Sound Ratings:
    - a. Each computer room air handling unit shall be constructed and shall operate for all conditions of air flow to provide an NC environment in the occupied space as specified in Section 23 05 07 titled "Design Conditions", except these units shall not produce higher than a NC 65 within 6' from the unit return air inlet. Sound rating required for the completed installation shall be achieved with the computer room air handling unit designed, constructed and installed to comply with the sound criteria listed herein with the room construction as indicated on the Architectural and Structural Drawings for this Project and with the ductwork and vibration isolation as indicated in these Specifications and on the Drawings.
  4. Unit Casing and Frame:
    - a. The unit framework shall be formed steel members of minimum 14 gauge galvanized steel. All exterior panels shall be fabricated from minimum 18 gauge galvanized steel. Exterior casing shall be powder coated or over-sprayed with a minimum of .75 mil alkyd finish. Color shall be selected by the Engineer from the manufacturer's standard color selections. All sections exposed to the air stream shall be insulated with minimum 1" thick multi-density, acoustical, flame attenuated fiber glass insulation. Insulation shall be faced with or manufactured with an environmentally acceptable material suitable for cleaning with a wet biocide or fungicide without disintegration or damage and shall meet the combustion requirements established by ASTM E24 the "Erosion Test Method" and air quality requirements stipulated in ASHRAE Standard 62-89. All insulation shall meet requirements of Fire Safety Specification NFPA 90A and 90B. The casing shall not have any penetrations in areas exposed to the fan compartments. All caulking shall be Class I, fire retardant. The panels and all materials shall not exceed the following limits:
      - 1) Flame Spread 25
      - 2) Smoke Developed 50

- b. The computer room air handling unit shall be provided with hinged doors and with quick release where required to allow service access to humidifiers, condensate pumps, control actuators, coils and valves. The access doors shall be constructed of minimum 18 gauge galvanized steel or glass fiber reinforced thermoplastic and shall have "lift-off" hinges or cam lock and be for quick complete removal of door for servicing. A gasketed panel with a minimum of two (2) hexkey tooled or slotted access latches shall be provided for access to fan, fan motor, drive package and fan bearings. All access doors and panels under positive pressure shall have bulb-seal EDPM gasket with a spring steel core. Access doors shall be secured with tool operated latches. Control panel door shall have the hinges to prevent door removal. Refrigerant piping shall be secured by clamps constructed of zinc plated steel with a vinyl or thermoplastic elastomer insert to prevent failure to piping due to vibration, stress, fatigue and electrolysis.
5. Supply Fan:
  - a. The supply fan shall be a double inlet or single width/single inlet forward curved or airfoil centrifugal type fan secured to a machined, ground and polished solid steel shaft. The shaft shall be coated with a rust inhibitor and shall be supported by pillow block bearings selected for a minimum of two hundred thousand (200,000) hours average life. The bearings shall have fully-accessible grease fittings or have the fittings extended to a common location in the blower access area. Drive package shall utilize two (2) V-Belts with a minimum service factor of two hundred (200%) percent above the fan motor horsepower for each belt and shall include an adjustable variable pitch sheave. Fan and motor assembly shall be mounted on a minimum 14 gauge galvanized steel frame.
  - b. All fans shall be guaranteed to fulfill the specified requirements. Fan shall not produce excessive noise as compared to units of like size and power when used in conjunction with the specified vibration isolation.
  - c. Each fan motor shall be sized to drive its respective fan when fan is operating at a speed (due to pulley adjustment) of five (5%) percent in excess of that required to meet the fan performance and when fan requires the maximum power at this speed. No motor shall operate within the service factor range. Motors shall be high efficiency type. Refer to Section 23 05 13 titled "Motor Requirements for HVAC Equipment" for additional requirements.
  - d. For upblast units with ducted discharge, provide a separate (additional) set of drive and driven sheaves (size to be determined in field) for final balancing of unit.
6. Unit Supports: The computer room air handling units shall be furnished with adjustable floor stands and spring vibration isolators. The floor stand shall be equipped with integral turning vane and shall isolate the unit from the floor and shall be constructed of welded tubular steel or galvanized angle iron frame with corner gussets. The floor stand shall have adjustable legs connected to vibration isolators. The spring vibration isolators shall be furnished and installed by the Division 23 mechanical contractor. The spring vibration isolators shall be similar to Mason Industries Type SLR, providing a minimum static deflection of 1" and designed for a minimum isolation efficiency of 90%. Refer to Specification Section 23 05 48 titled "Vibration Isolation" for additional requirements. The entire floor stand/vibration isolation assembly shall be located within an emergency galvanized drain pan provided by the Mechanical Subcontractor, which shall be located directly on the structural floor slab. For units with external condensate pumps, the pump shall be located within an extended section of the emergency drain pan. Approximate stand height shall be, as indicated by the Contract Documents, taking into account raised floor height and isolator heights (refer to Architectural Drawings for height of raised floor).
7. Compressors: Provide Hermetic scroll or Semi-hermetic type compressors utilizing R-134A refrigerant complete overload protection on all three power lines, internal thermostat for winding protection, anti-slug device, crankcase heater and low pressure override timer (air cooled only) for positive starting at low temperatures.
8. Refrigeration Circuits: Two completely independent refrigerant circuits each with thermal-expansion valve with external equalizer, liquid-line filter-drier with flare fittings, sight glass with moisture indicator, high and low pressure safety switches with schrader type fittings with valve core and charging valves.
  - a. DX Evaporator Coil: Alternate-row or split-face-circuit, A-frame or flat coil type, direct expansion coil of seamless copper tubes expanded into aluminum fins. Mount coil assembly over stainless-steel drain pan designed to drain completely dry upon unit shutdown.
  - b. Air-Cooled Condenser: Corrosion resistant cabinet, copper tube aluminum fin coils arranged for at least two independent circuits, multiple direct drive propeller fans with permanently lubricated ball bearings, single phase motors with internal overload protection, integral electric control panel, and disconnect switch. Control capacity by varying the speed of the fans. Variable fan speed control for low ambient winter operation. Refer to Section 23 05 13 titled "Motor Requirements for HVAC Equipment" for fan motor and variable speed drive requirements.

9. Filter:
  - a. Unit shall be provided with a filter assembly. Filters shall be front or side loading [Type "A"], UL, Class 2, 4" thick test standard mounted in a permanent frame at unit intake. Frames shall be equipped with foam gaskets, fasteners and filter centering dimples.
  - b. Provide a [Type "D"] 2" thick construction filters in front of the final filters.
  - c. A filter switch (furnished and installed by unit manufacturer) shall be a pressure differential type that senses the pressure drop through the filter bank. The adjustable set point operates within a range of 0" to 2.5" w.c. If the pressure differential switch is above set point, a contact closure is made for monitoring by the unit controller.
  - d. Refer to Specification Section 23 40 00 titled "Air Filtering" for filter specifications and additional requirements.
10. A solid state electronic control system shall be field programmable, self-calibrating microprocessor controller board with display to provide all system functions and alarm data modules and shall contain no moving parts. The system shall be provided in a factory wired electric control center. Both the temperature and humidity controls shall have only one (1) adjusting and sensing point for the room conditions. The sensing elements for dry bulb and humidity shall be located in the return air stream. The electric control center and electronic control system shall be serviceable by raising a hinged door on the front of the unit. This panel shall be isolated from the conditioned air stream. The control system shall be capable of maintaining room temperature and humidity within  $\pm 2^{\circ}\text{F}$  and  $\pm 5\%$  R.H. as scheduled. Each component circuit shall be individually fused. Starters or contractors and relays shall be controlled from a 24V AC circuit. The control system shall consist of:
  - a. Temperature Anticipation: Controller shall anticipate and adjust to changing room conditions to minimize the rate of change of temperature and energy consumption.
  - b. On Board Operator Instructions: The factory mounted display shall indicate a step-by-step troubleshooting procedure for pre-selected alarm conditions. It shall also provide built-in prompting instructions for field configuration of the controller.
  - c. Run Times: Controller shall store in memory and display on demand, the running hours of the motor devices, blowers, and humidifier.
  - d. Self-Diagnostics: Controller shall display both the microprocessor control output signal and the mode of operation that room conditions require. The system shall self-check the microprocessor status.
  - e. Restricted Program Access: The microprocessor shall have the restricted program access to prevent unauthorized modification of system set points and the system configuration options. The level of access shall be field selectable.
  - f. Easy Service: The microprocessor shall be mounted in an aluminum enclosure inside the air conditioner and shall be connected to all of the unit's wiring via a single edge connector to allow easy installation and removal. The microprocessor shall have individual microfuses for each controller output to a system contractor.
  - g. Software Communications Interface: Each computer room air handling unit shall be equipped with a Modbus RS-485 communications interface card to allow the Division 25 BMCS system to monitor, control, and alarm all available points.
  - h. Remote Interface to the BMCS: The microprocessor shall have at least two (2) pairs of dry contact outputs for connection to the Division 25 BMCS system for remote alarm and status monitoring.
  - i. Primary /Secondary Operation: Each microprocessor shall have a capability of switching to a secondary unit upon any of the alarm signals or another alternate means of redundancy provided.
  - j. The control system shall monitor by means of factory installed and calibrated equipment (audible alarm, indicator lights, and silencer switch) the following control conditions:
    - 1) Monitor: Temperature
      - a) Cooling/Heating
      - b) Historical Data
    - 2) Control: Temperature Set Point
      - a) Temperature Tolerance
      - b) High/Low Temperature Alarm
      - c) Remote Start/Stop
      - d) Compressor Short Cycle
    - 3) Alarms: High Temperature
      - a) Low temperature
      - b) Compressor High Pressure
      - c) Compressor Low Pressure
      - d) Compressor Short Cycle
      - e) Loss of Normal Electrical Power

- f) Condensate Pump High Level
  - g) Loss of Air Flow
  - h) Change Air Filters
  - i) Local Alarm
  - j) Water Detection
  - k) Smoke Detection
11. Drain Pans: Drain pans shall be constructed of minimum 18 gauge Type 304 stainless steel with non-ferrous connections and shall have factory installed removable brass plug connections for clean out and shall be water tight. Pan shall have a depth of minimum 2". Pan shall slope in two (2) directions towards the condensate drain connection. The condensate drain pans shall be graded within the unit as required to allow the drain pan to drain completely dry upon unit shutdown. Drain connection shall be located at the casing edge, shall be flush with bottom of drain pan to allow drain pan to drain dry upon unit shutdown. The unit shall have a field installed secondary water tight emergency stainless steel drain pan at the floor level. An integral condensate pump shall be factory installed and wired when noted on schedule.
12. Miscellaneous:
- a. Disconnect Switch: A factory installed disconnected switch shall be provided at the power connection. The disconnect shall be a molded case manual (non-automatic) circuit breaker with a lockable handle to provide protection for all line voltage components and shall be sized per NEMA Codes. Wire and conduit entrance shall be through side of unit at main control panel area.
  - b. Filter Switch: The filter switch shall be a pressure differential type that senses the pressure drop through the filter bank. The adjustable set point operates within a range of 0" to 2.5" w.c.
  - c. Life Safety Interface: The unit shall have terminals to connect to the remote life safety system. If the life safety system is activated, the unit shall shut down. Automatic restart of the computer room unit after a life safety shutdown trip shall be software or hardware prohibited through the start/stop contactor. Restarting of the computer room unit shall be manually started by the operator either locally or if a digital Division 25 BMCS interface is provided, remotely through the Division 25 BMCS system network computer.
  - d. High Temperature Thermostat or Fire Stat: The unit shall shut down if the high temperature thermostat reaches its set point (140°F adjustable).
  - e. Local Display Alarm: Unit mounted alarm lights shall be activated on water detection or static pressure high limit or high temperature condition.
  - f. Condensate Pump: Unit mounted condensate pump shall be provided for each unit. Condensate pump shall be integral to the unit, factory wired and piped, with a high level alarm connected to the unit microprocessor controller for local annunciation at the unit control panel.
  - g. Smoke Detector (provided by manufacturer): Unit shall stop upon activation of detector.
  - h. Under Voltage Protection: An excessive drop of voltage or power interruption as detected by the unit's in phase monitor (sensing all three {3}) shall disconnect the system until full power is restored. Upon return of power, the unit shall automatically restart through an adjustable time delay relay zero to two (0-2) minutes. Phase loss, under voltage and phase reversal conditions shall be protected by a UL listed phase monitor (SLA Series) provided for each unit and built in as an integral part of the unit.
  - i. Unit Service Connections: All openings through the casing for piping and electrical connection shall be grommets. Motor access and fan shaft removal shall be from either side.
  - j. Upblast Units: Non-ducted upblast units shall be equipped with discharge plenum and two (2) double deflection aluminum supply air registers located at 90° to each other. Ducted upblast units shall be equipped with extended discharge insulated plenum and flanged outlet on front side of unit suitable for connection of supply air distribution ductwork by others.
  - k. Shop Testing: Units shall be shop tested. Documentation of pressure, temperature, air capacity, electrical current draw and voltage of all motors shall be submitted to the Engineer for review prior to shipment from the factory. The acoustical performance test data shall include the NC level data recorded from each side of the computer room unit.
13. Inspection and Startup Service
- a. Provide a competent, factory service representative for final inspection and startup of each computer unit.
  - b. After the installation of the DX computer room unit is complete, perform a thorough inspection of the units in the presence of the Engineer and the Owner, including all controls and electrical and piping connections. The HVAC Subcontractor shall report deficiencies in writing to the Engineer prior to startup of each unit.

- c. Start up each computer room unit and remote DX condensing unit in the presence of the Owner at times convenient to the Owner, including during off hours as required and verify the correct operation of all safety devices, operating controls and auxiliary equipment.
- d. Provide onsite presence of a factory service representative to participate in computer room startups, final commissioning and the Owner's pull-the-plug test(s).

### **PART 3 EXECUTION**

#### **3.1 INSTALLATION**

- A. All computer room air handling units and air cooled condensing units shall be installed in accordance with the latest industry standards, per the manufacturer's recommendations, and as indicated on the Drawings.

#### **3.2 TRAINING**

- A. Instruct designated building operating personnel in proper operation and maintenance of all components of the computer room air handling units. Submit a proposed Training Schedule for review by the Engineer including extent of the scope and estimated time duration. See Section 23 00 10 for additional information.
- B. Provide sixteen (16) hours of on-site instruction of the Owner in the proper operation and maintenance of the equipment.

#### **3.3 FACTORY TESTING**

- A. All factory-built DX computer room air handling units shall be tested in accordance with the latest applicable industry standards as specified herein and be UL or ETL listed.
- B. A representative from the Engineer and/or the Owner's representative may witness factory testing of the equipment at the time of manufacture. The HVAC Subcontractor shall notify the Engineer and Owner in writing at least three (3) weeks prior to the day of the factory test. The HVAC Subcontractor shall have a representative attend the factory test with the Engineer and/or Owner's representative.

#### **3.4 FIELD TESTING**

- A. Prior to execution of field testing, submit test procedures, recording forms, and test equipment cut sheets to Engineer for review. Refer to Section 23 00 20 titled "Scope of Work" for "Scheduling Procedures".
- B. The HVAC Subcontractor shall notify the Engineer and Owner in writing at least two (2) weeks prior to the day of the field test. The Engineer and Owner may witness the field test if they so desire.
- C. Refer to Section 23 05 93 titled "Testing, Balancing and Adjusting" for additional testing requirements for factory-built computer room DX air handling units and air cooled condensing units.

**END OF SECTION**