

## University of Houston Master Specification

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### SECTION 23 8123 - COMPUTER ROOM AIR CONDITIONING UNITS

Maintain Section format, including the UH master spec designation and version date in bold in the center columns of the header and footer. Complete the header and footer with Project information.

Edit and finalize this Section, where prompted by Editor's notes, to suit Project specific requirements. Make selections for the Project at text identified in **bold**.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

Delete hidden text after this Section has been edited for the Project.

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor's attention is specifically directed, but not limited, to the following documents for additional requirements:
  - 1. The current version of the *Uniform General Conditions for Construction Contracts*, State of Texas, available on the web site of the Texas Facilities Commission.
  - 2. The University of Houston's *Supplemental General Conditions and Special Conditions for Construction*.

##### 1.2 DESCRIPTION OF WORK:

- A. Work Included: Provide computer room air conditioning unit work including, but not limited to, the furnishing and installation of complete, self-contained, factory-assembled, computer room air conditioning systems. Design the system for **[draw] [blow]** through air arrangement with **[downflow] [top]** delivery to ensure even air distribution across the face of the coil. System shall be completely pre-piped, prewired, and ready for final connection.
- B. Types: The types of computer room air conditioning units required for this project include, but are not limited to, the following:
  - 1. Chilled water/electric heat units.
  - 2. Chilled water/hot water units.
  - 3. Glycol/electric heat units.
  - 4. Chilled water with DX backup/electric heat units.
  - 5. Air cooled/electric heat units.

##### 1.3 QUALITY ASSURANCE:

- A. Manufacturer: Provide products complying with these specifications and produced by one of the following:
  - 1. Liebert Corporation. [UH Standard]

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2. **[Airflow.]**

3. **[Stultz.]**

### 1.4 SUBMITTALS:

- A. Shop drawings submittals shall include, but are not limited to, the following:
  - 1. Unit cutsheets clearly showing all features, accessories, dimensions, weights, and capacities.
  - 2. Written instructions for equipment to installation.
  - 3. Wiring and piping diagrams and connection locations.
  - 4. Performance certifications and test results.
  - 5. Warranty information.
  - 6. Additional information as required in Section 23 0100 "Mechanical General Provisions."

### 1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver computer room air conditioning units and accessories in factory-fabricated water-resistant wrapping.
- B. Handle computer room air conditioning units and accessories carefully to avoid damage to material components, enclosure and finish.
- C. Store computer room air conditioning units and accessories in a clean, dry space and protect from the weather.

## PART 2 - PRODUCTS

### 2.1 MATERIALS:

- A. General: Except as otherwise indicated, provide materials and components as indicated by manufacturer's product information and as required for a complete installation. Computer room air conditioning units shall utilize **[building chilled water and a chilled water cooling coil] [a glycol-cooled DX cooling system] [an air-cooled DX cooling system]** as the primary cooling and dehumidification source. **[When direct chilled water cooling is not adequate to provide the required temperature and humidity control, the unit controls shall automatically activate the DX cooling system to provide the required cooling and dehumidification while rejecting heat to the building chilled water system.]**
- B. Unit Capacities: Unit capacities shall be as scheduled or shown on the Drawings.
- C. Cabinet and Frame Construction: Unit frames shall be constructed of welded tubular steel. Interior sheet metal panels shall be welded to the frame assembly and the exterior panels shall be insulated with a minimum one inch, 1-1/2 pcf fiber insulation. All panels shall have concealed fasteners and be easily removed to provide access to equipment. Panels shall be arranged so as to provide access to electrical control panel and control valve compartment without interrupting air flow. The main unit color shall be IBM-white and the accent panel shall be **[IBM-blue]**.
- D. **[A-frame DX Cooling Coil: Cooling coil shall be of an A-frame design with four rows and a maximum face velocity of 550 fpm. Construction shall be of copper tubing mechanically expanded into aluminum plate fins. The refrigerant circuits shall be designed to distribute refrigerant into the entire coil face area. Entire coil assembly shall be mounted in a stainless steel condensate drain pan.]**

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- E. **[A-frame Chilled Water Cooling Coil:** Cooling coil shall be of an A-frame design with six rows and a maximum face velocity of 500 fpm. Construction shall be of copper tubing mechanically expanded into aluminum plate fins. The chilled water circuits shall be designed to distribute water into the entire coil face area. Entire coil assembly shall be mounted in a stainless steel condensate drain pan.]
- F. Chilled Water Cooling Coil: Cooling coil shall be a custom-designed six-row chilled water cooling coil with copper tubes and aluminum fins. The coil shall be installed in the return air portion of the unit and shall provide full cooling capacity with 45°F entering chilled water. Coil shall be tested at 300 psi air under water.
- G. **[Electric Reheat:** The units shall be furnished with electric reheat coils. Coils shall be low wattage density, fin tubular, stainless steel construction and shall be protected by thermal safety switches. Three stage reheat control shall be provided for CRAC Units [\_\_\_\_\_, \_\_\_\_\_] and [\_\_\_\_\_] and two stage reheat control shall be provided for CRAC Unit [\_\_\_\_\_, \_\_\_\_\_] and [\_\_\_\_\_]. Each stage of heating shall be 3-phase.]
- H. **[Hot Water Reheat:** Heating coil shall have copper tubes and aluminum fins. Coil shall be tested at 300 psi air under water.]
- I. Refrigeration System: [CRAC Units [\_\_\_\_\_, \_\_\_\_\_] and [\_\_\_\_\_]] shall employ two redundant and completely separate refrigerant circuits. [CRAC Units [\_\_\_\_\_, \_\_\_\_\_] and [\_\_\_\_\_]] shall employ a single refrigerant circuit. Each refrigeration circuit shall include hot gas mufflers, liquid line filter dryers, refrigerant sight glass with moisture indicator; adjustable, externally equalized expansion valves, and liquid line solenoid valves. All refrigerant piping shall be Type "L" copper tubing.
- J. Compressors: The compressors shall be located in a separate compartment so that they may be serviced during operation of the equipment. [CRAC Units [\_\_\_\_\_, \_\_\_\_\_] and [\_\_\_\_\_]] compressors shall be a semi-hermetic design with a suction gas-cooled motor, vibration isolators, thermal overloads, oil sight glass, manual reset high pressure switch, pump down low pressure switch, suction line strainer, reversible oil pumps for forced feed lubrication, and a maximum operating speed of 1750 rpm. Compressors shall have a minimum EER of 11.4 based on ARI standard conditions. Compressors shall have cylinder unloaders controlled via the unit microprocessor to provide energy efficient operation at reduced loads. [CRAC Units [\_\_\_\_\_, \_\_\_\_\_] and [\_\_\_\_\_]] compressor shall be a hermetic design with high and low pressure safety switches, externally equalized expansion valve and a refrigerant sight glass/moisture indicator. Compressors shall be warranted 5 years.
- K. Four-step Compressor Control: [CRAC Units [\_\_\_\_\_, \_\_\_\_\_] and [\_\_\_\_\_]] control systems shall include cylinder unloaders on the semi-hermetic compressors. The unloaders shall be activated by solenoid unloaders controlled by the control system microprocessor. In response to the return air temperature, the control system shall operate the unloader and liquid line solenoids to provide four stages of cooling. The stages shall be 1) one compressor unloaded, 2) two compressors unloaded, 3) one compressor unloaded and one compressor loaded, and 4) two compressors loaded. On a call for dehumidification, the control system shall cause at least one compressor to fully load for dehumidification.
- L. Air-Cooled Condensers: Each unit shall be provided with a low profile, slow speed, multiple direct drive propeller fan cooled, dual circuit air cooled refrigerant condenser. Condensers shall be aluminum construction with copper tube, aluminum fin coils and shall be arranged for [vertical] [horizontal]

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condenser air discharge. Condensers shall be sized to balance the heat rejection of each compressor when supplied with [105°F] [115°F] [ °F] inlet air.

- M. **[Glycol-cooled] [Chilled Water-cooled]** Condensers: Each refrigerant circuit shall be provided with a separate, cleanable, shell and tube counterflow-type condenser heat exchanger with removable heads. Condenser heat exchangers shall be ASME-stamped for a maximum refrigerant pressure of 400 psi at 300°F and a maximum water pressure of [150 psi] [300 psi] at 150°F. Unit [glycol] [chilled water] flow shall not exceed [55 gpm] [\_\_\_\_\_ gpm] and maximum pressure drop shall not exceed [18'] [\_\_\_\_\_'] of water column.
- N. **[Air-Cooled Condenser Control]:** Each air-cooled condenser shall be provided with a variable speed fan control system to allow positive computer room air conditioning unit startup and operation at ambient temperatures down to [-20°]. Controls shall be completely factory wired and shall sense the highest head pressure of either operating compressor and shall cycle fans and vary fan speed to properly maintain compressor head pressure.]
- O. **[[Glycol-regulating] [Chilled Water Regulating] Valves:** Each condenser heat exchanger shall be pre-piped with a 2-way head pressure activated control valve and a parallel bypass valve, each rated at [150 psi] [300 psi].]
- P. **[Chilled Water [and Hot Water] Control Valves:** Each chilled water [and hot water] coil shall be pre-piped with a [2-way] [3-way] modulating control valve, rated at 150 psi.
- Q. Electronic Control System:

[VERIFY CONTROL SYSTEM FEATURES/REQUIREMENTS]

- 1. Each unit control system shall be microprocessor-based and allow programming of temperature and humidity setpoints, alarm parameters, provide monitoring of operational status and maintain a data base of room conditions and environmental system operational status.
- 2. The control system shall allow programming of the following room conditions:
  - a. Temperature Setpoint (65°F - 85°F).
  - b. Temperature Sensitivity (1°F - 5°F in 0.1°F increments).
  - c. Humidity Setpoint 40% - 60% RH.
  - d. Humidity Sensitivity 1% - 10% RH in 0.1% increments.
- 3. All setpoints shall be adjustable from the individual unit front monitor panel or a hand-held service terminal.
- 4. Temperature and humidity sensors shall be capable of being calibrated using the front monitor panel controls to coordinate with other temperature and humidity sensors in the room.
- 5. The **[CRAC Units [\_\_\_\_\_, \_\_\_\_\_] and [\_\_\_\_\_]]** control systems shall also be capable of predictive control of temperature and humidity.
  - a. Temperature Anticipation: The microprocessor shall have the capability of responding the varying rates of temperature change in the computer room. The control system shall delay heating or cooling in response to very low rates of change and shall advance heating or cooling in response to rapid temperature changes.
  - b. Predictive Humidity Control: The microprocessor shall calculate the moisture content in the room and prevent unnecessary humidification and dehumidification cycles by responding to changes in dewpoint temperature.

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6. The **[CRAC Units [\_\_\_\_\_, \_\_\_\_\_] and [\_\_\_\_\_]]** control systems shall provide the following internal controls.
  - a. Compressor Short-cycle Control: The control system shall prevent compressor short-cycling by incrementally expanding the control hysteresis of the compressor stages when compressor cycles approach 10 cycles per hour. Timer-based short-cycle control shall not be used.
  - b. Automatic Compressor Sequencing: The microprocessor shall automatically change the lead/lag sequence of the compressors after each start to lengthen compressor-on cycles and even compressor wear.
  - c. System Auto/Restart: For start-up after power failure, the system shall provide automatic restart with a programmable (up to 10 minutes) time delay. Programming can be performed either at the unit or from the site monitoring system.
  - d. Sequential Load Activation: During start-up, or after power failure, the microprocessor shall sequence operational loads activation to minimize inrush current. Systems allowing multiple loads to start simultaneously shall not be used.
7. Each unit shall be provided with a monitor panel to display operational status, alarms, and permit calibration and programming of operation parameters. All indicators shall be in language form. Symbols or codes will not be acceptable. The front monitor panel shall be provided with a three digit, 0.43" high, seven segment LED numerical display to indicate temperature, humidity, percent capacity (cooling, heating, humidification, de-humidification, and econ-o-cycle), temperature and humidity setpoints and sensitivities, and humidifier flush rate. Operational status (heating, cooling, humidification and dehumidification) and alarm conditions shall be indicated by colored LEDs.
8. The microprocessor shall activate an audible and visual alarm in event of any of the following conditions.
  - a. High temperature.
  - b. Low temperature.
  - c. High humidity.
  - d. Low humidity.
  - e. High compressor head pressure (compressorized systems only).
  - f. Humidifier problem.
  - g. Loss of air flow.
  - h. Change filters.
  - i. Local alarm (customer assignable).
9. The microprocessor shall also provide four customer accessible local alarms to be indicated on the front panel. They shall be capable of being programmable activation time delays.
  - a. Audible Alarm: The audible alarm shall have adjustable volume to match the surrounding ambient sound level.
  - b. Common Alarm: A programmable common alarm shall be provided to interface selected alarms with a remote alarm device.
  - c. Remote Monitoring: **[All alarms shall be communicated to the Site Monitoring System with the following information: date and time of occurrence, unit number and present**

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temperature and humidity.] [A common alarm output contact shall be provided for monitoring by [\_\_\_\_\_].]

- d. **Alarms:** Two customer alarms shall be programmed and used to monitor **[underfloor moisture alarms and fire stat unit shutdown]**. The remaining two alarms shall be for future use.
- 10. The **[CRAC Units [\_\_\_\_\_, \_\_\_\_\_] and [\_\_\_\_\_]]** microprocessors shall provide the capability of maintaining a log of system performance and environmental conditions. This data shall be communicated and displayed at the Site Monitoring System. The following information shall be included in the log, complete with time and date:
  - a. Temperature (present, minimum and maximum for last 24 hours.
  - b. Humidity (present, minimum and maximum for last 24 hours).
  - c. Compressor operating hours.
  - d. Alarm occurrence.
- 11. All electronic circuitry shall be provided with self-diagnostics to aid in troubleshooting. Each printed circuit board shall be diagnosed and reported as pass/not pass.
- 12. The unit control module shall incorporate a RS-422 communications port for communications with the site monitoring system. No field-modification or programming shall be required for connection to the site monitoring system.
- R. **[Glycol System Control: Each computer room air conditioning unit shall include a dry contact output interface to start the glycol system whenever the unit is operating.]**
- S. **[Chilled Water Flow Switch: A factory-mounted and wired flow switch shall activate the unit alarm system upon loss of chilled water supply.]**
- T. **Filter Chambers:** Unit filter chambers shall be an integral part of the system, designed within the frame and cabinet. The filters shall be rated not less than [60%] [\_\_\_\_\_%] efficiency by the NBS Atmospheric Dust Spot Test. The filters shall be serviceable from either end of the unit without the use of ladders or special rigging.
- U. **Fan Section:** Unit fans shall be centrifugal-type, double width, double inlet, and shall be statically and dynamically balanced at the factory as a completed assembly to a maximum vibration level of 2 mils in any plane. Wheels shall be supported on a heavy-duty steel shaft having self-aligning ball bearings with a minimum life span of 100,000 hours. Wheels shall be driven by a [high efficiency, energy efficient type] 1750 rpm fan motor mounted on an adjustable slide base. Refer to Section 15140 for additional motor requirements. The drive package shall be 2-belt, variable speed, sized for 200% of fan motor horsepower. Fans shall be located to draw air over the A-frame coil to ensure even air distribution and optimum coil performance.
- V. **Humidifier:** Unit humidifiers shall be of the infrared-type consisting of high intensity quartz lamps mounted above and out of the water supply or the self-contained steam generating type with replaceable steam cylinder and shall have a capacity of 22.1 pounds per hour. The evaporator pan shall be stainless steel and arranged to be serviceable for cleaning without disconnecting water supply lines, drain lines, or electrical connections. The complete humidifier section shall include liquid level control and emergency overflow, and shall be pre-piped ready for final connection. The primary water supply for the humidifiers shall be distilled condensate water from the cooling coil to ensure that minimum deposits accumulate in the infrared humidifier pan, minimum make-up water is consumed and to maximize the time between cleaning cycles. The infrared humidification system shall use bypass air to

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prevent over-humidification of the computer room. The infrared humidifier shall be provided with an automatic flush control system. The flush control system shall be field-adjustable to change the cycle time in accordance with local water conditions. The flush system shall ensure that the primary distilled water supply to the infrared humidifier be from the condensate drain pan and virtually eliminate cleaning maintenance.

- W. Disconnect Switch (Nonlocking Type): Units shall include a non-automatic molded case circuit breaker mounted in the high voltage section of the electrical panel. The complete switch shall include an operating mechanism which is operated from the outside of the unit when the cover for the electrical panel is closed. The operating mechanism shall prevent access to the high voltage electrical components until switched to the "OFF" position.
- X. Floor Stand: Each unit shall be furnished with an adjustable floor stand. The floor stand shall isolate the air conditioning unit from the raised floor and shall be constructed of a welded tubular steel frame with corner gussets. The floor stand shall have adjustable legs connected to vibration isolation pads. The floor stand shall be used to install the air conditioning equipment before the raised floor is put into place to allow all piping and wiring from the unit to be completed before the raised floor is installed. The height shall correspond to the level of the raised floor and have provision for raising the unit one inch and lowering the unit one inch from the raised floor level. A factory-mounted turning vane shall be provided on each stand. The turning vane location shall be coordinated with piping routed under the unit, as detailed on the Drawings.]
- Y. Automatic Restart: Provide each unit with integral automatic restart. The unit shall restart automatically if the unit is stopped due to interruption in power supply. Manual restart is required if unit is stopped by the smoke detector or other safety device.
- Z. Water Detection Tape: Each unit shall be provided with water detection tape which shall be installed under the raised floor where shown on the Drawings to detect the presence of water. Tape length shall be as required to provide detection as shown on the Drawings. The detection tape shall be field-connected to the alarm panel in each unit which shall provide a red indicator and audible alarm. The water detection system shall be an integral part of the unit alarm system which shall display "WATER UNDER FLOOR", when the detection tape is activated.
- AA. Factory Piping and Wiring: Each unit shall be fully factory-piped, wired, and tested such that the only field connections required are for:
1. **[Glycol] [Chilled water] [Refrigerant] [and hot water]** supply and return.
  2. Humidifier cold water make-up.
  3. Condensate drain.
  4. Unit power wiring.
  5. **[External site monitor wiring.]**
  6. **[External EPO system wiring.]**
  7. **[Water detection tape wiring.]**
  8. **[Glycol system control interface wiring.]**
- BB. Firestat: Each unit shall be provided with a factory-installed and wired firestat which senses the return air path and shuts down the unit and activates the alarm system upon sensing excessive heat.

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- CC. Turning Vanes: A radius elbow turning vane shall be installed below the raised floor at the unit discharge to direct airflow in the direction noted on the Drawings. The turning vane shall be designed so as to not interfere with the raised floor system.
- DD. Temperature/Humidity Recorders: Provide 7 day/24-hour temperature/humidity recorders of the full scope, two pen type, where shown on the Mechanical and Electrical Drawings. Recorders shall be 110 volts, single phase and shall be supplied with 100 spare charts and red and blue ink supplies.
- EE. Factory Testing: Each unit shall be fully tested at the factory to verify proper operation. All **[refrigerant] [and] [water]** piping and coils shall be fully leak-tested using the manufacturer's standard test procedure.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION:

- A. General: Install each computer room air conditioning system in accordance with manufacturer's instructions, the NEC, and applicable local codes and ordinances. Test installed system for compliance with these Specifications. Rework as required and as directed to ensure that specified and indicated requirements are met and that installed systems function as intended.
- B. Floor Mounting: Units shall be mounted **[on floor stands. Coordinate floor stand installation with raised floor installation.] [directly on the raised floor system. A felt or elastomeric seal shall be provided between the units and the raised floor to provide an air seal. Coordinate required floor panel cutouts for unit connections and air discharge with the General Contractor. Floor system stringers shall not be modified, cut, or removed.]**
- C. Turning Vanes: Install turning vanes below all units mounted on the room perimeter. Vanes shall be installed below the raised floor and shall be notched to fit around the floor system stringers.
- D. **[Refrigerant Piping: Install, test, evacuate and charge refrigerant piping per the manufacturer's recommendations and as specified in Section 23 2000 "HVAC Piping Systems."]**
- E. Start-up: Unit checkout, start-up, adjustment, and control calibration shall be provided by factory trained technicians in the direct employ of the equipment manufacturer or the manufacturer's local representative. Start-up and unit checkout schedule shall be coordinated with UH representative and unit operation demonstrated to Owner's representative.
- F. Identification: Refer to Division 23 Section Basic Materials and Methods for applicable nameplate and labeling requirements. **[Nameplates shall be installed inside the unit cover and the unit manufacturers labeling system shall be used for exposed labeling of units.]**

**END OF SECTION 23 8123**

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