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UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 9 October 2006

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SECTION 23 81 23.00 40

COMPUTER-ROOM AIR-CONDITIONERS

06/06

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SECTION 23 81 23.00 40

COMPUTER-ROOM AIR-CONDITIONERS 06/06

NOTE: Delete, revise, or add to the text in this section to cover project requirements. Notes are for designer information and will not appear in the final project specification.

This section covers chilled water and direct expansion/air cooled and water cooled computer room air conditioning units. Air-cooled condensing units, refrigerant piping, chilled water piping and microprocessor interface requirements are referenced in the applicable sections. Water cooled condensers are referenced in this section.

Drawings and schedules must include configuration, all capacity conditions, coils, fans, filters, humidifiers, filter operating pressure ranges, access, drainage provisions, vibration isolation, piping, control diagrams, etc.

The following sections should be included when applicable:

Section 23 00 00.00 40 HEATING, VENTILATING, AND AIR-CONDITIONING

Section 23 05 00.00 40 COMMON WORK RESULTS FOR HVAC

Section 23 07 13.00 40 DUCT INSULATION

Section 22 07 19.00 40 PLUMBING PIPING INSULATION

Section 23 73 33.00 40 INDOOR INDIRECT FUEL-FIRED HEATING AND VENTILATING UNITS

Section 23 23 16.00 40 REFRIGERANT PIPING SPECIALTIES

Section 42 23 13.00 40 PROCESS CONDENSERS

Section 23 82 16.00 40 AIR COILS

Section 23 31 11.11 40 DUCTS, LOW PRESSURE

Section 23 09 33.13 40 ELECTRIC CONTROL SYSTEM FOR
HVAC

Section 26 05 00.00 40 COMMON WORK RESULTS FOR
ELECTRICAL

Section 26 18 39.00 40 MEDIUM-VOLTAGE MOTOR
CONTROLLERS

Comments and suggestions on this guide specification
are welcome and should be directed to the technical
proponent of the specification. A listing of
technical proponents, including their organization
designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as
a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer
choices or locations where text must be supplied by
the designer.

PART 1 GENERAL

1.1 REFERENCES

NOTE: This paragraph is used to list the
publications cited in the text of the guide
specification. The publications are referred to in
the text by basic designation only and listed in
this paragraph by organization, designation, date,
and title.

Use the Reference Wizard's Check Reference feature
when you add a RID outside of the Section's
Reference Article to automatically place the
reference in the Reference Article. Also use the
Reference Wizard's Check Reference feature to update
the issue dates.

References not used in the text will automatically
be deleted from this section of the project
specification when you choose to reconcile
references in the publish print process.

The publications listed below form a part of this specification to the
extent referenced. The publications are referred to within the text by the
basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

- AMCA 99 (2003) Standards Handbook
- ANSI/AMCA 210 (1999; 2001a) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating

AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

- ARI 430 (1999) Standard for Central-Station Air-Handling Units

AMERICAN IRON AND STEEL INSTITUTE (AISI)

- AISI SG-03-2 (2002; R 2004) Cold-Formed Steel Design Manual

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

- ASHRAE 51 (1999; Errata, 2006) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
- ASHRAE 52.1 (1992) Gravimetric and Dust Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter

ASTM INTERNATIONAL (ASTM)

- ASTM A 653/A 653M (2004a) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- ASTM B 280 (2003) Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

- ISO 1940-1 (2003) Mechanical Vibration - Balance Quality Requirements for Rotors in a Constant (Rigid) State - Part 1: Specification and Verification of Balance Tolerance - International Restrictions

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- NEMA MG 1 (2003) Standard for Motors and Generators

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

- NEBB TABES (2005) Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2005) National Electrical Code

NFPA 90A (2002) Standard for the Installation of
Air Conditioning and Ventilating Systems

1.2 SUBMITTALS

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Connection Diagrams shall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

Fabrication drawings shall be submitted for the following items consisting of fabrication and assembly details to be performed in the factory.

Cabinet
Blower
Coils
Panel
Compressors
Condenser

Installation Drawings shall be submitted for computer room air conditioning units in accordance with the paragraph entitled, "Installation," of this section.

SD-03 Product Data

Equipment and performance data shall be submitted for computer room air-conditioning systems in accordance with the paragraph entitled, "General," of this section, consisting of use life, total static pressure and coil face area classifications, and performance ratings.

Manufacturer's catalog data shall be submitted for the following items:

Cabinet
Blower
Coil
Filters
Controls
Humidifier
Panel
Compressors
Condenser
Accessories
Spare Parts

SD-06 Test Reports

Test reports shall be submitted for system tests in accordance with the paragraph entitled, "Tests," of this section.

SD-07 Certificates

Certificates shall be submitted for following items showing conformance with the referenced standards contained in this section.

Cabinet
Blower
Coil
Filters
Humidistat
Panel
Controls
Compressors
Condenser
Accessories
Spare Parts

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals shall be submitted in accordance with paragraph entitled, "Operation and Maintenance ," of this section.

1.3 GENERAL REQUIREMENTS

NOTE: If Section 23 00 00.00 40 HEATING, VENTILATING, AND AIR-CONDITIONING is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted.

Section 23 00 00.00 40 HEATING, VENTILATING, AND AIR-CONDITIONING applies to work specified in this section.

Connection Diagrams shall be submitted for computer room air conditioning systems indicating the relations and connections of devices and apparatus by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

PART 2 PRODUCTS

2.1 GENERAL

NOTE: Select one of the following paragraphs based upon type of system required. Coordinate subsequent selections with this paragraph.

NOTE: Fan and motor balance shall conform to ISO 1940-1 - (1986) Balance Quality Requirements of Rigid Rotors - Determination of Permissible Residual Unbalance unless otherwise noted. Motor vibration levels shall conform to NEMA Specification MG-1, Motors and Generators, Part 7 unless otherwise noted.

Spare parts information and data shall be provided by Contractor, meeting referenced standards within this section and referenced sections.

[Data center air conditioning system shall consist of [a] self-contained chilled water type computer room air handling unit[s] capable of precision environmental control. Unit[s] shall be factory fabricated, fully assembled and shall include components and auxiliaries specified herein and defined under ARI 430. Units shall be of the type, class and capacities as shown in the schedules on the drawings.]

[Data center air conditioning system shall consist of computer room air handling units with semi-hermetic compressors and direct expansion cooling coils, and remote mounted air-cooled condensing units specified in Section 42 23 13.00 40 PROCESS CONDENSERS capable of precision environmental control. Computer room air handling units direct expansion coils and the remote air-cooled condensers shall have matched capacities and shall be shipped fully charged with refrigerant. Air handling units shall be

factory fabricated, fully assembled, and shall include all components and auxiliaries as specified herein and shall be of the type, class and capacities as shown in the schedules on the drawings.]

[Data center air conditioning system shall consist of [a] self-contained, air conditioning unit[s] with semi-hermetic compressor[s], direct expansion cooling coil[s], and water cooled condenser[s], capable of precision environmental control. Entire system shall be factory piped, charged with refrigerant and sealed. Air handling units shall be factory fabricated, fully assembled, and shall include all components and auxiliaries as specified herein and shall be of the type, class and capacities as shown in the schedules on the drawings.]

[Data center air conditioning system shall be a combination chilled water/direct expansion cooling system consisting of computer room air handling units with both chilled water cooling coils and direct expansion cooling coils, and remote mounted air-cooled condensing units specified in Section 42 23 13.00 40 PROCESS CONDENSERS capable of precision environmental control. Computer room air handling units direct expansion coils and the remote air-cooled condensers shall have matched capacities and shall be shipped fully charged with refrigerant. Air handling units shall be factory fabricated, fully assembled, and shall include all components and auxiliaries as specified herein and defined, as applicable, under ARI 430. Air handling units shall be of the type, class and capacities as shown in the schedules on the drawings.]

2.1.1 Air Return and Delivery Orientation

**NOTE: Select one of the following two paragraphs to
specify air delivery and air return orientation.**

[Computer room air handling unit shall be downflow discharge, top return, draw-thru cooling coil, and shall discharge air into a raised floor plenum with a turning vane provided to direct the flow of air away from the back of the unit.]

[Computer room air handling unit shall be upflow discharge, bottom return, draw-thru cooling coil, and shall be fitted with a collar for top supply duct connection.]

2.1.2 Components and Accessories

Unit shall be complete with a [floor stand] [chilled water cooling coil,] [direct expansion cooling coil,] [hot water reheat coil,] [electric reheat coil,] [infra-red humidifier,] [electric cartridge steam humidifier,] [steam grid humidifier,] [filters,] [pre-filters,] [main power panel,] [non-locking electrical disconnect switch,] [centrifugal fans,] [microprocessor based control system,] [firestat,] [smoke detector,] [and] [solid-state underfloor water sensor].

2.1.3 Performance

Each computer room air handling unit and its components shall be performance tested for conformance to the manufacturer's ratings and in accordance with ASHRAE 51 or ANSI/AMCA 210. Ratings shall comply with Section 7 of ARI 430. Total static pressure and coil face area classification shall conform to AMCA 99.

2.2 CABINET

Unit frame shall be minimum 1.9 millimeter 14-gage welded steel tubes or steel angles and shall be mill-galvanized or coated with a corrosion-inhibiting epoxy finish. Exterior panels shall be furniture grade steel sheet, mill-galvanized or coated with a corrosion-inhibiting epoxy finish, and insulated with neoprene coated, 25 millimeter one inch minimum thickness, 24 kilogram per cubic meter 1-1/2 pound per cubic foot density fiberglass insulation. Insulation shall be applied to the cabinet panels with 100 percent adhesive coverage and both the insulation and the adhesive shall conform to NFPA 90A. Mill galvanized sheet metal shall conform to ASTM A 653/A 653M and shall be coated with not less than 380 gram per square meter 1.25 ounces of zinc per square foot of two-sided surface. Mill rolled structural steel shall be hot-dip galvanized or primed and painted. Cut edges, burns and scratches in galvanized surfaces shall be corrosion protected. Panels shall be gasketed to prevent air leakage under system operating pressure and shall be removable for service access without the use of special tools. Condensate pans shall be minimum 0.85 millimeter 22-gage AISI SG-03-2 Type 304 stainless steel for corrosion protection and shall be piped to drain. Unit color shall be as selected by the Contracting Officer.

Exterior surfaces of cabinets constructed of mill-galvanized steel shall be prepared by a phosphatizing treatment, and painted with two coats of manufacturer's standard enamel finish in color selected by the Contracting Officer.

[Unit shall be supplied with elevating floorstand or jacks for freestanding installation on the main building floor. Floorstand or jacks shall elevate the unit to the height of the raised computer floor and shall allow for leveling and locking at the desired height. Floorstand or jacks shall be retractable, or removable, for installing the unit directly on the raised floor. Unit shall be fully gasketed (rubber or neoprene) to prevent air leakage at the raised floor penetration.]

2.3 BLOWER

Fans shall be the double width, double inlet, centrifugal type with forward curved blades. Fan wheels shall be galvanized steel and the entire fan assembly shall be statically and dynamically balanced to ISO 1940-1 G6.3 [G2.5] [G1.0] [_____]. Blower shafts shall be heavy duty steel with self-aligning, permanently lubricated ball bearings having a minimum rating of 100,000 hours. Fans shall be belt driven and shall have adjustable motor sheaves, fixed fan sheaves and a minimum of two belts. Drive assembly shall be sized for a minimum of 140 percent of the fan motor nameplate power. Blower and motor assembly shall be mounted on a vibration-isolating sub-base.

Blower motors shall be UL listed, conform to NEMA MG 1, have copper windings, be equipped with [heavy duty ball bearings] [sealed, permanently lubricated bearings], and be mounted on an adjustable base. Motor shall have internal overload protection and be UL listed for having protection against primary single phasing. Blower motors shall meet the requirements of Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL and Section 26 18 39.00 40 MEDIUM-VOLTAGE MOTOR CONTROLLERS.

2.4 COOLING COIL

NOTE: Select one or both of the following
paragraphs based upon type of system selected.

[Chilled water coil shall be constructed of minimum DN15 1/2-inch od copper tubing with corrugated aluminum fins. Maximum face velocity shall be 2.5 meter per second 500 feet per minute at [] cubic meter per second CFM. Minimum coil face area shall be 260 watt per square meter one (1) square foot per ton (12,000 Btuh) of unit capacity. Chilled water circuit shall be designed to evenly distribute water throughout the entire coil face area and shall be controlled by a [2-way throttling] [3-way modulating] valve. Microprocessor control shall position the valve in response to room conditions. [Cooling capacity shall be controlled by bypassing chilled water around the coil.] Coil shall be supplied with [] degrees C [] degree F entering water temperature, with a [] degrees C [] degree F temperature rise. Coil shall require [] liter per second [] GPM of chilled water and the pressure drop shall not exceed [] PSI pascal. Entire coil assembly shall be mounted in a 0.85 millimeter 22-gage AISI SG-03-2 Type 304 stainless steel condensate pan. Chilled water coil shall meet the requirements of section 23 82 16.00 40 AIR COILS.]

[Direct expansion coil shall be [A-frame design and] constructed of copper tubing with corrugated aluminum fins. Maximum face velocity shall be 2.5 meter per second 500 feet per minute at [] cubic meter per second CFM. Refrigerant shall be evenly distributed throughout the entire coil face area from any of the unit's compressors. Direct expansion coils shall meet the requirements of section 23 82 16.00 40 AIR COILS.]

NOTE: Select the following paragraph only if a
chilled water system has been selected.

Water flow control valves shall be [[two-way throttling type, cast brass spring return, normally [closed] [open].] Assembled valves shall be rated for an operating pressure of 1050 kilopascal 150 psig. Control valve assembly shall be [capable of tight shut-off, when controls are operating at system pressure, with the system pump operating at shut-off head and shall be] mounted in the circuit with dielectric union[s] for protection and ease of service.]

2.5 REHEAT COIL

NOTE: Select one of the following paragraphs based
upon type of heating coil chosen.

[Hot water reheat coil shall be constructed of minimum DN15 1/2-inch od copper tubing with corrugated aluminum fins and have a capacity of [] watt [] BTU/HR when supplied with [] degrees C [] degree F entering water temperature. Coil shall require [] liter per second [] GPM of hot water and the pressure drop shall not exceed [] pascal [] PSI. Maximum face velocity shall be 2.5 meter per second 500 feet per minute at [] cubic meter per second [] CFM. Water

circuit shall be designed to evenly distribute water through out the entire coil face area and shall be controlled by a [two-way throttling] [3-way modulating] type valve. Valve shall be made of cast brass. Microprocessor control shall position the valve in response to room conditions. Reheat coil shall be capable of maintaining room dry bulb temperature conditions when the system is calling for dehumidification. Assembled valves shall be rated for an operating pressure of 1050 kilopascal 150 psig. [Control valve assembly shall be capable of tight shut-off when operating at system pressure with the system pump operating at shut-off head and shall be mounted in the circuit with dielectric union for ease of service.] Hot water reheat coil shall meet the requirements of Section 23 82 16.00 40 AIR COILS.]

[Electric reheat coil shall be finned, enclosed, and constructed with a stainless steel core sheath with plated fins to withstand moist conditions. Reheat coil shall be installed down stream of the cooling coil and shall have the capacity of [_____] kilowatt. Coil shall have a minimum of 3 stages of capacity control and shall be protected by UL approved thermal safety switches to protect the system from overheating. Reheat coil shall be capable of maintaining room dry bulb temperature conditions when the system is calling for dehumidification. Electric reheat coil shall meet the requirements of Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL.]

2.6 HUMIDIFICATION

NOTE: Select one of the following three paragraphs
based upon the type of humidification system chosen.

[An infra-red humidification system shall be furnished within the unit. Evaporator pan shall be stainless steel and shall be serviceable without disconnecting high voltage connections. Humidifier shall be pre-piped for final connections and shall include an automatic water supply system. Infra-red humidifier shall be provided with a flush control system which shall be field adjustable to change the flush cycle time in accordance with local water conditions. Flush system shall ensure that the humidifier pan remains clean to reduce maintenance and eliminate unwanted particles.]

[A self-contained electric cartridge humidifier shall be furnished and shall discharge steam directly into the air stream. Humidification system shall consist of a replaceable electric steam generation cartridge, a flush control system suitable for field adjustment to change the flush cycle time an automatic fill system, and steam discharge tubing designed to evenly distribute the steam into the passing airflow.]

[A steam grid humidifier shall be furnished and shall be the steam separator type with a steam jacketed stainless steel distribution manifold and internal drying chamber. System shall be complete with all control valves, traps and strainers. Control components shall be located in a separate compartment away from the air stream. Humidifier capacity and steam supply pressure shall be as scheduled.]

2.7 FILTRATION

NOTE: Select one of the following paragraphs based
upon the type of filtration system chosen.

[Filters shall be accessible from either side of the unit and shall consist of a main filter and a pre-filter in standard sizes. Pre-filter shall be fiberglass filament media having a minimum average atmospheric dust spot efficiency of 15 percent based on ASHRAE 52.1 test methods. Main filter shall be non-woven synthetic or natural fiber media having a minimum average atmospheric dust spot efficiency of 35 percent and a minimum average synthetic dust arrestance of 90 percent based on ASHRAE 52.1 test methods. Unit shall be shipped with all filters installed. Filtration system shall meet the requirements of Section 23 73 33.00 40 HEATING / VENTILATION / AIR CONDITIONING SYSTEMS.]

[Filters shall be accessible from the side of the unit and shall consist of a main filter in standard sizes for ease of replacement. Main filter shall be non-woven synthetic or natural fiber media having a minimum average atmospheric dust spot efficiency of 35 percent and a minimum average synthetic dust arrestance of 90 percent based upon ASHRAE 52.1 test methods. Unit shall be shipped with all filters installed. Filtration system shall meet the requirements of Section 23 73 33.00 40 HEATING / VENTILATION / AIR CONDITIONING SYSTEMS.]

2.8 MAIN POWER PANEL

Main power panel shall include individually [fused] [Circuit breakers] branch circuits, which will isolate any electrical component from the main power supply and completely protect each electrical component from primary single phasing and overcurrent. [Fuses] [Circuit breakers] shall be provided by the manufacturer and factory installed. Components shall be coded to correspond to a wiring diagram for servicing of the power panel. Panel shall have terminal blocks for the main power supply and for auxiliary connections, all clearly marked for identification. Components shall be UL listed. Main power panel shall meet the requirements of Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL.

Access to main power panel shall be from the front of the unit without interrupting the operation of the unit and shall have one main door for check of voltage and current of each component and two (2) doors for access to main power terminal block and auxiliary terminals. Control panel box shall conform to the requirements for a NEMA Type 1 enclosure.

All internal wiring shall be not less than 2 millimeter 14-gage, 105 degrees C, appliance type wire for high voltage, and not less than 1.3 millimeter 18-gage, 105 degrees C, for low voltage control wiring. All wiring shall be in accordance with UL and NFPA 70.

NOTE: Select the following paragraph if a main disconnect switch is desired.

[Unit shall be supplied with a non-locking main circuit breaker to provide an external switch for disconnecting electrical power without directly accessing the high voltage electrical section.]

2.9 CONTROLS

NOTE: Select the following paragraph if local

control and remote monitoring of the air handling
unit through dry contact closures are desired.

[Control system shall be microprocessor based and shall control all cooling, humidification and reheating locally, based on return air conditions. Control system shall be low voltage and provide dry contact closures for all listed alarm points. Manufacturer shall provide a labeled terminal strip for remote monitoring of the alarm points as well as remote start/stop.]

NOTE: Select the following paragraph if local
control and both remote monitoring and control
adjustment of the air handling unit through a remote
building control computer is desired.

[Control system shall be microprocessor based and shall control all cooling, humidification and reheating locally, based on return air conditions. Additionally, the microprocessor shall permit remote communication with an external building control system for data acquisition, alarm monitoring, alarm point adjustment and set point adjustment. Control system shall meet the requirements of Section
23 09 33.13 40 ELECTRIC CONTROL SYSTEM FOR HVAC.]

2.9.1 System Controls

Control system shall be located on the front of the unit and shall contain the following controls:

- [- Unit main on/off switch]
- [- System reset]
- [- Setpoint adjustment for temperature and humidity]
- [- Alarm silence switch which silences audible malfunction alarm, alarm lights stay illuminated until corrective measures have been taken]
- [- Press-to-test switch illuminates all malfunction lights and sounds malfunction alarm (test purposes only)]

2.9.2 System Display

Control panel shall contain indicator lights or illuminated function display for the following:

- [- Systems on]
- [- Power on]
- [- De-humidification, heating, cooling (number of stages as required)]

2.9.3 System Alarms

Control system shall monitor unit operation and shall activate an audible and visual alarm in the event of any of the following alarm conditions:

- [- High room temperature]
- [- Low room temperature]
- [- High room humidity]
- [- Low room humidity]
- [- Dirty filters]
- [- Loss of airflow]

- [- Humidifier problem]
- [- Underfloor water alarm]
- [- Return air smoke detector]
- [- Loss of water flow]

All indicator functions shall be illuminated when in alarm mode.

2.9.4 Thermostat

Thermostat shall be an electronic solid state device with its element located in the filtered return air stream. Thermostat shall have a minimum range of [16] [60] [_____] to [27] [80] [_____] degrees C [_____] degrees F and shall be accurate to within [0.5] [1.0] [_____] degrees at the set point.

2.9.5 Humidistat

Humidistat shall be an electronic solid state device with its element located in the filtered return air stream entering the unit's coils. Humidistat shall have an accuracy of plus or minus [5] [_____] percent in reading relative humidity and shall have a minimum adjustable dead band of plus or minus [5] [_____] percent. Humidistat shall have a minimum operating range of [35] [_____] to [65] [_____] percent relative humidity and shall be adjustable over the full range.

NOTE: Select the following paragraph if humidity is
to be controlled by the use of reheat.

[Humidistat shall start the cooling system upon an increase in humidity while the thermostat regulates room temperature using reheat.]

2.9.6 Heating Coil Interlock

[An interlock shall be provided to de-energize the electric heating coil in the event of air flow failure.]

2.9.7 Air Sensor

Air sensing devices shall be installed to indicate clogged filters and loss of air flow.

2.9.8 Water Sensor

A water sensor shall be mounted on the main floor directly below the unit and shall activate the alarm system if it detects the presence of moisture.

2.9.9 Smoke Detector

Smoke detector shall be located in the return air stream and shall shut down the air handling unit and activate the alarm when smoke is detected. [Alarm shall be connected to building alarm system.]

2.10 COMPRESSORS

NOTE: Select the following paragraph if the system
type is direct expansion (dx)/air-cooled.

[Air conditioning unit shall contain [a single] [multiple] hermetic or semi-hermetic compressor[s] complete with high pressure and low pressure switches, service valves, charging ports, crankcase heaters, three-phase short circuit protection and thermal overload protection. Compressor[s] shall operate at 1750 RPM, be balanced to ISO 1940-1, [G6,3] [G2.5] [G1.0] [____], and shall be set on vibration isolators. Refrigerant circuit[s] within the air handling unit shall be made up of copper tubing manufactured to ASTM B 280 and shall include liquid line filter dryer[s], liquid and moisture indicator[s], expansion valves, and liquid line solenoid valves.]

2.11 WATER COOLED CONDENSER

NOTE: Select one of the following paragraphs if a water cooled condenser has been chosen.

[Water cooled condenser[s] shall be [internal] [remote] coaxial counter flow type designed to balance the heat rejection requirements of the system at [____] degrees C [____] degrees F entering water temperature with a flow rate of [____] liter per second [____] GPM, and shall have a maximum pressure drop of [____] kilopascal [____] psi.]

[Water cooled condenser[s] shall be [internal] [remote] counterflow shell and coil type designed to balance the heat rejection requirements of the system at [____] degrees C [____] degrees F entering water temperature with a flow rate of [____] liter per second [____] GPM, and shall have a maximum pressure drop of [____] kilopascal [____] psi. Condenser[s] shall be ASME stamped for maximum refrigerant pressure of 2800 kilopascal at 149 degrees C 400 psi at 300 degrees F.]

[Water cooled condenser[s] shall be cleanable, [internal] [remote] counterflow shell and tube type with removable heads designed to balance the heat rejection requirements of the system at [____] degrees C [____] degrees F entering water temperature with a flow rate of [____] liter per second [____] GPM, shall and have a maximum pressure drop of [____] kilopascal [____] psi. Condenser[s] shall be ASME stamped for maximum refrigerant pressure of 2800 kilopascal at 149 degrees C 400 psi at 300 degrees F.]

[Water cooled condenser[s] shall be factory piped with [manual] [head-pressure actuated] water regulating valve [and hand operated isolation valves].]

[Condenser[s] shall be designed to permit pump-down and isolation of the entire refrigerant charge within 80 percent of available condenser volume. If the condenser does not have sufficient pump-down capacity, a receiver shall be provided.]

PART 3 EXECUTION

3.1 INSTALLATION

Equipment shall be installed, adjusted and tested in accordance with manufacturer's recommendations.

Installation drawings shall be in accordance with referenced standards in

this section.

[Brass] [Aluminum] [_____] identification tags providing manufacturer's name, address, equipment type or style, catalog number or model, and serial number, shall be securely attached to major equipment components.

Air conditioning unit shall be installed on an elevated floorstand [, independent of adjacent raised flooring.] [beneath the flooring, providing additional support.]

3.2 ELECTRICAL SERVICE

Electrical service shall conform to NFPA 70 [and local Electrical Codes].

3.2.1 Air Conditioning Unit

Air conditioning unit shall operate on [208] [230] [460] [_____] volt, [single] [three] phase electrical service.

3.2.2 Condenser Unit

Remote air cooled condenser shall operate on [120] [208] [230] [460] [_____] volt, [single] [three] phase electrical service.

3.3 PIPE INSTALLATION

NOTE: To provide for emergency water leaks and the consequences of sub-floor flooding, floor drains with wet traps should be provided and a water detection system with alarm should be installed below the elevated floor.

All piping below the elevated floor shall be located so that it offers the least resistance to air flow discharging from the system.

Provide drainage connections for [water cooled units] [condensate] [and] [humidifier flushing system.]

NOTE: Include the following paragraph for air handlers utilizing water cooled condensers.

Provide shut-off valves in condenser water inlet and outlet piping on water cooled units.

Condensate drain piping shall be provided with a P-trap.

3.4 VIBRATION ISOLATION

Air handling unit shall be vibration isolated from building structure and from connecting ductwork. Refer to Section 23 05 48.00 40 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT for vibration isolation considerations.

3.5 TESTS

Entire system shall be tested and balanced per **NEBB TABES** to provide specified quantities of air, plus or minus [10] [_____] percent, and to ensure that each piece of equipment and each system operates in accordance with the manufacturer's instructions.

3.5.1 Vibration Analyzer

Contractor shall use an FFT analyzer to measure vibration levels. It shall have the following characteristics: A dynamic range greater than 70 dB; a minimum of 400 line resolution; a frequency response range of 5 Hz-10 KHz(300-600000 cpm); the capacity to perform ensemble averaging, the capability to use a Hanning window; auto-ranging frequency amplitude; a minimum amplitude accuracy over the selected frequency range of plus or minus 20 percent or plus or minus 1.5 dB.

An accelerometer, either stud-mounted or mounted using a rare earth, low mass magnet and sound disk(or finished surface) shall be used with the FFT analyzer to collect data. The mass of the accelerometer and its mounting shall have minimal influence on the frequency response of the system over the selected measurement range.

3.5.2 ACCEPTANCE

Prior to final acceptance, precision alignment shall be used to demonstrate that fan/compressor and motor are aligned as specified.

Prior to final acceptance, vibration analysis shall verify conformance to specifications. Vibration levels shall not be more than .075 in/sec at 1 times run speed and at fan/blade frequency, and .04 in/sec at other multiples of run speed.

Final test reports shall be provided to the Contracting Officer. Reports shall have a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Reports - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

3.6 OPERATION AND MAINTENANCE

Contractor shall submit [6] [_____] copies of the **Operation and Maintenance Manuals** 30 calendar days prior to testing the computer room air conditioning units. Data shall be updated and resubmitted for final approval no later than 30 calendar days prior to contract completion.

-- End of Section --