

**SECTION 23 81 23
COMPUTER-ROOM AIR-CONDITIONERS**

SPEC WRITER NOTES:

1. Delete between //-- --// if not applicable to project. Also delete any other item or paragraph not applicable in the Section and renumber the paragraphs.
2. Provide the year of latest edition to each publication listed in Article 1.6 APPLICABLE PUBLICATIONS.
3. The spec writer shall review the Physical Security Design Manual for VA Facilities to determine and include any Mission Critical or Life Safety requirements called out.
4. At the time of the last update for this specification variable speed compressors were only available for the larger size (8 tons and larger units). However, the industry indicated that smaller units would soon be available with variable speed compressors. This specification includes as an option //variable speed // on all systems. Specification writer to research availability at the project time and edit accordingly.
5. More than one type of refrigerant may be required for use on this project. Carefully select refrigerants using the EPA SNAP website.
6. There may be several acceptable refrigerants, listing more than one type of acceptable refrigerants is authorized for increased competition.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies process cooling split systems air conditioning unit.
- B. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- C. Definitions:
 1. Energy Efficiency Ratio (EER): A ratio calculated by dividing the cooling capacity in Btu per hour by the power input in watts at any given set of rating conditions, expressed in Watts (Btu/h) per watt.
 2. Integrated Energy Efficiency Ratio (IEER): Calculated by weighting the EER values at different load capacities and adding them together. The formula is based in the approximate number of hours a

unit spends at each load point throughout its life. A minimum of four loads points are used for the calculation.

3. Coefficient of Performance (COP): A ratio calculated by dividing the change in heating or cooling capacity (Btu/h) to the energy consumed by the system (kW), expressed in Btu/kWh.
4. Unitary (AHRI): Consists of one or more factory-made assemblies, which normally include an evaporator or cooling coil, a compressor and condenser combination, and may include a heating function.
5. CRAC Units: Computer Room Air Conditioning Units.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.
- D. //Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.//
- E. //Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING.//
- F. //Section 22 11 00, FACILITY WATER DISTRIBUTION.//
- G. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- H. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT.
- I. //Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.//
- J. //Section 23 05 93: TESTING, ADJUSTING, and BALANCING FOR HVAC.//
- K. //Section 23 07 11, HVAC, and BOILER PLANT INSULATION.//
- L. //Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//
- M. //Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.//
- N. Section 23 21 13, HYDRONIC PIPING.
- O. //Section 23 22 13, STEAM and CONDENSATE HEATING PIPING.//
- P. Section 23 21 23, HYDRONIC PUMPS and Section 23 22 23, STEAM CONDENSATE PUMPS.
- Q. Section 23 22 13, STEAM and CONDENSATE HEATING PIPING.
- R. Section 23 23 00, REFRIGERANT PIPING.
- S. //Section 23 31 00, HVAC DUCTS and CASINGS.//
- T. //Section 23 40 00, HVAC AIR CLEANING DEVICES.//

1.3 SUBMITTALS

- A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 81 23, COMPUTER-ROOM-AIR-CONDITIONERS", with applicable paragraph identification.
- C. Manufacturer's Literature and Data Including: Rated capacities (at design indoor and outdoor conditions), EER/COP, operating characteristics, required specialties and accessories. Submit published catalog selection data showing equipment ratings and compliance with required sensible ratio.
1. Indoor Air Conditioning Unit
 2. Glycol Pump Package
 3. Dry Cooler
 4. Air Cooled Condensing Unit
- D. Submit detailed equipment assemblies with dimensions, operating weights, required clearances.
- E. Submit wiring diagrams for power, alarm and controls.
- F. Certification: Submit, simultaneously with shop drawings, a proof of certification:
- G. //Completed System Readiness Checklists provided by the CxA and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.//
- H. //Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//

1.4 **QUALITY ASSURANCE**

- A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.5 **GUARANTEE**

- A. The unit shall be guaranteed against all mechanical defects in material, parts or workmanship and shall be repaired or replaced at the Contractor's expense within the period of one year from final acceptance. Contractor shall adhere to a four-hour service response time to troubles during the guarantee period.

1.6 **APPLICABLE PUBLICATIONS**

SPEC WRITER NOTES:

1. Make material requirements agree with requirements specified in the referenced Applicable Publications. Verify and update the publication list to that which applies to the project, unless the reference applies to all

mechanical systems Publications that apply to all mechanical systems may not be specifically referenced in the body of the specification, but, shall form a part of this specification.

2. Insert the year of approved latest edition of the publications between the brackets // // and delete the brackets if applicable to this project.
- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standards will govern.
- B. Air-Conditioning, Heating and Refrigeration Institute (AHRI) Standards:
- 210/240-//2023 (2020)//.Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment
 - 340/360-//(I-P 2019)//..Performance Rating of Commercial and Industrial Unitary Air Conditioning and Heat Pump Equipment
 - 410-//2001//.....Forced-Circulation Air-Cooling and Air-Heating Coils
 - 460-//2005//.....Performance Rating of Remote Mechanical-Draft Air-Cooled Refrigerant Condensers
 - 520-//2004//.....Performance Rating of Positive Displacement Condensing Units
 - DCPP (Web-based).....Directory of Certified Product Performance - Applied Directory of Certified Products
- C. Air Movement and Control Association (AMCA):
- 210-//2016//.....Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating (ANSI)
 - 410-//1996//.....Recommended Safety Practices for Users and Installers of Industrial and Commercial Fans
- D. American Society of Heating, Refrigerating, and Air-Conditioning Engineers Inc. (ASHRAE):
- 15-//2019//.....Safety Standard for Refrigeration Systems
 - 34-//2022//.....Designation and Classification of Refrigerants (ANSI)
 - 52.1-//1992//(withdrawn) Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices used in General Ventilation for Removing Particulate Matter

62-1-//2019//.....Ventilation for Acceptable Indoor Air Quality
(ANSI)

90.1-//2019 (I-P)//.....Energy Standard for Buildings except Low-Rise
Residential Buildings (ANSI Approved; IES Co-
sponsored)

//2020//HVAC Systems and Equipment Handbook

//2018//Refrigeration Handbook

E. American Society of Testing and Materials (ASTM):

B117-//2017//.....Standard Practice for Operating Salt Spray
(Fog) Apparatus

F. National Electrical Manufacturer's Association (NEMA):

MG 1-//2016 (R2019)//...Motors and Generators (ANSI)

G. National Fire Protection Association (NFPA) Publications:

70-//2020//.....National Electrical Code

90A-//2021//.....Standard for the Installation of Air-
Conditioning and Ventilating Systems

H. Department of Veterans Affairs (VA):

PG-18-10-//2017(R2023)// HVAC Design Manual

1.7 AS-BUILT DOCUMENTATION

SPEC WRITER NOTE: Coordinate O&M Manual requirements with Section 01 00 00, GENERAL REQUIREMENTS. O&M Manuals shall be submitted for content review as part of close-out documents.

A. Comply with requirements in Paragraph AS-BUILT DOCUMENTATION of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 2 - PRODUCTS

SPEC WRITER NOTE: Coordinate the Computer Room Air Conditioning Unit location with the OIT (Office of Information Technology) requirements. For remote location outside the computer room, select the equipment and accessories to account for higher static pressure and possible requirement for a larger fan motor.

2.1 FLOOR-MOUNTED UNITS 28 KW (8 TONS) AND LARGER

A. Description: Packaged, factory assembled, prewired, and prepiped; consisting of cabinet, fans, filters, humidifier, and controls.

B. Cabinet and Frame: Welded steel, braced for rigidity, and supporting compressors and other mechanical equipment and fittings.

- C. Doors and Access Panels: Galvanized steel with polyurethane gaskets, hinges, and concealed fastening devices.
- D. Insulation: Thermally and acoustically insulate cabinet interior with - 25-mm (1-inch) thick 24 kilogram/cubic meter (1.5 pound/cubic foot) high-density mineral fiber duct liner coated on airstream side.
- E. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- F. Finish of Exterior Surfaces: Baked-on, textured vinyl enamel; color // as selected from manufacturer's standard colors // to match computer equipment //.
- G. Floor Stand: Welded tubular steel, _____ high, with adjustable legs and vibration isolation pads.
- H. Supply-Air Fan(s): Double-inlet, forward-curved centrifugal // or plenum fans(s)//, statically and dynamically balanced.
- I. Drive:
1. //Forward-Curved Centrifugal Fan(s): V-belt, with steel shaft with self-aligning ball bearings and cast-iron or steel sheaves, variable and adjustable-pitch motor sheave, minimum of two matched belts, with drive rated at a minimum of two times the nameplate rating of motor.//
 2. //Plenum Fans: Direct-drive, Arrangement 4, variable-speed drive fan(s) with aluminum wheels; with multiple fans, the number of fans shall not exceed four. //
- J. Compressors: Hermetic scroll; //variable speed// with //oil strainer, internal motor overload protection, // resilient suspension system, crankcase heater, manual-reset high-pressure switch, and pump-down low-pressure switch. Compressors shall have multiple stages of cooling as listed on the drawing equipment schedule.
- K. Refrigeration Circuits: Two; each with hot-gas mufflers, thermal-expansion valve with external equalizer, liquid-line solenoid valve, liquid-line filter-dryer, sight glass with moisture indicator, service shutoff valves, charging valves, and charge of refrigerant.
- SPEC WRITER NOTE: Refrigerant must be an
EPA approved refrigerant listed in
<https://www.epa.gov/snap/>.
- L. Use refrigerant type //____//. EPA approved refrigerants are listed at <https://www.epa.gov/snap/>. Submit proposed refrigerant for government approval.

- M. Refrigerant Evaporator Coil: Alternate-row or split-face-circuit, direct-expansion coil of seamless copper tubes expanded into aluminum fins.
1. Coil assembly shall be mounted over stainless-steel drain pan complying with ASHRAE 62.1 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir.
- N. Integral, Water-Cooled Refrigerant Condenser: // Shell-and-tube type fabricated and labeled according to ASME Boiler and Pressure Vessel Code, Section VIII. // Coaxial tube-in-tube type. // Condenser shall have liquid-line stop valve and head-pressure-actuated, // two-way // // three-way // regulating valve. Terminate fluid connections outside cabinet.
1. Cooling Medium: // Water // Glycol solution //.
- SPEC WRITER NOTE: For high-humidity locations (VA HVAC Design Manual), provide E-coated aluminum fins and corrosion-resistant cabinets. See Article 2.7 below.
- O. Remote Air-Cooled Refrigerant Condenser: Corrosion-resistant cabinet, copper-tube //aluminum-fins// //E-coated aluminum-fins// coils arranged for two circuits, multiple direct-drive propeller fans with permanently lubricated ball bearings, and single-phase motors with internal overload protection and integral electric control panel // and disconnect switch //. Control capacity by // cycling fans // modulating fan speeds // three-way refrigerant bypass with receiver and isolation valve //.
- P. Hydronic Cooling Coil: Seamless copper tubes expanded into aluminum fins with modulating //two-way // three-way // control valve.
1. Control Valve: Class 125 body, with a maximum pressure drop of // 21 kPa (3 psig)// 35 kPa (5 psig) // at design flow rate.
 2. Close-Off (Differential) Pressure Rating: 100 percent of pressure differential across valve or 100 percent of total system (pump) head.
 3. Mount coil assembly over stainless-steel drain pan complying with ASHRAE 62.1-2010 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir.
- SPEC WRITER NOTE: For high-humidity locations (VA HVAC Design Manual), provide E-coated aluminum fins and

corrosion-resistant cabinets. See Article 2.7 below.

Q. Remote, Air-Cooled, Propylene Glycol-Solution Cooler: Corrosion-resistant cabinet, copper-tube //aluminum-fin //E-coated aluminum-fin// coil, multiple direct-drive propeller fans with fan guards, and single-phase motors with internal overload protection and integral electric control panel. Control capacity by cycling fans.

1. Disconnect Switch: Nonautomatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.

R. Propylene Glycol-Solution Pump Package: Weatherproof and vented enclosure of enameled, galvanized steel on structural base frame containing // one // two // centrifugal pump(s) with mechanical seals; electrical-control cabinet with starters, lead-lag switch, automatic switchover, and alarm light.

1. Piping: Interconnecting piping, to and from remote, air-cooled, glycol-solution cooler, with shutoff valves, flow switches, check valves in pump discharge, unions, and pressurized expansion tank with air purge vent and system-charging connection.

SPEC WRITER NOTE: Confirm glycol concentration with actual atmospheric conditions in accordance with the VA HVAC Design Manual. Ensure adequate concentration to allow cold start at winter design temperatures.

2. Glycol: Inhibited propylene glycol and water solution mixed //50:50// // : //, suitable for operating temperature of minus //28// // // degree C (minus //33// // // degree C).

3. Disconnect Switch: Nonautomatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.

SPEC WRITER NOTE: Choose one of the following coil types as per project requirements.

S. Heating Coil:

SPEC WRITER NOTE: Typically, staged control of electric heat is sufficient for computer room applications. Provide SCR control if more precise control is required.

1. Electric-Resistance Heating Coil: Enclosed finned-tube electric elements arranged for //minimum of three stages//SCR control//, with thermal safety switches, manual-reset overload protection, and branch-circuit over current protection.
2. Refrigerant Heating Coil: Hot-gas coil of seamless copper tubes expanded into aluminum fins with three-way solenoid valve on first-stage refrigerant circuit.
3. Hot-Water Heating Coil: Seamless copper tubes expanded into aluminum fins with two-way modulating control valve and strainer.
 - a. Control Valve: Class 125 body.
 - b. Maximum Pressure Drop: // 21 kPa (3 psig) // 35 kPa (5 psig) // at design flow rate.
 - c. Close-Off (Differential) Pressure Rating: 100 percent of pressure differential across valve or 100 percent of total system (pump) head.
4. Steam Heating Coil: Seamless copper tubes expanded into aluminum fins with two-way modulating control valve, strainer, and float-and-thermostatic trap.
 - a. Control Valve: Class 125 body.
 - b. Maximum Pressure Drop (103-kPa (15-psig) Steam): 80 percent of inlet steam pressure.
 - c. Close-Off (Differential) Pressure Rating: 150 percent of operating (inlet) pressure.
- T. Filter Extended-Surface, Disposable, Panel type: Pleated, lofted, nonwoven, reinforced cotton fabric; supported and bonded to welded wire grid; enclosed in cardboard frame // with 50-mm (2-inch) thick, disposable, glass-fiber prefilter.
 1. Thickness: // 50 mm (2 inches)// 100 mm (4 inches).
 2. Initial Resistance: _____ Pa (inches wg).
 3. Recommended Changeover Resistance: _____ Pa (inches wg).
 4. Arrestance: 90 percent according to ASHRAE 52.1.
 5. MERV Rating: 7, according to ASHRAE 52.2.

SPEC WRITER NOTE: Be aware that deleting one or more humidifier option can create a sole source condition as some manufacturers do not offer all available options.

U. Humidifier:

1. Infrared Humidifier: High-intensity quartz lamps mounted above stainless-steel evaporator pan, serviceable without disconnecting water, drain, or electrical connections; prepiped and using condensate water from cooling coils with stainless-steel or brass float-valve mechanism; located in bypass airstream; with flush-cycle timer and solenoid drain valve.
2. Evaporative Pan Humidifier: Stainless-steel pan and cover, serviceable without disconnecting water, drain, or electrical connections; prepiped with stainless-steel or brass float-valve mechanism; // electric-resistance heating coil // or // steam heating coils // low-water-cutoff switch; flush-cycle timer; and solenoid drain valve.
3. Electrode Steam Humidifier: Self-contained, microprocessor-controlled unit with disposable, polypropylene-plastic cylinders, and having field-adjustable steel electrodes and stainless-steel steam dispersion tube.
4. Plumbing Components and Valve Bodies: Plastic, linked by flexible rubber hosing, with water fill with air gap and solenoid valve incorporating built-in strainer, pressure-reducing and flow-regulating orifice, and drain with integral air gap.
5. Control: Fully modulating to provide gradual 0 to 100 percent capacity with field-adjustable maximum capacity; with high-water probe.
6. Drain Cycle: Field-adjustable drain duration and drain interval.

V. Controls:

1. Integral Electrical Controls: Unit-mounted electrical enclosure with piano-hinged door, grounding lug, combination magnetic starters with overload relays, circuit breakers and cover interlock, and fusible control-circuit transformer.
 - a. Disconnect Switch: Nonautomatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.
 2. Electronic-Control System: Solid state, with start button, stop button, temporary loss of power indicator, manual-reset circuit breakers, temperature control, humidity control, and monitor panel.
- W. Microprocessor-Control System: Continuously monitors operation of process cooling system; continuously displays room temperature and room

relative humidity; sounds alarm on system malfunction and simultaneously displays problem. If more than one malfunction occurs, system displays fault in sequence with room temperature and continues to display fault when malfunction is cleared until system is reset.

X. Malfunctions:

1. Power loss, loss of airflow, clogged air filter, high room temperature, and low room temperature.
2. High humidity.
3. Low humidity.
4. Smoke/fire, water under floor supply fan overload, compressor No. 1, overload compressor No. 1 low pressure.
5. Compressor No. 1, high pressure.
6. Compressor No. 2 overload.
7. Compressor No. 2, low pressure.
8. Compressor No. 2 high pressure.
9. Digital Display:
 - a. Control power on.
 - b. Humidifying.
 - c. Dehumidifying
 - d. Compressor No. 1 operating.
 - e. Compressor No. 2 operating.
 - f. Heat operating.
 - g. Economy cooling.
10. Push buttons shall stop and start process cooling system, silence audible alarm, test indicators, and display room's relative humidity.

Y. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display unit status and alarms via an open protocol BACnet data interface.

Z. Hardwired Points:

1. Monitoring: On-off status, //common trouble alarm//space temperature//space relative humidity/.
2. Control: On-off operation, //space temperature set-point adjustment//space relative humidity set-point adjustment//

SPEC WRITER NOTE: "Hardwired Points"
Subparagraph above and retain
subparagraph below if extensive interface
with the DDC or the BAS is required and
is beyond what hardwired points can

provide. Requirement may exclude some manufacturers.

AA. Compatible with // ASHRAE 135 (BACnet) Industry-accepted, open-protocol // for communication interface with the BAS shall enable the DDC or the BAS operator to remotely control and monitor the unit from an operator workstation. Control features and monitoring points displayed locally at unit control panel shall be available through the DDC or the BAS.

2.2 FLOOR-MOUNTED UNITS 24 KW (7 TONS) AND SMALLER

A. Description: Self-contained, factory assembled, prewired, and prepiped; consisting of cabinet, fan, filters, and controls; for vertical floor mounting in upflow or downflow configuration.

B. Cabinet and Frame: Welded tubular-steel frame with removable steel panels with baked-enamel finish, insulated with 1-inch- (25-mm-) thick duct liner.

C. Floor Stand: Welded tubular steel, 300 mm (12 inches), with adjustable legs and vibration isolation pads.

D. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

E. Supply-Air Fan:

1. //Forward-Curved Centrifugal Fan: Provide with adjustable V-belt drive.//

2. //Plenum Fans: Direct-drive, Arrangement 4, variable-speed drive fan(s) with aluminum wheels; with multiple fans, the number of fans shall not exceed four.//

Spec Writer Note: Verify variable speed option is currently available in this size / type of system by more than one manufacturer.

F. Compressor: Hermetic, scroll // variable speed // with oil strainer, internal motor overload protection, resilient suspension system, and crankcase heater.

G. Refrigeration Circuit: Low-pressure switch, manual-reset high-pressure switch, thermal-expansion valve with external equalizer, sight glass with moisture indicator, service shutoff valves, charging valves, and charge of refrigerant.

Spec Writer Note: Refrigerant must be an EPA approved refrigerant listed in <https://www.epa.gov/snap/>.

- H. Use refrigerant type //____//. EPA approved refrigerants are listed at <https://www.epa.gov/snap/>. Submit proposed refrigerant for government approval.
- I. Refrigerant Evaporator Coil: Direct-expansion coil of seamless copper tubes expanded into aluminum fins, with two circuits, each with solenoid valve.
1. Mount coil assembly over stainless-steel drain pan complying with ASHRAE 62.1-2010 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir.
- J. //Integral, Water-Cooled Refrigerant Condenser: Brazed-plate type with liquid-line stop valve and head-pressure-actuated, two-way regulating valve.//
- K. Cooling Medium: // Water // Propylene Glycol solution //.
- SPEC WRITER NOTE: For high-humidity locations (VA HVAC Design Manual), provide E-coated aluminum fins and corrosion-resistant cabinets. See Paragraph 2.7 below.
- L. Remote Air-Cooled Refrigerant Condenser: Integral, copper-tube //aluminum-fin //E-coated aluminum-fin// coil with // propeller // centrifugal // fan, // direct // belt // driven.
- M. Split system shall have suction- and liquid-line compatible fittings and refrigerant piping for field interconnection.
- N. Hydronic Cooling Coil: Seamless copper tubes expanded into aluminum fins with modulating three-way control valve.
1. Cooling Medium: //Water// Propylene Glycol solution//.
 2. Coil assembly shall be mounted over stainless-steel drain pan complying with ASHRAE 62.1 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir.
- SPEC WRITER NOTE: For high-humidity locations (VA HVAC Design Manual), provide E-coated aluminum fins and corrosion-resistant cabinets. See Paragraph 2.7 below.
- O. Remote Air-Cooled, Glycol-Solution Cooler: Corrosion-resistant cabinet, copper-tube //aluminum-fin//E-coated aluminum-fin// coil, direct-drive propeller fan with fan guards, and single-phase motors with internal overload protection.

- P. Disconnect Switch: Nonautomatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.
- Q. Propylene Glycol-Solution Pump Package: Weatherproof and vented enclosure of enameled, galvanized steel on structural base frame containing centrifugal pump with mechanical seal.
1. Piping: Interconnecting piping, from suction to discharge, with shutoff valves, flow switches, unions, and pressurized expansion tank with air purge vent and system-charging connection.

SPEC WRITER NOTE: Confirm glycol concentration with actual atmospheric conditions in accordance with the VA HVAC Design Manual. Ensure adequate concentration to allow cold start at winter design temperatures.
 2. Glycol: Inhibited Propylene glycol and water solution mixed //50:50// // : //, suitable for operating temperature of minus 40 //28// // // degrees C (minus //33// // // degrees F).
 3. Disconnect Switch: Nonautomatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.
- R. Electric-Resistance Heating Coil: Finned-tube electric elements with contactor and high-temperature-limit switches.
- S. Filter: 50-mm (2-inch) thick, disposable, glass-fiber media.
1. Initial Resistance: _____ Pa (inches wg).
 2. Recommended Final Resistance: _____ Pa (inches wg).
 3. Arrestance: 90 percent according to ASHRAE 52.1.
 4. MERV Rating: 7, according to ASHRAE 52.2.
- T. Infrared Humidifier: High-intensity quartz lamps mounted above stainless-steel evaporator pan, serviceable without disconnecting water, drain, or electrical connections; prepiped and located in bypass airstream; with flush-cycle timer and solenoid drain valve.
- U. Electrode Steam Humidifier: Self-contained, microprocessor-controlled unit with disposable, polypropylene-plastic cylinders and having field-adjustable steel electrodes and stainless-steel steam dispersion tube.
- V. Plumbing Components and Valve Bodies: Plastic, linked by flexible rubber hosing, with water fill with air gap and solenoid valve incorporating built-in strainer, pressure-reducing and flow-regulating orifice, and drain with integral air gap.

- W. Control: Fully modulating to provide gradual 0 to 100 percent capacity with field-adjustable maximum capacity; with high-water probe.
- X. Drain Cycle: Field-adjustable drain duration and drain interval.
- Y. Disconnect Switch: Nonautomatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.
- Z. Control System: Unit-mounted panel with main fan contactor, compressor contactor, compressor start capacitor, control transformer with circuit breaker, solid-state temperature // and humidity // control modules // humidity contactor //, time-delay relay, heating contactor, and high-temperature thermostat. Provide solid-state, wall-mounted control panel with start-stop switch//adjustable humidity set point,// and adjustable temperature set point.
- AA. DDC Interface or BAS: Provide connection to the DDC or the BAS.

2.3 CEILING-MOUNTED UNITS

- A. Description: Self-contained, factory assembled, prewired, and prepiped; consisting of cabinet, fan, filters, and controls; for horizontal ceiling mounting to fit T-bar ceiling opening of 610 by 1220 mm (24 by 48 inches).
- B. Cabinet: Galvanized steel with baked-enamel finish, insulated with 13-mm (1/2-inch) thick duct liner.

SPEC WRITER NOTE: Retain first subparagraph below for units where grilles are available, usually 5.2 kW (1.5 tons) and smaller.

- C. Integral factory-supplied supply and return grille to fit ceiling grid kit of 610 by 1220 mm (24 by 48 inches), with filter.
- D. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- E. Supply-Air Fan:
 - 1. //Forward-Curved, Centrifugal Fan: Provide with directly-driven fan with two-speed motor.//
 - 2. //Plenum Fans: Direct-drive, Arrangement 4, variable-speed drive fan(s) with aluminum wheels; with multiple fans, the number of fans shall not exceed four.//

Spec Writer Note: Verify variable speed option is currently available in this size / type of system by more than one manufacturer.

- F. Compressor: Hermetic scroll, // variable speed // with oil strainer, internal motor overload protection, resilient suspension system, and crankcase heater.
- G. Refrigeration Circuit: Low-pressure switch, manual-reset high-pressure switch, thermal-expansion valve with external equalizer, sight glass with moisture indicator, service shutoff valves, charging valves, and charge of refrigerant.

SPEC WRITER NOTE: Refrigerant must be an EPA approved refrigerant listed in <https://www.epa.gov/snap/>.

- H. Use refrigerant type //____//. EPA approved refrigerants are listed at. Submit proposed refrigerant for government approval.
<https://www.epa.gov/snap/>
- I. Refrigerant Evaporator Coil: Direct-expansion coil of seamless copper tubes expanded into aluminum fins.
1. Mount coil assembly over stainless-steel drain pan complying with ASHRAE 62.1 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir.
- J. Integral, Water-Cooled Refrigerant Condenser: // Coaxial, counterflow, tube-in-tube // Brazed-plate // type with liquid-line stop valve and head-pressure-actuated, water-regulating valve.
1. Cooling Medium: // Water // Propylene Glycol solution //.

SPEC WRITER NOTE: For high-humidity locations (VA HVAC Design Manual), provide E-coated aluminum fins and corrosion-resistant cabinets. See Paragraph 2.7 below.

- K. Remote Air-Cooled Refrigerant Condenser: Integral, copper-tube //aluminum-fin //E-coated aluminum-fin// coil with // propeller // centrifugal // //plenum // fan, direct driven.
- L. Split system shall have suction- and liquid-line compatible fittings and refrigerant piping for field interconnection.
- M. Hydronic Cooling Coil: Seamless copper tubes expanded into aluminum fins with two-way control valve.
1. Cooling Medium: // Water // Propylene Glycol solution //.
 2. Mount coil assembly over stainless-steel drain pan complying with ASHRAE 62.1 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir.

- N. Electric-Resistance Heating Coil: Finned-tube electric elements with contactor, dehumidification relay, and high-temperature-limit switches.
- O. Filter: 25-mm (1 inch) thick, disposable, glass-fiber media.
 - 1. Recommended Final Resistance: // Pa (inches wg)>.
 - 2. Initial Resistance: _____ Pa (inches wg)//.
 - 3. Arrestance: 90 percent according to ASHRAE 52.1.
 - 4. MERV Rating: 7 according to ASHRAE 52.2.
- P. Atomizing Humidifier: Centrifugal atomizer with stainless-steel pan, demister pad, and solenoid valve.
- Q. Electrode Steam Humidifier: Self-contained, microprocessor-controlled unit with disposable, polypropylene-plastic cylinders, and having field-adjustable steel electrodes and stainless-steel steam dispersion tube.
- R. Plumbing Components and Valve Bodies: Plastic, linked by flexible rubber hosing, with water fill with air gap and solenoid valve incorporating built-in strainer, pressure-reducing and flow-regulating orifice, and drain with integral air gap.
- S. Control: Fully modulating to provide gradual 0 to 100 percent capacity with field-adjustable maximum capacity; with high-water probe.
- T. Drain Cycle: Field-adjustable drain duration and drain interval.
- U. Disconnect Switch: Nonautomatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.
- V. Control System: Unit-mounted panel with main fan contactor, compressor contactor, compressor start capacitor, control // transformer with circuit breaker, solid-state temperature- // and humidity // control modules // humidity contactor //, time-delay relay, heating contactor, and high-temperature thermostat. Wall-mounted control panel shall be solid-state, with start-stop switch // adjustable humidity // dirty set point, // and adjustable temperature set point.
- W. DDC or BAS Interface: Provide // BACnet //connection to the DDC or BAS system.

2.4 CONSOLE UNITS

- A. Description: Split system consisting of evaporator section for floor or wall mounting and remote condensing section.
- B. Evaporator Cabinet: Furniture-grade steel with baked-enamel finish; with front access and containing direct-drive centrifugal fans and two-speed motor.

- C. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.
- D. Condenser Cabinet: Steel with baked-enamel finish and containing compressor and condenser.

SPEC WRITER NOTE: Verify variable speed option is currently available in this size / type of system by more than one manufacturer.

- E. Compressor: Hermetic scroll, // variable speed // with oil strainer, internal motor overload protection, resilient suspension system, and crankcase heater.
- F. Refrigeration Circuit: Filter/dryer, manual-reset high-pressure switch, thermal-expansion valve with external equalizer, sight glass with moisture indicator, service shutoff valves, charging valves, and charge of refrigerant.

SPEC WRITER NOTE: Refrigerant must be an EPA approved refrigerant listed in <https://www.epa.gov/snap/>.

- G. Use refrigerant type //____//. EPA approved refrigerants are listed at <https://www.epa.gov/snap/>. Submit proposed refrigerant for government approval.
- H. Refrigerant Evaporator Coil: Direct-expansion coil of seamless copper tubes expanded into aluminum fins.
1. Mount coil assembly over stainless-steel drain pan//complying with ASHRAE 62.1 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir.
- I. Integral, Water-Cooled Refrigerant Condenser: // Coaxial, counterflow, tube-in-tube // Brazed-plate // type with liquid-line stop valve and head-pressure-actuated, water-regulating valve.

SPEC WRITER NOTE: For high-humidity locations (VA HVAC Design Manual), provide E-coated aluminum fins and corrosion-resistant cabinets. See Paragraph 2.7 below.

- J. Remote Air-Cooled Refrigerant Condenser: Integral, copper-tube //aluminum-fin //E-coated aluminum-fin// coil with // propeller // centrifugal // plenum // fan, direct driven.

SPEC WRITER NOTE: Retain subparagraph below if retaining one of last two subparagraphs above.

- K. Split system shall have suction- and liquid-line compatible fittings and refrigerant piping for field interconnection.
- L. Hydronic Cooling Coil: Seamless copper tubes expanded into aluminum fins with modulating control valve.
 - 1. Cooling Medium: // Water // Propylene Glycol solution //.
 - 2. Mount coil assembly over stainless-steel drain pan complying with ASHRAE 62.1 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir.
- M. Electric-Resistance Heating Coil: Finned-tube electric elements with contactor and high-temperature-limit switches.
- N. Filter: // Cleanable // Disposable, glass-fiber media // 25-mm (1-inch) thick.
 - 1. Initial Resistance: _____ Pa (inches wg)>.
 - 2. Recommended Final Resistance: _____ Pa (inches wg)>.
 - 3. Arrestance: 90 percent according to ASHRAE 52.1.
 - 4. MERV Rating: 7 according to ASHRAE 52.2.
- O. Electrode Steam Humidifier: Self-contained and microprocessor controlled; with replaceable cylinder.
- P. Disconnect Switch: Nonautomatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.
- Q. Control System: Unit-mounted panel with contactors, control transformer with circuit breaker, and solid-state temperature-//and humidity- // control modules. Wall-mounted control panel shall be solid-state, with start-stop switch //, adjustable humidity set point, // and adjustable temperature set point.
- R. DDC or BAS Interface: Provide connection to the DDC or the BAS system.

2.5 FAN MOTORS

- A. Default motor characteristics are specified in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT.
- B. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT.
- C. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0. //Provide high static fan motors for ducted applications.//

- D. **Controllers, Electrical Devices, and Wiring:** Comply with requirements for electrical devices and connections specified in Division 26 Sections.

2.6 **SPECIAL TOOLS**

- A. If any part of equipment furnished under these specifications requires a special tool for assembly, adjustment, setting, or maintenance and the tool is not readily available from the commercial tool market, furnish the necessary tools with equipment as a standard accessory.

2.7 **CORROSION CONTROL**

- A. **Remote Outdoor Condenser Coils:**

1. **Epoxy Immersion Coating - Electrically Deposited:** The multi-stage corrosion-resistant coating application comprises of cleaning (heated alkaline immersion bath) and reverse-osmosis immersion rinse prior to the start of the coating process. The coating thickness shall be maintained between 0.6-mil and 1.2-mil. Before the coils are subjected to high-temperature oven cure, they are treated to permeate immersion rinse and spray. Where the coils are subject to UV exposure, UV protection spray treatment comprising of UV-resistant urethane mastic topcoat shall be applied. Provide complete coating process traceability for each coil and minimum five years of limited warranty. The coating process shall be such that uniform coating thickness is maintained at the fin edges. The quality control shall be maintained by ensuring compliance to the applicable ASTM Standards for the following:
 - a. Salt Spray Resistance (Minimum 6,000 Hours)
 - b. Humidity Resistance (Minimum 1,000 Hours)
 - c. Water Immersion (Minimum 260 Hours)
 - d. Cross-Hatch Adhesion (Minimum 4B-5B Rating)
 - e. Impact Resistance (Up to 160 Inch/Pound)

- B. **Exposed Outdoor Cabinet**

1. **Casing Surfaces (Exterior and Interior):** All exposed and accessible metal surfaces shall be protected with a water-reducible acrylic with stainless steel pigment spray-applied over the manufacturer's standard finish. The spray coating thickness shall be 2-4 mils and provide minimum salt-spray resistance of 1,000 hours (ASTM B117) AND 500 hours UV resistance (ASTM D4587).

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Handle and install refrigeration units and accessories in accordance with the instructions and recommendations of the manufacturer.
- B. Coordinate installation of Computer room Air Conditioning Units with Computer room access flooring installer.
- C. Field Refrigerant Piping: As specified in specification Section 23 23 00, REFRIGERANT PIPING.
- D. Field Piping: Glycol Piping, Hot water Piping, Steam and Condensate Piping, as specified in specification Section 23 21 13, HYDRONIC PIPING and Section 23 22 13, STEAM and CONDENSATE HEATING PIPING.
- E. Fill glycol system with 40 percent glycol mixture and perform start-up procedures as recommended by the manufacturer.
- F. Electrical System Connections and Equipment Ground: As specified in Division 26 Sections.
- G. Install outdoor equipment to withstand wind velocity of // // kmph (// // mph) in coastal areas.

3.2 CONNECTIONS

- A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.
- B. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Install piping adjacent to machine to allow service and maintenance.
- D. Water and Drainage Connections: Comply with applicable requirements in Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING and Section 22 11 00, FACILITY WATER DISTRIBUTION. Provide adequate connections for water-cooled units, condensate drain, and humidifier flushing system.
- E. Retain first paragraph below for units with hot-water coils.
- F. Hot-Water Heating Piping: Comply with applicable requirements in Section 23 21 13, HYDRONIC PIPING. Provide shutoff valves in inlet and outlet piping to heating coils.
- G. Steam and Condensate Piping: Comply with applicable requirements in Section 23 22 13, STEAM and CONDENSATE HEATING PIPING. Provide shutoff valves in steam inlet and steam trap in condensate outlet piping to heating coils.

- H. Condenser-Water Piping: Comply with applicable requirements in Section 23 21 13, HYDRONIC PIPING. Provide shutoff valves in water inlet and outlet piping on water-cooled units.
- I. Refrigerant Piping: Comply with applicable requirements in Section 23 23 00, REFRIGERANT PIPING. Provide shutoff valves and piping.

3.3 **FIELD QUALITY CONTROL**

- A. Tests and Inspections:
 1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 2. After installing computer-room air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. After startup service and performance test, change filters and flush humidifier.

3.4 **STARTUP AND TESTING**

- A. //The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Provide a minimum of 7 days prior notice.//
- B. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of computer room air conditioning equipment.

3.5 **//COMMISSIONING**

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the CxA.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.//

3.6 **DEMONSTRATION AND TRAINING**

- A. Provide services of manufacturer's technical representative for //4//
// //hour//s// to instruct VA personnel in operation and maintenance of units.

B. //Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//

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