SECTION 23 81 00 DECENTRALIZED UNITARY HVAC EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies self-contained, split-systems, and rooftop equipment.
- B. Definitions:
 - Energy Efficiency Ratio (EER): The ratio of net cooling capacity is Btu/h to total rate of electricity input in watts under designated operating conditions (Btu hour/Watt).
 - 2. Seasonal Energy Efficiency Ratio (EER): The ratio of the total cooling output of an air conditioner during its normal annual usage period for cooling in Btu/h divided by total electric energy input in watts during the same period (Btu hour/Watt).
 - 3. Unitary: A Unitary Air Conditioner consists of one or more factorymade assemblies which normally include an evaporator or cooling coil, a compressor and condenser combination, and may include a heating function as well.
 - 4. Where such equipment is provided in more than one assembly the separated assemblies are to be designed to be used together and the requirements of rating are based upon use of matched assemblies.

1.2 RELATED WORK

Seismic requirements for non-structural equipment.

- A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.
- B. Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT: Requirements for different types of vibration isolators and noise ratings in the occupied areas.
- C. Section 23 07 11, HVAC and BOILER PLANT INSULATION: Requirements for piping insulation.
- D. Section 23 23 00, REFRIGERANT PIPING: Requirements for refrigerant pipes and fittings.
- E. Section 23 36 00, AIR TERMINAL UNITS: Requirements for other similar units.

- F. Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS: Requirements for air handling units using chilled water and hot water coils.
- G. Section 23 40 00, HVAC AIR CLEANING DEVICES: Requirements for air filtration.
- H. Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS: Requirements for commissioning, systems readiness checklists, and training.
- I. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC: Requirements for testing and adjusting air balance.

1.3 QUALITY ASSURANCE

- A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Safety Standards: ASHRAE Standard 15, Safety Code for Mechanical Refrigeration.

1.4 SUBMITTALS

- A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's literature and data:
 - Sufficient information, including capacities, pressure drops and piping connections clearly presented, shall be included to determine compliance with drawings and specifications for units noted below:
 - a. Unitary air conditioners:
 - 1) Self-contained units
 - 1) Split systems.
 - 3) Rooftop units
 - Unit Dimensions required clearances, operating weights accessories and start-up instructions.
 - 3. Electrical requirements, wiring diagrams, interlocking and control wiring showing factory installed and portions to be field installed.
 - 4. Mounting and flashing of the roof curb to the roofing structure with coordinating requirements for the roof membrane system.
- C. Certification: Submit proof of specified ARI Certification.
- D. Performance Rating: Submit catalog selection data showing equipment ratings and compliance with required sensible-to-heat-ratio, energy efficiency ratio (EER), and coefficient of performance (COP).
- E. Operating and Maintenance Manual: Submit three copies of Operating and Maintenance manual to COR three weeks prior to final inspection.
- F. Completed System Readiness Checklists provided by the Commissioning Agent 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.

1.5 APPLICABLE PUBLICATIONS

- 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.
- B. Federal Specifications (Fed. Spec.): A-A-50502-90..... Air conditioner (Unitary Heat Pump) Air to Air (3000-300,000 Btu)
- C. Military Specifications (Mil. Specs.): MIL-PRF-26915D-06.....Primer Coating, for Steel Surfaces
- D. Air-Conditioning, Heating, and Refrigeration Institute (AHRI): 210/240-08.....Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment 270-08.....Sound Rating of Outdoor Unitary Equipment
 - 310/380-04.....Standard for Packaged Terminal Air-Conditioners and Heat Pumps (CSA-C744-04)
 - 340/360-07.....Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment
 - 520-04.....Performance Rating of Positive Displacement Condensing Units
- E. Air Movement and Control Association (AMCA):

210-07.....Laboratory Methods of Testing Fans for Aerodynamic Performance Rating (ANSI)

- 410-96.....Recommended Safety Practices for Users and
 - Installers of Industrial and Commercial Fans
- F. American National Standards Institute (ANSI): S12.51-02(R2007)....Acoustics - Determination of Sound Power Levels of Noise Sources Using Sound Pressure -Precision Method for Reverberation Rooms (same as ISO 3741:1999)

G. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): 2008 Handbook.....HVAC Systems and Equipment 15-10....Safety Standard for Refrigeration Systems (ANSI)

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

B117-09.....Standard Practice for Operating Salt Spray (Fog) Apparatus

I. American Society of Civil Engineers (ASCE)
ASCE 7-10.....Minimum Design Loads for Buildings and Other

Structures

J. National Electrical Manufacturer's Association (NEMA): MG 1-09 (R2010).....Motors and Generators (ANSI) ICS 1-00 (R2005, R2008).Industrial Controls and Systems: General

Requirements

K. National Fire Protection Association (NFPA) Publications: 90A-09.....Standard for the Installation of Air-Conditioning and Ventilating Systems

PART 2 - PRODUCTS

2.1 UNITARY AIR CONDITIONERS - GENERAL

- A. Applicable ARI Standards:
 - 1. Cooling Capacity 39.6 kW (135,000 Btu/h) and More: AHRI 340/ 360.
 - 2. Cooling Capacity Less Than 39.6 kW (135,000 Btu/h): AHRI 210/240. Units shall be listed in the ARI Directory of Certified Unitary Air-Conditioners.
- B. Performance Rating: Cooling capacity of units shall meet the sensible heat and total heat requirements shown in the contract documents. In selecting unit size, make true allowance for "sensible to total heat ratio" to satisfy required sensible cooling capacity.
- C. Machinery Guards: Provide guards as shown in AMCA 410 for belts, chains, couplings, pulleys, sheaves, shafts, gears and other moving parts regardless of height above the floor. Drive guards may be excluded where motors and drives are inside factory fabricated casings.
- D. Corrosion Prevention: Unless specified otherwise, equipment fabricated from ferrous metals that do not have a zinc coating or a duplex coating of zinc and paint shall be treated for prevention of rust with a factory coating or paint system that will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall be tested for 500 hours. The salt-spray fog test shall be in accordance with ASTM B117 using a 20 percent sodium chloride solution. Immediately after completion of the test, the coating shall show no signs of blistering, wrinkling or cracking, no loss of adhesion, and the specimen shall show no signs of rust beyond 3 mm (1/8-inch) on both sides from the scratch mark.

2.2 SPLIT-SYSTEM AIR CONDITIONERS

- A. Description: Factory assembled and tested, wall-mounted or ceiling mounted unit, with an air-cooled remote condensing unit, and fieldinstalled refrigeration piping.
- B. Concealed Evaporator Components:
 - Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
 - 2. Insulation: Factory-applied duct liner.
 - 3. Drain Pans: Galvanized steel, with connection for drain; insulated and complying with ASHRAE 62.1-2007.
 - 4. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.
 - 5. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with thermal-expansion valve.
 - Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
 - 7. Fan Motors: Comply with requirements in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT for multi-tapped, multi-speed motors with internal thermal protection and permanent lubrication.
 - 8. Disposable Filters: 25 mm (1 inch) thick, in fiberboard frames with MERV rating of 7 or higher according to ASHRAE 52.2.
 - 9. Wiring Terminations: Connect motor to chassis wiring with plug connection.,
- C. Wall-Mounting, Evaporator-Fan Components:
 - Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
 - 2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.
 - 3. Drain Pan and Drain Connection: Comply with ASHRAE 62.1-2007.
 - 4. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with thermal-expansion valve.
 - 5. Electric-Resistance Heating Coil: Helical, nickel-chrome, resistance-wire heating elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contactors; manual-reset thermal cutout; airflow proving device; and one-time fuses in terminal box for overcurrent protection.

- 6. Fan: Direct drive, centrifugal fan.
- 7. Fan Motors: Comply with requirements in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT for multi-tapped, multi-speed motors with internal thermal protection and permanent lubrication.
- 8. Filters: Disposable, with MERV rating of 7 or higher according to ASHRAE 52.2.
- D. Ceiling-Mounting, Evaporator-Fan Components:
 - Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
 - 2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
 - 3. Drain Pan and Drain Connection: Comply with ASHRAE 62.1-2007.
 - 4. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with thermal-expansion valve.
 - 5. Electric-Resistance Heating Coil: Helical, nickel-chrome, resistance-wire heating elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contactors; manual-reset thermal cutout; airflow proving device; and one-time fuses in terminal box for overcurrent protection.
 - 6. Fan: Direct drive, centrifugal fan, and integral condensate pump.
 - 7. Fan Motors: Comply with requirements in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT for multi-tapped, multi-speed motors with internal thermal protection and permanent lubrication.
 - 8. Filters: Disposable, with MERV rating of 7 or higher according to ASHRAE 52.2.
- E. Air-Cooled, Compressor-Condenser Components:
 - Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Service valves, fittings, and gage ports shall be brass and located outside of the casing.
 - Compressor: Hermetically sealed scroll with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

- 3. Compressor motor with manual-reset, high-pressure switch and automatic-reset, low-pressure switch.
- 4. Refrigerant: R-410A unless otherwise indicated.
- 5. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with liquid subcooler.
- 6. Fan: Aluminum, propeller type, directly connected to motor.
- 7. Motor: Permanently lubricated, with integral thermal-overload protection.
- 8. Low Ambient Kit: Permit operation down to minus 18 deg C (0 deg F).
- 9. Mounting Base: Polyethylene.
- 10. Minimum Energy Efficiency: Comply with ASHRAE/IESNA 90.1-2004, "Energy Standard for Buildings except Low-Rise Residential Buildings."
- 2.4 Rooftop AIR CONDITIONERS: A. Casing: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed. Exterior casing of 1.6 mm (0.0626 inch) thick galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs. Galvanized inner casing of 0.7 mm (0.028 inch) thick, 40 percent free area . Casing insulation and adhesive shall comply with NFPA 90A or NFPA 90B and comply with ASTM C 1071, Type I and shall be 25 mm (1 inch) thick. Space between double wall panels filled with foam insulation and sealed moisture tight. Removable cam latched access panel to allow access to internal parts.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.
- D. Supply-Air Fan: Direct driven, double width, forward curved backward inclined, centrifugal; with permanently lubricated, multi-speed EC motor resiliently mounted in the fan inlet. Fan wheel shall be aluminum or painted-steel, and fan scroll shall be galvanized- or painted-steel.
- F. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.
- H. Seismic Fabrication Requirements: Fabricate fan section, internal mounting frame and attachment to fans, fan housings, motors, casings, accessories, and other fan section components with reinforcement strong enough to withstand seismic forces defined in Section 23 05 41, NOISE

and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT when fan-mounted frame and RTU-mounted frame are anchored to building structure.

- I. Fan Motor: Comply with requirements in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT.
- J. Supply-Air Refrigerant Coil: Aluminum -plate fins and seamless copper tube in steel casing with equalizing-type vertical distributor.
- K. Condensate Drain Pan: Formed sections of stainless-steel sheet, a minimum of 50 mm (2 inches) deep, and complying with ASHRAE 62.1-2007. Drain connections shall be threaded nipple Outdoor-Air Refrigerant Coil: Aluminum -plate fins and seamless copper tube in steel casing with equalizing-type vertical distributor. Hot-Gas Reheat Refrigerant Coil: Aluminum -plate fins and seamless copper tube in steel casing with equalizing-type vertical distributor. Electric-Resistance Heating Coil: Resistance wire of 80 percent nickel and 20 percent chromium, supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame.
 - 1. Terminals: Stainless-steel machine-staked terminals secured with stainless-steel hardware.
 - Overtemperature Protection: Disk-type, automatically reset, thermalcutout, safety device; serviceable through terminal box.
 - 3. Overcurrent Protection: Manual-reset thermal cutouts, factory wired in each heater stage.
 - Control Panel: Unit mounted with disconnecting means and overcurrent protection and shall include magnetic mercury contactors.
 - 5. Step Controller: Have pilot lights and override toggle switch for each step.
 - 6. SCR Controller: Have pilot lights operate on load ratio, a minimum of five steps.
 - 7. Time-delay relay.
 - 8. Airflow proving switch.

Refrigerant Circuit Components:

- 1. Number of Independent Refrigerant Circuits: One
- Compressor: Hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater .
- P. Refrigerant: R-410A

- Q. Refrigeration Specialties:
 - 1. Expansion valve with replaceable thermostatic element.
 - 2. Refrigerant filter/dryer.
 - 3. Manual-reset high-pressure safety switch.
 - 4. Automatic-reset low-pressure safety switch.
 - 5. Minimum off-time relay.
 - 6. Automatic-reset compressor motor thermal overload.
 - Brass service valves installed in compressor suction and liquid lines.
 - 8. Low-ambient kit high-pressure sensor.
 - 9. Hot-gas reheat solenoid valve with a replaceable magnetic coil.
 - 10. Hot-gas bypass solenoid valve with a replaceable magnetic coil.
- U. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.
- W. Relief-Air Damper: Gravity actuated or motorized, complying with ASHRAE/IESNA 90.1-2004, and having bird screen and hood.
- Y. Controls:
 - 1. Basic Unit Controls:
 - a. Control-voltage transformer.
 - b. Wall-mounted thermostat or sensor with heat-cool-off switch.
 - c. Fan on-auto switch.
 - d. Fan-speed switch.
 - e. Automatic changeover.
 - f. Adjustable deadband.
 - g. Exposed set point.h. Exposed indication.i. Degree F indication.
 - j. Unoccupied-period-override push button.
 - k. Data entry and access port to input temperature set points, occupied and unoccupied periods, and output room temperature, supply-air temperature, operating mode, and status.
 - . DDC controller or programmable timer and interface with HVAC instrumentation and control system and to digital display outdoorair temperature, supply-air temperature, return-air temperature, economizer damper position, indoor-air quality, and control parameters. Interface with BMS/DDC system via BACnet MS/TP trunk.2.

Electronic DDC controller shall have volatile-memory backup.

- . Safety Control Operation:
 - a. Smoke Detectors: Stop fan and close outdoor-air damper if smoke is detected and with additional contacts for alarm interface to fire alarm control panel.
 - b. Fire Stats: Stop fan and close outdoor-air damper if air greater than 54 deg C (130 deg F)] enters unit and with additional contacts for alarm interface to fire alarm control panel.
 - c. Fire Alarm Control Panel Interface: Control interface to coordinate with operating sequence described in Section 28 31 00, FIRE DETECTION and ALARM.
 - d. Low-Discharge Temperature: Stop fan and close outdoor-air damper if supply air temperature is less than 4 deg C (40 deg F)].
 - e. Defrost Control for Condenser Coil: Pressure differential switch to initiate defrost sequence.
- Scheduled Operation: Occupied and unoccupied periods on 7 365 day clock with a minimum of 4 programmable periods per day.
- 5. Unoccupied Period: Heating Setback: 5.6 deg C (10 deg F)].
- 6. Cooling Setback: System off.
- 7. Override Operation: Two hours unless otherwise indicated.
- 8. Supply Fan Operation:
 - a. Occupied Periods: Run fan continuously.
 - b. Unoccupied Periods: Cycle fan to maintain setback temperature.
- 9. Refrigerant Circuit Operation:
 - a. Occupied Periods: Cycle or stage compressors, and operate hotgas bypass to match compressor output to cooling load to maintain room discharge temperature. Cycle condenser fans to maintain maximum hot-gas pressure. Operate low-ambient control kit to maintain minimum hot-gas pressure.
 - b. Unoccupied Periods: Compressors off
- 11. Electric-Resistance Heating-Coil Operation:
 - a. Occupied Periods: Cycle Stage / Modulate coil to maintain room discharge temperature.
 - b. Unoccupied Periods: Energize coil to maintain setback temperature.
 - c. Supplemental Electric Heat Operation: Electric-resistance heating coil with compressor for heating with outdoor temperature below minus 4 deg C (25 deg F).
- 12. Fixed Minimum Outdoor-Air Damper Operation:

- a. Occupied Periods: Open to 25 percent.
- b. Unoccupied Periods: Close the outdoor-air damper.
- 13. Economizer Outdoor-Air Damper Operation:
 - a. Occupied Periods: Open to 10 percent fixed minimum intake, and maximum 100 percent of the fan capacity to comply with ASHRAE Cycle II. Controller shall permit air-side economizer operation when outdoor air is less than 15 deg C (60 deg F). Use outdoorair temperature and select between outdoor-air and return-air enthalpy to adjust mixing dampers. Start relief-air fan with end switch on outdoor-air damper. During economizer cycle operation, lock out cooling.
 - b. Unoccupied Periods: Close outdoor-air damper and open return-air damper.
- 16. Interface Requirements for HVAC Instrumentation and Control System:
 - a. Interface relay for scheduled operation.
 - b. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.

COMPATIBLE WITH BACNET FOR CENTRAL HVAC CONTROL WORKSTATION FOR ADJUSTING SET POINTS, MONITORING SUPPLY FAN START, STOP, AND OPERATION, INQUIRING DATA TO INCLUDE OUTDOOR-AIR DAMPER POSITION, SUPPLY- AND ROOM-AIR TEMPERATURE MONITORING OCCUPIED AND UNOCCUPIED OPERATIONS, MONITORING CONSTANT AND VARIABLE MOTOR LOADS, MONITORING VARIABLE-FREQUENCY DRIVE OPERATION, MONITORING COOLING LOAD, MONITORING ECONOMIZER CYCLES AND MONITORING AIR-DISTRIBUTION STATIC PRESSURE AND VENTILATION AIR VOLUME.3. WIND AND SEISMIC RESTRAINTS: METAL BRACKETS COMPATIBLE WITH THE CURB AND CASING, PAINTED TO MATCH RTU, USED TO ANCHOR UNIT TO THE CURB, AND DESIGNED FOR LOADS AT PROJECT SITE. COMPLY WITH REQUIREMENTS IN SECTION 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT FOR WIND-LOAD REQUIREMENTSPART 3 EXECUTION

3.1 INSTALLATION

- A. Rooftop Unit Support: Install unit level on equipment rails. Coordinate wall penetrations and flashing with wall construction. Secure rooftop units to structural support with anchor bolts.
- B. Install wind and seismic restraints according to manufacturer's written instructions. Wind and seismically restrained vibration isolation roofcurb rails are specified in Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.
- C. Install units level and plumb maintaining manufacturer's recommended clearances and tolerances.
- D. Install and connect precharged refrigerant tubing to component's quickconnect fittings. Install tubing to allow access to unit.

E. Install wall sleeves in finished wall assembly and weatherproof. Install and anchor wall sleeves to withstand, without damage seismic forces as required by code.

3.2 CONNECTIONS

- A. Verify condensate drainage requirements.
- B. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.
- C. Install piping adjacent to units to allow service and maintenance.
- D. Install ducts to termination at top of roof curb. Cut roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
- E. Connect supply ducts to units with flexible duct connectors specified in Section 23 31 00, HVAC DUCTS and CASINGS.
- F. Install return-air duct continuously through roof structure.
- G. Install normal-weight, 20.7-MPa (3000-psi), compressive strength (28day) concrete mix inside roof curb, 100 mm (4 inches) thick.
- H. Ground equipment and install power wiring, switches, and controls for self contained and split systems.
- I. Connect refrigerant piping to coils with shutoff valves on the suction and liquid lines at the coil and a union or flange at each connection at the coil and condenser.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections: After installing units and after electrical circuitry has been energized, test units for compliance with requirements. Inspect for and remove shipping bolts, blocks, and tiedown straps. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Remove and replace malfunctioning units and retest as specified above.

3.4 INSTRUCTIONS

Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.

3.5 STARTUP AND TESTING

The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing

schedules with the COR and Commissioning Agent. Provide a minimum of 7 days prior notice.

3.6 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 Commissioning Agent.
- 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.

3.7 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for four hours 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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