

SECTION 23 81 00
DECENTRALIZED UNITARY HVAC EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies split-systems, and rooftop, air conditioners.
- B. Definitions:
 - 1. 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 factory-made 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

- A. Section 01 00 00, GENERAL REQUIREMENTS: Requirements for pre-test of equipment: Seismic requirements for non-structural equipment.
- B. 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.
- C. 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.
- D. Section 23 07 11, HVAC and BOILER PLANT INSULATION: Requirements for piping insulation.
- E. Section 23 23 00, REFRIGERANT PIPING: Requirements for refrigerant pipes and fittings.
- F. Section 23 36 00, AIR TERMINAL UNITS and Section 23 82 00, CONVECTION HEATING and COOLING UNITS: Requirements for other similar units.
- G. Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS: Requirements for air handling units using chilled water and hot water coils.

- H. Section 23 40 00, HVAC AIR CLEANING DEVICES: Requirements for air filtration.
- I. Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS: Requirements for commissioning, systems readiness checklists, and training.
- J. 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:
 - 1. 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) Split systems
 - 2) Rooftop units (deduct alternate #1)
 - 2. 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 Resident Engineer 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.

2.3 ROOFTOP AIR CONDITIONERS (DEDUCT ALTERNATE #1)

A. Casing: Formed and reinforced foil faced insulated panels, fabricated to
allow removal for access to internal parts and components, with joints
between sections sealed. Exterior casing of 1.0 mm (0.040 inch) thick
galvanized steel with factory-painted finish, with seamless roof panels
and through the base knockouts with grommet seals for electrical and
piping connections and lifting lugs. Casing insulation and adhesive
shall comply with NFPA 90A or NFPA 90B and comply with ASTM C 1071,

Type I and shall be (1/2 inch) thick. Hinged access panel to allow access to internal parts.

- B. Corrosion Prevention: Paint shall be treated for prevention of rust with a factory coating or paint system that will withstand 500 hours in a salt-spray fog test. The salt-spray fog test shall be in accordance with ASTM B117 using a 20 percent sodium chloride solution.
- 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, 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.
- E. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.
- F. 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.
- G. Fan Motor: Comply with requirements in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT.
- H. Supply-Air Refrigerant Coil: Aluminum -plate fins and seamless copper tube in steel casing with equalizing-type vertical distributor. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan. Coil split shall be interlaced.
- I. Condensate Drain Pan: Formed sections of stainless-steel sheet or polycarbonate, a complying with ASHRAE 62.1-2007. Drain connections shall be threaded nipple.
- J. Outdoor-Air Refrigerant Coil: Aluminum -plate fins and seamless copper tube in steel casing with equalizing-type vertical distributor. Polymer strip shall prevent copper coil from contacting steel coil frame or condensate pan.
- K. Hot-Gas Reheat Refrigerant Coil: Aluminum -plate fins and seamless copper tube in steel casing with equalizing-type vertical distributor. Polymer strip shall prevent copper coil from contacting steel coil frame or condensate pan.
- L. Refrigerant Circuit Components:
 - 1. Number of Independent Refrigerant Circuits: One.

2. Compressor: Hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.
- M. Refrigerant: R-410A unless otherwise indicated.
- N. 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.
 7. 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.
- O. Air Filtration: Minimum arrestance according to ASHRAE 52.1, and MERV rating according to ASHRAE 52.2.
1. Pleated: Minimum 90 percent arrestance, and MERV 7.
- P. Outdoor-Air Damper: Linked damper blades, for 0 to 25 percent outdoor air, with motorized damper filter.
- Q. 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.
- R. Damper Motor: Modulating with adjustable minimum position.
- S. Exhaust-Air Damper: Gravity actuated or motorized, complying with ASHRAE/IESNA 90.1-2004, and having bird screen and hood.
- T. Electrical Power Connection: A single connection of power to unit with unit-mounted circuit breaker accessible from outside unit and control-circuit transformer with built-in overcurrent protection.
- U. 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.
 - f. Adjustable deadband.
 - g. Exposed set point.

- h. Unoccupied-period-override push button.
 - i. 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.
 - j. Interface with HVAC instrumentation and control system to digital display outdoor-air temperature, supply-air temperature, return-air temperature, economizer damper position, and control parameters. Interface with BMS/DDC system via BACnet open protocol.
2. DDC controller shall have volatile-memory backup.
 3. Safety Control Operation:
 - a. Smoke and Fire Devices by others.
 - b. Low-Discharge Temperature: Stop fan and close outdoor-air damper if supply air temperature is less than 4 deg C (40 deg F)].
 - c. Defrost Control for evaporator Coil: Temperature or pressure differential switch to initiate defrost sequence.
 4. Scheduled Operation: Occupied and unoccupied periods on via BAS.
 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 hot-gas bypass to match compressor output to cooling load to maintain room temperature and humidity. Cycle condenser fans to maintain maximum hot-gas pressure.
 - b. Unoccupied Periods: Compressors off
 10. Fixed Minimum Outdoor-Air Damper Operation:
 - a. Occupied Periods: Open to 25 percent.
 - b. Unoccupied Periods: Close the outdoor-air damper.
 11. Economizer Outdoor-Air Damper Operation:
 - a. Occupied Periods: Open to 25 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 mixed-air 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.

12. 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.
- c. 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 and humidity, monitoring occupied and unoccupied operations, monitoring constant and variable motor loads, monitoring cooling load, monitoring economizer.

V. Accessories:

- 1. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.
- 2. Low-ambient kit using variable-speed condenser fans for operation down to -17.0 deg C (0 deg F).
- 3. Filter differential pressure switch with sensor tubing on both sides of filter. Set for final filter pressure loss.
- 4. Coil guards of painted, galvanized-steel wire.
- 5. Power exhaust.
- 6. Ventilation override interface with binary contacts.

- W. Roof curbs: Vibration isolators and wind or seismic restraints shall be as specified in Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT. Manufacturer's standard curbs constructed of galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.

- 1. Curb Height: (24 inches).
- 2. 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 requirements.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Roof Curb: Install on roof structure, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual,"

Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." ARI Guideline B. Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction. Secure RTUs to upper curb rail, and secure curb base to roof framing with anchor bolts.

- B. Install wind and seismic restraints according to manufacturer's written instructions. Wind and seismically restrained vibration isolation roof-curb 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.

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 (28-day) 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.
- J. Install ducts to the units with flexible duct connections.
- K. Connect piping with shutoff duty valves on the supply and return side of the coil and unions at all connections and with a throttling valve on the return piping near the coil.

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 tie-down 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 Resident Engineer 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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