

SECTION 23 81 26
SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 – GENERAL

1.01 WORK INCLUDED

- A. The work of this Section shall include, but is not limited to, the following:
 - 1. Ductless split air-conditioning system shall consist of:
 - a. Outdoor-mounted, air-cooled condensing unit suitable for on-the-ground, rooftop, wall-hung, or condensing units may be stacked.
 - b. Condensing unit shall consist of a fully hermetic reciprocating, scroll, or rotary compressor(s), an air-cooled coil, propeller-type blow-through condenser fan(s), full refrigerant charge, and control box. Condensing unit shall discharge air horizontally as shown on the Drawings. Condensing units shall function as the outdoor component of an air-to-air cooling system. Condensing units shall be used in a refrigeration circuit matched to an indoor fan coil(s).
 - c. Indoor, direct-expansion fan coil matched with the condensing unit.

1.02 RELATED DOCUMENTS

- A. Section 23 05 01 – HVAC General Provisions
- B. Section 23 05 13 – Electric Motors for HVAC Equipment
- C. Section 23 05 29 – Hangers and Supports for HVAC
- D. Section 23 05 48 – Vibration and Seismic Controls for HVAC
- E. Section 23 05 93 – Testing, Adjusting and Balancing for HVAC
- F. Section 23 07 00 – Insulation for HVAC
- G. Section 23 09 23 – Building Management System (BMS)
- H. Section 23 21 00 – Refrigerant Piping and Accessories
- I. Section 23 33 19 – Acoustics
- J. Section 23 34 00 – HVAC Fans
- K. Section 23 40 00 – HVAC Air-Cleaning Devices
- L. Division 26 – Electrical Specifications

1.03 REFERENCED DOCUMENTS

Published specifications, standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section where cited below.

A. AMCA – Air Movement Control Association

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| 1. | AMCA 99 | Standards Handbook |
| 2. | AMCA 203 | Field Performance Measurement of Fan Systems |
| 3. | AMCA 204 | Balance Quality and Vibration Levels for Fans |
| 4. | AMCA 210 | Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating |
| 5. | AMCA 300 | Reverberant Room Method for Sound Testing of Fans |
| 6. | AMCA 301 | Methods for Calculating Sound Ratings for Laboratory Test Data |

B. AHRI – Air Conditioning and Refrigeration Institute

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|----|--------------|-----------------------------------------------------------------------------------|
| 1. | AHRI 210/240 | Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment |
| 2. | AHRI 270 | Sound Rating of Outdoor Unitary Equipment |

C. ASHRAE – American Society of Heating, Refrigeration, and Air Conditioning Engineers

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|----|-----------------------|----------------------------------------------------------------------------------------------------|
| 1. | ASHRAE Std 15-2016 | Safety Standard for Refrigeration Systems |
| 2. | ASHRAE Std. 52.2-2017 | Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size |
| 3. | ASHRAE Std. 90.1-2016 | Energy Standard for Buildings Except Low-Rise Residential Buildings |

D. NEMA – National Electrical Manufacturers Association

E. NFPA – National Fire Protection Association

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|----|----------|---------------------------------------------------------------------------|
| 1. | NFPA 70 | National Electrical Code |
| 2. | NFPA 90A | Standard for the Installation of Air-Conditioning and Ventilating Systems |
| 3. | | |

F. OSHA – Occupational Safety and Health Administration

G. UL – Underwriters Laboratories Inc.

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| 1. | UL 486A-486B | Wire Connectors |
| 2. | UL 1995 | Heating and Cooling Equipment |

1.04 QUALITY ASSURANCE

- A. Fan Coil(s) and Condensing Unit(s) shall be listed in the ARI directory as a matched set.
- B. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Standards for Buildings Except Low-Rise Residential Buildings".
- C. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Standards for Buildings Except Low-Rise Residential Buildings".
- D. Condensing unit cabinet shall be capable of withstanding Federal Test Standard No. 141 (Method 6061) 500 hour salt spray test.

- E. Rate air-cooled condensers up to and including 135,000 BTU per hour according to ARI 210/240.
- F. Air-cooled condensers factory-test sound-power-level ratings shall be according to ARI 270.
- G. AC units shall be constructed in accordance with UL standards and shall carry the UL listing label. AC units shall have CSA approval.
- H. Air-cooled condenser coils shall be leak-tested at 350 psig air pressure with the coil submerged in water.

1.05 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
 - 1. Details of equipment assemblies indicating dimensions, weights, loads, required clearances, method of field assembly, method of fan coil and condensing unit installation, components, and location and size of each field connection.
 - 2. Wiring Diagrams: Power, signal, and control wiring including detailed wiring diagrams that clearly differentiate between manufacturer-installed and field-installed wiring.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. AC system shall be shipped in two pieces (fan coil and condensing unit) and shall be stored and handled per AC system manufacturer's recommendations.

1.07 WARRANTY

- A. Warranty Period for Compressors: Manufacturer's standard, but not less than **five** years from date of Substantial Completion.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Air-Cooled Condensers: Mr. Slim, MHI, Daikin, Carrier
- B. DX Fan Coils: Mr. Slim, MHI, Daikin, Carrier

2.02 AIR-COOLED CONDENSERS

- A. General: Factory-assembled, single unit, air-cooled outdoor condensing unit. Contained within an enclosure and shall be completely factory-assembled with wiring, piping, controls, compressor(s), full charge of R-410A refrigerant, and specified components.
- B. Unit Cabinet:
 - 1. Condensing unit cabinet shall be constructed of galvanized-steel, bonderized and

- coated with a baked-enamel finish.
- 2. Condensing unit access panels shall be removable with minimal screws and shall provide full access to the compressor, fan, and control components.
- 3. Compressor compartment shall be isolated and have an acoustic lining to assure quiet operation.

C. Fans:

- 1. Condenser fans shall be direct-drive propeller type, shall discharge air horizontally, and shall blow air through the condenser coil.
- 2. Condenser fan motor(s) shall be totally enclosed, single-phase motors with Class B insulation and permanently lubricated sleeve bearings. Motor shall be protected by internal thermal overload protection.
- 3. Shaft shall have inherent corrosion resistance.
- 4. Fan blades shall be corrosion resistant and shall be statically and dynamically balanced.
- 5. Condenser fan openings shall be equipped with PVC-coated protection grille over fan and coil.

D. Compressor(s):

- 1. Compressor(s) shall be fully hermetic reciprocating, scroll or rotary type.
 - a. Provide one compressor for systems up to two-tons cooling capacity.
 - b. Provide two compressors for systems over two-tons cooling capacity.
- 2. Compressor shall be equipped with oil system, operating oil charge, and motor. Internal overloads shall protect the compressor from over-temperature and over-current. Compressors shall also have high discharge gas temperature protection.
- 3. Motor shall be NEMA rated Class F, suitable for operation in a refrigerant atmosphere.
- 4. Reciprocating compressors shall be equipped with crankcase heaters to minimize liquid refrigerant accumulation in compressor during shut-down and to prevent refrigerant dilution of oil.
- 5. Compressor assembly shall be installed on rubber vibration isolators.
- 6. Compressors shall be single-phase or 3 phase, as specified on the Drawings.

E. Condenser coil shall be constructed of aluminum fins mechanically bonded to internally enhanced, seamless copper tubes, which are cleaned, dehydrated, and sealed.

F. Refrigeration Components: Refrigerant circuit components shall include brass external vapor supply line service valves with service gauge port connections, vapor return line service valve(s) with service gauge connection port, service gauge port connections on compressor suction and discharge lines with Schrader-type fittings with brass caps, filter drier(s), pressure relief, liquid line solenoid valves, thermostatic expansion valves, and a full charge of refrigerant. **[Heat pumps shall be provided with reversing valve, and heating mode metering device.]**

G. Controls and Safeties: Operating controls and safeties shall be factory-selected, -assembled, and -tested. The minimum control function shall include:

- 1. Controls:

- a. Time delay restart to prevent compressor reverse rotation
- b. Automatic restart on power failure
- c. Safety lockout if any condensing unit safety is open
- d. A time delay control sequence
- e. High and low-pressure switches
- f. Automatic condenser-fan motor protection
- g. Start capacitor and relay (single-phase AC units without scroll compressors)

2. Safeties:

- a. High condensing temperature protection
- b. Compressor motor current and temperature overload protection
- c. High-pressure relief
- d. Condenser fan failure protection

H. Electrical Requirements:

1. Condensing units shall operate on voltage and phase as scheduled on the Drawings.
2. Condensing unit electrical power shall be a single-point connection.
3. Condensing unit control voltage to the indoor fan coil shall be 24 volt.
4. All power and control wiring shall be installed per NEC and all local building codes.
5. Condensing unit shall have low-voltage terminal block connections.

2.03 WALL-MOUNTED DX FAN COIL

- A. Provide indoor, direct-expansion, wall-mounted fan coil. Fan coil unit shall be complete with cooling[/heating] coil, fan, fan motor, piping connectors, electrical controls, condensate pump, and mounting brackets. The fan coil unit shall be matched with the outdoor condensing unit. The combination of the outdoor condensing unit and the indoor fan coil unit shall have a total net cooling[/heating] capacity as scheduled on the Drawings.
- B. Fan coil cabinet shall be constructed of zinc-coated bonderized steel, fully insulated and finished with a baked enamel paint. Discharge and inlet grilles shall be high-impact polystyrene.
- C. Fan shall be tangential direct-drive blower type with air intake at the upper front face of the fan coil unit and discharge at the bottom front. Automatic, motor-driven vertical air sweep shall be provided. Air sweep operation shall be user-selectable. Horizontal direction may be manually adjusted (using remote controller) and vertical air sweep may be manually set.
- D. Coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion. A drain pan under the coil shall have a drain connection for attachment of piping to remove condensate. Condensate drain pan shall have an internal trap and auxiliary drain pan under coil header.
- E. Refrigerant metering device: The fan coil unit shall have a piston type refrigerant metering device. **[The outdoor condensing unit shall have a piston type refrigerant metering device at the liquid line service valve for heating application.]**

- F. Motor shall be fully enclosed and permanently lubricated with inherent overload protection. Fan motors shall be 3 speed.
- G. Controls shall consist of a microprocessor-based control system that shall control space temperature, determine optimum fan speed, and run self-diagnostics. The temperature control range shall be from 64 degs F to 84 degs F. The AC system shall have the following functions as a minimum:
 - 1. Automatic restart after power failure at the same operating conditions as at the time of power failure.
 - 2. Timer function: 24 hour/7day timer cycle for system Auto/Start/Stop. Provide 4 setback periods per day plus weekday/weekend cycle.
 - 3. Temperature-sensing controls shall sense return-air temperature. Fan coil high air discharge temperature shut-down shall be provided.
 - 4. Evaporator coil freeze protection.
 - 5. Wireless infrared remote control to enter setpoints and operating conditions.
 - 6. Auto stop features shall have integral setback control.
 - 7. Automatic airsweep control to provide on/off activation of airsweep louvers.
 - 8. Dehumidification mode shall provide increased latent removal capability by modulating fan speed and setpoint temperature.
 - 9. "Fan only" operation shall provide room air circulation when no cooling[/heating] is required.
 - 10. Diagnostics shall provide continuous checks of AC system operation and warn of possible malfunctions. Error messages shall be displayed at the fan coil unit and at the remote controller.
 - 11. An indoor-to-outdoor thermistor connection cable shall be provided with the fan coil unit.
 - 12. Fan speed control shall be user-selectable: high, medium, low, or microprocessor automatic operation during all operating modes.
 - 13. A time delay shall prevent compressor restart in less than 3 minutes.
 - 14. Float control shall be in the condensate drain pan to shut fan coil down in case of condensate malfunction.
 - 15. Heat pump system shall be provided with an automatic heating-to-cooling change-over to provide automatic heating and cooling operation. Control shall include dead-band to prevent rapid mode cycling.
 - 16. Demand defrost shall be provided and shall minimize defrost cycles by internally adjusting defrost timing based on frost accumulation.
 - 17. Heat pump system shall be provided with an indoor coil high-temperature protection to detect excessive indoor discharge temperature when AC system is in heating mode.
- H. Fan coil unit shall have a filter track with factory-supplied cleanable filters.
- I. Fan coil unit shall operate on voltage and phase as scheduled on the Drawings. Power and control connections shall have terminal block connections.
- J. Refrigerant Lines: All AC system refrigerant connections shall be flared, and a 90 degree suction elbow shall be provided for rear connection. **[All heat pump systems shall have rotatable refrigerant lines for penetration through the wall using flare connections.]**

- K. Condensate Pump: The condensate pump shall remove condensate from the drain pan when gravity drainage cannot be used. Pump shall be designed for quiet operation. Pump shall consist of two parts: an internal reservoir/sensor assembly, and a remote sound-shielded pump assembly. The lift capability of the condensate pump shall be 25 feet. A level sensor on the condensate drain pan shall stop cooling operation if the level in the condensate drain pan is unacceptable.

2.04 CEILING-SUSPENDED DX FAN COIL

- A. Provide indoor, direct-expansion, ceiling-suspended fan coil. Fan coil unit shall be complete with cooling coil, fan, fan motor, piping connectors, electrical controls, condensate pump, and mounting brackets. The fan coil unit shall be matched with the outdoor condensing unit. The combination of the outdoor condensing unit and the indoor fan coil unit shall have a total net cooling capacity as scheduled on the Drawings.
- B. Fan coil cabinet shall be constructed of zinc-coated bonderized steel, fully insulated and finished with a baked enamel paint. Discharge and inlet grilles shall be high-impact polystyrene. Matching mounting brackets shall be provided.
- C. Fans shall be centrifugal blower type with air intake in the bottom rear of the fan coil unit and discharge in the front. The discharge grille louvers shall be adjustable for 2-, 3- or 4 way discharge.
- D. Coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion. A drain pan under the coil shall have a drain connection for attachment of piping to remove condensate. Condensate drain pan shall have an internal trap and auxiliary drain pan under coil header.
- E. Refrigerant metering device: The fan coil unit shall have a piston type refrigerant metering device.
- F. Motor shall be fully enclosed and permanently lubricated with inherent overload protection. Fan motor shall be 3 speed.
- G. Fan coil unit shall have a filter track with factory-supplied cleanable filters accessible from below with a ¼ turn fastener.
- H. Controls shall consist of a microprocessor-based control system that shall control space temperature, determine optimum fan speed, and run self-diagnostics. The temperature control range shall be from 64 degs F to 84 degs F. The AC system shall have the following functions as a minimum:
1. Automatic restart after power failure at the same operating conditions as at the time of power failure.
 2. Programmable thermostat to provide cooling and heating setpoints and day/night setback modes.
 3. Wired control to enter setpoints and operating conditions.
 4. Filter status indication after 250 hours of indoor fan operation.
 5. Cooling mode to provide modulating fan speed based on difference between temperature setpoint and space temperature.
 6. "Fan only" operation shall provide room air circulation when no cooling is required.
 7. A 50 foot indoor-to-outdoor control connection cable shall be provided with the

- fan coil unit.
 - 8. Fan speed control shall be user-selectable: high, medium, low, or microprocessor automatic operation during all operating modes.
 - 9. A time delay shall prevent compressor restart in less than 2 or 4 minutes (adjustable).
 - 10. Evaporator coil freeze protection.
 - 11. Automatic heating-to-cooling change-over to provide automatic heating and cooling operation. Control shall include dead-band to prevent rapid mode cycling.
- I. Fan coil unit shall operate on voltage and phase as scheduled on the Drawings.
- J. Internal Condensate Pump: The condensate pump shall remove condensate from the drain pan when gravity drainage cannot be used. Pump shall be designed for quiet operation. Pump shall consist of two parts: an internal reservoir/sensor assembly, and a remote sound-shielded pump assembly. The lift capability of the condensate pump shall be 25 feet. A level sensor on the condensate drain pan shall stop cooling operation if the level in the condensate drain pan is unacceptable.
- K. Outside Air Intake Kit: Kit shall include filter and duct connections to provide for outdoor ventilation air.
- L. Power Ventilation Kit: Kit shall be used with the accessory fresh air kit and shall include booster fan and adjustable speed control to properly balance fan to achieve required airflow rate.
- M. Electronic Programmable Thermostat: Thermostat shall be commercial grade and shall provide 7 day, 4 event scheduling. Integral sub-base shall be included. Thermostat shall also provide 3 speed fan switchover capability, and shall not require a battery to retain memory.

PART 3 – EXECUTION

3.01 INSTALLATION, GENERAL

- A. Install air-cooled condensers level and plumb, maintaining manufacturer's recommended clearances.
- B. Curb Support: Install and secure roof-mounted condensing units on curbs and coordinate roof penetrations and flashing with roof construction. Secure condensing units to curb support with seismically designed anchor bolts.
- C. Install suspended components level and plumb, maintaining manufacturer's recommended clearances. Coordinate wall penetrations and flashing with wall construction.
- D. Support suspended fan coil units from structure using threaded steel rods and spring hanger, with vertical-limit stop having deflection specified Section 23 05 48 – Vibration and Seismic Controls for HVAC.
- E. Connections:

1. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
2. Install piping adjacent to machine to allow service and maintenance.
3. Drainage Connections: Comply with applicable requirements in Section 23 21 13 – Hydronic Piping. Provide adequate connections for condensate drain.
4. Refrigerant Piping: Comply with applicable requirements in Section 23 21 13 – Hydronic Piping. Provide service valves and piping accessories.
5. Electrical System Connections: Comply with applicable requirements in Division 26 Sections for power wiring, switches, and motor controls. Electrically ground all equipment as specified in Division 26.
6. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

F. Startup Service:

1. Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field-testing.
 - a. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 - b. Operational Test: After electrical circuitry has been energized, start AC systems to confirm proper motor rotation and AC system operation.
 - c. Leak Test: After installation, charge systems with refrigerant and oil and test for leaks. Repair leaks and replace lost refrigerant and oil.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Perform start-up service. Verify that AC systems are installed and connected according to manufacturer's written instructions and the Contract Documents.
4. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 Sections.
5. Complete installation and start-up checks according to manufacturer's written instructions.
6. After start-up service and performance test, clean filters.
7. Adjust initial temperature setpoints.
8. Set field-adjustable switches and circuit breaker trip ranges as indicated.
9. Remove and replace malfunctioning AC system with new components and retest.

- G. After completing system installation, including outlet fittings and devices, inspect exposed finish. Clean to remove burrs and construction debris and repair damaged finishes.

END OF SECTION 23 81 26

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