

**SECTION 23 73 23**  
**AIR-COOLED CONDENSING UNITS**

**PART 1 - GENERAL****1.1 DESCRIPTION**

- A. This section includes the design, controls and installation requirements for air-cooled condensing units.

**1.2 RELATED WORK**

- A. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic restraints for 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: Sound and vibration requirements.
- D. Section 23 07 11, HVAC INSULATION: Piping and duct insulation.
- E. Section 23 21 13, HYDRONIC PIPING; Section 23 22 13, STEAM AND CONDENSATE HEATING PIPING; and Section 23 23 00, REFRIGERANT PIPING: Piping and valves.
- F. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: HVAC controls.
- G. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC: Testing, adjusting and balancing of air and water flows.
- H. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT: Types of motors.
- I. Section 26 29 11, MOTOR CONTROLLERS: Types of motor starters.
- J. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS: General Commissioning.
- K. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS: HVAC Commissioning.
- L. Section 23 73 13, INDOOR CUSTOM AIR-HANDLING UNITS: Air handling unit to serve refrigerant coil.

**1.3 QUALITY ASSURANCE**

- A. Unit and refrigeration system shall comply with ASHRAE 15, Safety Standard for Mechanical Refrigeration.
- B. Unit shall be certified in accordance with UL Standard 1995/CSA C22.2 No. 236, Safety Standard for Heating and Cooling Equipment.

- C. Unit Energy Efficiency Ratio (EER) shall be equal to or greater than prescribed by ASHRAE 90.1, Energy Efficient Design of New Buildings except Low-Rise Residential Buildings.
- D. Unit shall be safety certified by ETL and be ETL US and ETL Canada listed. Unit nameplate shall include the ETL/ETL Canada label.

#### **1.4 SUBMITTALS**

- A. The contractor shall, in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish a complete submission for air-cooled condensing units. The submission shall include all information listed below. Partial and incomplete submissions shall be rejected without review.
- B. Manufacturer's Literature and Data:
  - 1. Submittals for air-cooled condensing units shall include fans, motors, coils, and all other related accessories. The contractor shall provide custom drawings showing plans and elevations of the total air-cooled condensing unit assembly including dimensions, operating weight, controls penetrations, electrical disconnect, switches, wiring, utility connection points, unit support system, vibration isolators, pressure drops.
  - 2. Submittal drawings of section or component only will not be acceptable. Contractor shall also submit performance data including performance test results, charts, curves or certified computer selection data; data sheets; fabrication and insulation details. This data shall be submitted in hard copies and in electronic version compatible to AutoCAD version 2014.
  - 3. Submit sound power levels in each octave band for the inlet and discharge of the fans at scheduled conditions. In absence of sound power ratings refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
  - 4. Ladder-type schematic drawing of power and auxiliary utility field hook-up requirements, indicating all items that are furnished by the manufacturer.
  - 5. Approximate shipping weight.
- C. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS. Include instructions for lubrication, motor and drive replacement, spare part lists, and wiring diagrams.
- D. Submit written test procedures two weeks prior to factory testing. Submit written results of factory tests for approval prior to shipping.

- E. Submit shipping information that clearly indicates how the units will be shipped in compliance with the descriptions below.
1. Units shall be shipped in shrink wrapping to protect the unit from dirt, moisture and/or road salt.
  2. If not shipped in one (1) piece, provide manufacturer approved shipping splits where required for installation or to meet shipping and/or job site rigging requirements in modular sections. Indicate clearly that the shipping splits shown in the submittals have been verified to accommodate the construction constraints for rigging as required to complete installation and removal of any section for replacement through available access without adversely affecting other sections.
  3. If shipping splits are provided, each component shall be individually shrink wrapped to protect the unit and all necessary hardware (e.g. bolts, gaskets etc.) will be included to assemble unit on site (see section 2.1.A.4).
  4. Lifting lugs will be provided to facilitate rigging on shipping splits and joining of segments. If the unit cannot be shipped in one piece, the contractor shall indicate the number of pieces that each unit will have to be broken into to meet shipping and job site rigging requirements.

#### **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. American Society for Testing and Materials (ASTM):
- ASTM B117-11.....Standard Practice for Operating Salt Spray  
(Fog) Apparatus
- ASTM D1929-08.....Standard Test Method for Determining Ignition  
Temperature of Plastics
- C. Energy Policy Act of 2005 (P.L.109-58)
- D. American Society of Heating, Refrigerating and Air Conditioning  
Engineers (ASHRAE)
- ASHRAE 15-2013.....Safety Standard for Refrigeration Systems
- ASHRAE 90.1-2013.....Energy Standard for Buildings except Low-Rise  
Residential Buildings

## E. Underwriters Laboratories (UL)

UL CSA C22.2 No. 236....Heating and Cooling Equipment

UL 1995.....Heating and Cooling Equipment

**PART 2 - PRODUCTS****2.1 CONDENSING UNITS**

## A. General Description

1. Condensing unit shall include compressors, air-cooled condenser coils, condenser fans, suction and liquid connection valves, and unit controls.
2. Unit shall be factory assembled and tested including leak testing of the coils and pressure testing of the refrigeration circuit. Run test report shall be supplied with the unit in the controls compartment's literature pocket.
3. Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
4. Unit components shall be labeled, including pipe stub outs, refrigeration system components and electrical and controls components.
5. Installation, Operation and Maintenance manual shall be supplied within the unit.
6. Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's access door.
7. Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's access door.

## B. Construction

1. All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.
2. Unit insulation shall have a minimum thermal resistance R-value of 13. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D-1929 for a minimum flash ignition temperature of 320°C (610°F).
3. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation,

provides a cleanable interior, prevents heat transfer through the panel, and prevents exterior condensation on the panel.

4. Cabinet shall have rain break overhangs above access doors.
5. Access to compressors and electrical and controls components shall be through hinged access doors with quarter turn, zinc cast, lockable handles. Full length stainless steel piano hinges shall be included on the doors.
6. Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117 test procedure.
7. Unit shall include lifting lugs along the base of the unit.

C. Electrical

1. Unit shall be provided with standard power block for connecting power to the unit.
  - a. Unit shall be provided with factory installed and factory wired, non-fused disconnect switch.
  - b. Unit shall be provided with factory installed and factory wired 115V, 13 amp GFI outlet with outlet disconnect switch in the unit control panel.
  - c. Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more that 10% out of balance on voltage, the voltage is more that 10% under design voltage, or on phase reversal.

D. Refrigeration System

1. Provide a minimum of one variable frequency drive (VFD) compressor per refrigeration circuit.
2. Compressors shall be scroll type with thermal overload protection and be independently circuited. One with a VFD on each circuit.
3. Compressors shall be mounted in an isolated service compartment that can be accessed without affecting unit operation. Lockable hinged access doors shall be fabricated of double wall, rigid polyurethane foam insulated panels to prevent the transmission of noise outside the cabinet.
4. Compressors shall be isolated from the base pan with the compressor manufacturer's recommended rubber vibration isolators, to reduce any transmission of noise from the compressors.

5. Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high pressure and low pressure sides, and service valves for liquid and suction connections. Liquid line filter driers shall be factory provided. Finished field installed refrigerant circuits shall include the low side cooling components, refrigerant, electronic expansion valve, liquid line and insulated suction line.

6. Accessories:

- a. Each refrigeration circuit shall be equipped with suction and discharge compressor isolation valves.
- b. Refrigeration circuits shall include an adjustable compressor lockout.
- c. Lead refrigeration circuit(s) shall be equipped with flooded condenser low ambient head pressure control to allow operation down to minus 18°C (0°F).

E. Condensers

1. Air-Cooled Condenser

- a. Condenser fans shall be vertical discharge, axial flow, direct drive fans.
- b. Coils shall be designed for use with R-410A refrigerant. Coils shall be multi-pass and fabricated from aluminum microchannel tubes.
- c. Coils shall be designed for a minimum of minus 12°C (10°F) of refrigerant sub-cooling.
- d. Coils facing away from the unit shall be protected by perforated sheet metal condenser coil guards.

2. Accessories: Condenser fan banks shall be VFD driven variable speed for condenser head pressure control. Factory provided and factory programmed VFDs shall continuously modulate the fan air flow to maintain head pressure at acceptable levels. Cooling operation shall be allowed down to 0.7°C (35°F) with adjustable compressor lockouts.

F. Controls

1. Field Installed DDC Controls provided under Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

- a. Controls shall be field provided and field installed under Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

2. Accessories: Isolation relays shall be factory installed.

**PART 3 - EXECUTION**

**3.1 INSTALLATION, OPERATION, AND MAINTENANCE**

- A. Installation, Operation and Maintenance manual shall be supplied with the unit.
- B. Installing contractor shall install unit, including field installed components, in accordance with Installation, Operation and Maintenance manual instructions.
- C. Startup and maintenance requirements shall be complied with to ensure safe and correct operation of the unit.

**3.2 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.

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