

SECTION 236426.13 - AIR-COOLED, ROTARY-SCREW WATER CHILLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes split, packaged, air-cooled chillers.

1.2 DEFINITIONS

- A. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input using consistent units for any given set of rating conditions.
- B. DDC: Direct digital control.
- C. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in terms of Btu/h to the total power input given in terms of watts at any given set of rating conditions.
- D. IPLV: Integrated part-load value. A single-number part-load efficiency figure of merit calculated per the method defined by AHRI 550/590 and referenced to AHRI standard rating conditions.
- E. kW/Ton (kW/kW): The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons (kW) at any given set of rating conditions.
- F. NPLV: Nonstandard part-load value. A single-number part-load efficiency figure of merit calculated per the method defined by AHRI 550/590 and intended for operating conditions other than AHRI standard rating conditions.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Source quality-control reports.
- B. Field Test Reports: Startup service reports.

- C. Sample warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

#### 1.6 QUALITY ASSURANCE

- A. AHRI Rating: Rate chiller performance according to requirements in AHRI 550/590.
- B. ASHRAE Compliance:
  - 1. ASHRAE 15 for safety code for mechanical refrigeration.
- C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1.
- D. ASME Compliance: Fabricate and label chiller to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, and include an ASME U-stamp and nameplate certifying compliance.
- E. Comply with NFPA 70.
- F. Comply with requirements of UL and UL Canada and include label by a qualified testing agency showing compliance.

### PART 2 - PRODUCTS

#### 2.1 PACKAGED, AIR-COOLED CHILLERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Carrier Corporation; a unit of United Technologies Corp.
  - 2. Daikin Applied.
  - 3. Dunham-Bush.
  - 4. Trane.
- B. Description: Factory-assembled and run-tested chiller complete with base and frame, condenser casing, compressors, compressor motors and motor controllers, remote evaporator, condenser coils, condenser fans and motors, electrical power, controls, and accessories.
- C. Fabricate base, frame, and attachment to chiller components strong enough to resist chiller movement during a seismic event when chiller base is anchored to field support structure.
- D. Cabinet:

1. Base: Galvanized-steel base extending the perimeter of chiller. Secure frame and compressors to base to provide a single-piece unit.
  2. Frame: Rigid galvanized-steel frame secured to base and designed to support cabinet, condenser, control panel, and other chiller components not directly supported by base.
  3. Casing: Galvanized steel.
  4. Architectural Louvered Panels: Architecturally pleasing louvered panels to cover the complete condensing coil and service area beneath the condenser.
- E. Compressors:
1. Description: Positive displacement, hermetically sealed.
  2. Casing: Cast iron, precision machined for minimum clearance about periphery of rotors.
  3. Rotors: Manufacturer's standard one- or two-rotor design.
  4. Each compressor provided with discharge shutoff valves, crankcase oil heater, and suction strainer.
- F. Service: Easily accessible for inspection and service.
- G. Capacity Control: Step and variable load and unloader valves to achieve performance indicated.
1. Maintain stable operation within 1/2 degree Fahrenheit throughout range of operation. Configure to achieve most energy-efficient operation possible.
- H. Oil Lubrication System: Consisting of pump if required, filtration, heater, cooler, factory-wired power connection, and controls.
1. Provide lubrication to bearings, gears, and other rotating surfaces at all operating, startup, shutdown, and standby conditions including power failure.
  2. Thermostatically controlled oil heater properly sized to remove refrigerant from oil.
  3. Factory-installed and pressure-tested piping with isolation valves and accessories.
  4. Oil compatible with refrigerant and chiller components.
  5. Positive visual indication of oil level.
- I. Vibration Control:
1. Vibration Balance: Balance chiller compressors and drive assemblies to provide a precision balance that is free of noticeable vibration over the entire operating range.
    - a. Overspeed Test: 25 percent above design operating speed.
  2. Isolation: Mount individual compressors on vibration isolators.
- J. Compressor Motors:
1. Hermetically sealed and cooled by refrigerant suction gas.
  2. High-torque, induction type with inherent thermal-overload protection on each phase.
- K. Compressor Motor Controllers:
1. Wye-Delta, closed transition.

L. Refrigerant Circuits:

1. Refrigerant: Type as indicated on Drawings.
2. Refrigerant Type: R-134a. Classified as Safety Group A1 according to ASHRAE 34.
3. Refrigerant Compatibility: Chiller parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.
4. Refrigerant Circuit: Each shall include a thermal- or electronic-expansion valve, refrigerant charging connections, compressor discharge shutoff valves, a liquid-line shutoff valve, a replaceable-core filter-dryer, a liquid-line solenoid valve, and an insulated suction line.
5. Pressure Relief Device:
  - a. Comply with requirements in ASHRAE 15 and in applicable portions of ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
  - b. ASME-rated, spring-loaded pressure relief valve; single- or multiple-reseating type.

M. Remote Evaporator:

1. Description: Shell-and-tube design.
  - a. Flooded type with fluid flowing through tubes and refrigerant flowing around tubes within the shell.
2. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Shell Material: Carbon steel.
4. Shell Heads: Removable carbon-steel heads located at each end of the tube bundle.
5. Fluid Nozzles: Terminated with mechanical-coupling or flanged end connections for connection to field piping.
6. Tube Construction: Individually replaceable copper tubes with enhanced fin design, expanded into tube sheets.

N. Air-Cooled Condenser:

1. Plate-fin coil with integral subcooling on each circuit, rated at 450 psig (3103 kPa).
  - a. Construct coil casing of galvanized steel.
  - b. Construct coils of copper tubes mechanically bonded to aluminum fins.
  - c. Coat coils with a corrosion-resistant coating after fabrication.
2. Fans: Direct-drive propeller type with dynamically balanced fan blades, arranged for vertical air discharge.
3. Fan Motors: Totally enclosed nonventilating or totally enclosed air over enclosure, with permanently lubricated bearings. Equip each motor with overload protection integral to either the motor or chiller controls.
4. Fan Guards: Steel safety guards with PVC or corrosion-resistant coating.

O. Electrical Power:

1. Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point, field-power connection to chiller. Provide separate 115V, 15 amp field provided single phase power for convenience outlet.
2. House in a unit-mounted, NEMA 250, Type 3R enclosure with hinged access.
3. Wiring shall be numbered to match wiring diagram.
4. Install factory wiring outside of an enclosure in a raceway.
5. Field-power interface shall be to a standard interrupting molded case circuit breaker.
  - a. Disconnect means shall be interlocked with door operation.
6. Provide each motor with overcurrent protection.
7. Overload relay sized according to UL 1995 or an integral component of chiller control microprocessor.
8. Phase-Failure and Undervoltage Relays: Solid-state sensing with adjustable settings.
9. Control Relays: Auxiliary and adjustable time-delay relays.

P. Controls:

1. Microprocessor based.
2. Enclosure: Share enclosure with electrical power devices or provide a separate enclosure for remote mounting in the field.
3. Operator Interface: Multiple-character digital or graphic display with dynamic update of information and with keypad or touch-sensitive display located on front of control enclosure.
4. Control Functions:
  - a. Manual or automatic startup and shutdown time schedule.
  - b. Entering and leaving chilled-water temperatures, control set points, and motor load limits.
  - c. Current limit and demand limit.
  - d. External chiller emergency stop.
  - e. Antirecycling timer.
  - f. Automatic lead-lag switching
5. Manually Reset Safety Controls: The following conditions shall shut down chiller and require manual reset:
  - a. Low evaporator pressure or high condenser pressure.
  - b. Low chilled-water temperature.
  - c. Refrigerant high pressure.
  - d. High or low oil pressure.
  - e. High oil temperature.
  - f. Loss of chilled-water flow.
  - g. Control device failure.
6. Interface with Trane Tracer Summit DDC System for HVAC: Factory-installed hardware and software to enable the DDC system for HVAC to monitor, control, and display chiller status and alarms.

- a. ASHRAE 135 (BACnet) communication interface with the DDC system for HVAC shall enable the DDC system for HVAC operator to remotely control and monitor the chiller from the chiller plant controllers. Control features and monitoring points displayed locally at chiller control panel shall be available through the DDC system for HVAC.

Q. Insulation: Closed-cell, flexible elastomeric, thermal insulation complying with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

R. Accessories:

1. Factory-furnished, chilled-water flow switches for field installation.
2. Individual compressor suction and discharge pressure gages with shutoff valves for each refrigerant circuit.
3. Factory-furnished neoprene or spring isolators for field installation.

S. Capacities and Characteristics: As indicated on drawings

## 2.2 SOURCE QUALITY CONTROL

A. Perform functional tests of chillers before shipping.

B. Factory run test each air-cooled chiller with water flowing through evaporator.

C. Factory performance test air-cooled chillers, before shipping, according to AHRI 550/590.

1. Test the following conditions:

- a. Design conditions indicated.
- b. Reduction in capacity from design to minimum load in steps of 10 with condenser air at design conditions.

2. Prepare test report indicating test procedures, instrumentation, test conditions, and results. Submit copy of results within one week of test date.

D. Factory sound test air-cooled chillers, before shipping, according to AHRI 370.

1. Test the following conditions:

- a. Design conditions indicated.
- b. Chiller operating at calculated worst-case sound condition.

2. Prepare test report indicating test procedures, instrumentation, test conditions, and results. Submit copy of results within one week of test date.

E. Factory test and inspect evaporator and condenser according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

F. For chillers located indoors, rate sound power level according to AHRI 575.

- G. For chillers located outdoors, rate sound power level according to AHRI 370.

### PART 3 - EXECUTION

#### 3.1 CHILLER INSTALLATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.
- B. Coordinate sizes, locations, and anchoring attachments of structural-steel support structures.
- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- D. Install chillers on support structure indicated.
- E. Equipment Mounting:
  - 1. Install chillers on existing steel framing.
- F. Maintain manufacturer's recommended clearances for service and maintenance.
- G. Charge chiller with refrigerant and fill with oil if not factory installed.
- H. Install separate devices furnished by manufacturer and not factory installed.

#### 3.2 CONNECTIONS

- A. Install piping adjacent to chiller to allow service and maintenance.
- B. Evaporator Chilled Water Connections: Connect to evaporator inlet with shutoff valve, flexible connector, thermometer, and plugged tee with pressure gage. Connect to evaporator outlet with shutoff valve, balancing valve, flexible connector, thermometer, plugged tee with shutoff valve and pressure gage, and drain connection with valve. Make connections to chiller with a flange or mechanical coupling.
- C. Refrigerant Connections: Refrigerant piping shall be installed per the manufacturer's written instructions.
- D. Refrigerant Pressure Relief Device Connections: For remote evaporators installed indoors, extend separate vent piping for each evaporator to the outdoors without valves or restrictions. Comply with ASHRAE 15. Connect vent to evaporator pressure relief device with flexible connector and dirt leg with drain valve.
- E. Connect each chiller drain connection with a union and drain pipe, and extend pipe, full size of connection, to floor drain. Provide a shutoff valve at each connection.

3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Verify that refrigerant charge is sufficient and chiller has been leak tested.
  - 3. Verify that pumps are installed and functional.
  - 4. Verify that thermometers and gages are installed.
  - 5. Operate chiller for run-in period.
  - 6. Check bearing lubrication and oil levels.
  - 7. For remote evaporators installed indoors, verify that refrigerant pressure relief device is vented outdoors.
  - 8. Verify proper motor rotation.
  - 9. Verify static deflection of vibration isolators, including deflection during chiller startup and shutdown.
  - 10. Verify and record performance of fluid flow and low-temperature interlocks for evaporator and condenser.
  - 11. Verify and record performance of chiller protection devices.
  - 12. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
- B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assembly, installation, and connection.
- C. Prepare test and inspection startup reports.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain chillers.

END OF SECTION 236426.13