

**SECTION 15629**

**SCROLL WATER CHILLERS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Packaged, air-cooled, electric-motor-driven, scroll water chillers.

**1.3 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. 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.
- C. IPLV: Integrated part-load value. A single number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and referenced to ARI standard rating conditions.
- D. kW/Ton: The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons at any given set of rating conditions.
- E. NPLV: Nonstandard part-load value. A single number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and intended for operating conditions other than the ARI standard rating conditions.

**1.4 SUBMITTALS**

- A. Product Data: Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.
  - 1. Performance at ARI standard conditions and at conditions indicated.
  - 2. Performance at ARI standard unloading conditions.
  - 3. Minimum evaporator flow rate.
  - 4. Refrigerant capacity of water chiller.
  - 5. Oil capacity of water chiller.
  - 6. Fluid capacity of evaporator.
  - 7. Characteristics of safety relief valves.
  - 8. Minimum entering condenser-air temperature

9. Performance at varying capacity with constant design entering condenser-air temperature. Repeat performance at varying capacity for different entering condenser-air temperatures from design to minimum in 10 deg F increments.
- B. Shop Drawings: Complete set of manufacturer's prints of water chiller assemblies, control panels, sections and elevations, and unit isolation. Include the following:
  1. Assembled unit dimensions.
  2. Weight and load distribution.
  3. Required clearances for maintenance and operation.
  4. Size and location of piping and wiring connections.
  5. Wiring Diagrams: For power, signal, and control wiring.
- C. Certificates: For certification required in "Quality Assurance" Article.
- D. Startup service reports.
- E. Operation and Maintenance Data: For each water chiller to include in emergency, operation, and maintenance manuals.
- F. Warranty: Sample of special warranty.

#### 1.5 QUALITY ASSURANCE

- A. ARI Rating: Rate water chiller performance according to requirements in ARI 550/590, "Water Chilling Packages Using the Vapor Compression Cycle."
- B. ASHRAE Compliance: ASHRAE 15 for safety code for mechanical refrigeration.
- C. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- D. ASME Compliance: Fabricate and stamp water chiller heat exchangers to comply with ASME Boiler and Pressure Vessel Code.
- E. Comply with NFPA 70.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Ship water chillers from the factory fully charged with refrigerant and filled with oil.

#### 1.7 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

#### 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water chillers that fail in materials or workmanship within specified period.

1. Compressor Warranty Period: Five years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 PACKAGED AIR-COOLED WATER CHILLERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Carrier Corporation; a United Technologies company.
  2. Trane.
  3. York International Corporation.
- B. Description: Factory-assembled and run-tested water chiller complete with base and frame, condenser casing, compressors, compressor motors and motor controllers, evaporator, condenser coils, condenser fans and motors, electrical power, controls, and accessories.
- C. Cabinet:
  1. Base: Galvanized-steel base extending the perimeter of water chiller. Secure frame, compressors, and evaporator 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 from base.
  3. Casing: Galvanized steel.
  4. Finish: Coat base, frame, and casing with a corrosion-resistant coating capable of withstanding a 500-hour salt-spray test according to ASTM B 117.
  5. Sound-reduction package consisting of the following:
    - a. Acoustic enclosure around compressors.
    - b. Reduced-speed fans with acoustic treatment.
    - c. Designed to reduce sound level without affecting performance.
- D. Compressors:
  1. Description: Positive-displacement direct drive with hermetically sealed casing.
  2. Each compressor provided with suction and discharge service valves, crankcase oil heater, and suction strainer.
  3. Operating Speed: Nominal 3600 rpm for 60-Hz applications.
  4. Capacity Control: On-off compressor cycling.
  5. Oil Lubrication System: Automatic pump with strainer, sight glass, filling connection, filter with magnetic plug, and initial oil charge.
  6. Vibration Isolation: Mount individual compressors on vibration isolators.
- E. Compressor Motors:
  1. Hermetically sealed and cooled by refrigerant suction gas.
  2. High-torque, two-pole induction type with inherent thermal-overload protection on each phase.
- F. Compressor Motor Controllers:
  1. Across the Line: NEMA ICS 2, Class A, full voltage, nonreversing.

G. Refrigeration:

1. Refrigerant: R-134a. Classified as Safety Group A1 according to ASHRAE 34.
2. Refrigerant Compatibility: Parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.
3. Refrigerant Circuit: Each circuit shall include a thermal-expansion valve, refrigerant charging connections, a hot-gas muffler, compressor suction and discharge shutoff valves, a liquid-line shutoff valve, a replaceable-core filter-dryer, a sight glass with moisture indicator, a liquid-line solenoid valve, and an insulated suction line.
4. Refrigerant Isolation: Factory install positive shutoff isolation valves in the compressor discharge line and the refrigerant liquid-line to allow the isolation and storage of the refrigerant charge in the chiller condenser.

H. Evaporator:

1. Shell and Tube:
  - a. Description: Direct-expansion, shell-and-tube design with fluid flowing through the shell and refrigerant flowing through the tubes within the shell.
  - b. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code.
  - c. Shell Material: Carbon steel.
  - d. Shell Heads: Removable carbon-steel heads with multipass baffles designed to ensure positive oil return and located at each end of the tube bundle.
  - e. Shell Nozzles: Fluid nozzles located along the side of the shell and terminated with mechanical-coupling end connections for connection to field piping.
  - f. Tube Construction: Individually replaceable copper tubes with enhanced fin design, expanded into tube sheets.
2. Heater: Factory-installed and -wired electric heater with integral controls designed to protect the evaporator to minus 20 deg F.

I. Air-Cooled Condenser:

1. Plate-fin coil with integral subcooling on each circuit, rated at 450 psig.
  - a. Construct coils of copper tubes mechanically bonded to aluminum fins.
  - b. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.
2. Fans: Direct-drive propeller type with statically and dynamically balanced fan blades, arranged for vertical air discharge.
3. Fan Motors: Totally enclosed nonventilating (TENV) or totally enclosed air over (TEAO) enclosure, with permanently lubricated bearings, and having built-in overcurrent- and thermal-overload protection.
4. Fan Guards: Steel safety guards with corrosion-resistant coating.

J. 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 water chiller.
2. House in a unit-mounted, NEMA 250, Type 3R enclosure with hinged access door with lock and key or padlock and key.
3. Wiring shall be numbered and color-coded to match wiring diagram.
4. Install factory wiring outside of an enclosure in a raceway.

5. Field power interface shall be to NEMA KS 1, heavy-duty, nonfused disconnect switch.
6. Provide branch power circuit to each motor and to controls with one of the following disconnecting means:
  - a. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
  - b. NEMA KS 1, heavy-duty, nonfusible switch.
  - c. NEMA AB 1, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
7. Provide each motor with overcurrent protection.
8. Overload relay sized according to UL 1995, or an integral component of water chiller control microprocessor.
9. Phase-Failure and Undervoltage: Solid-state sensing with adjustable settings.
10. Provide power factor correction capacitors to correct power factor to 0.95 at full load.
11. Transformer: Unit-mounted transformer with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.
  - a. Power unit-mounted controls where indicated.
  - b. Power unit-mounted, ground fault interrupt (GFI) duplex receptacle.
12. Control Relays: Auxiliary and adjustable time-delay relays.
13. Indicate the following for water chiller electrical power supply:
  - a. Current, phase to phase, for all three phases.
  - b. Voltage, phase to phase and phase to neutral for all three phases.
  - c. Three-phase real power (kilowatts).
  - d. Three-phase reactive power (kilovolt amperes reactive).
  - e. Power factor.
  - f. Running log of total power versus time (kilowatt hours).
  - g. Fault log, with time and date of each.

K. Controls:

1. Stand-alone, microprocessor based.
2. Enclosure: Share enclosure with electrical power devices or provide a separate enclosure of matching construction.
3. Operator Interface: Keypad or pressure-sensitive touch screen. Multiple-character, backlit, liquid-crystal display or light-emitting diodes. Display the following:
  - a. Date and time.
  - b. Operating or alarm status.
  - c. Operating hours.
  - d. Outside-air temperature if required for chilled-water reset.
  - e. Temperature and pressure of operating set points.
  - f. Entering and leaving temperatures of chilled water.
  - g. Refrigerant pressures in evaporator and condenser.
  - h. Saturation temperature in evaporator and condenser.
  - i. No cooling load condition.
  - j. Elapsed time meter (compressor run status).
  - k. Pump status.
  - l. Antirecycling timer status.
  - m. Percent of maximum motor amperage.
  - n. Current-limit set point.
  - o. Number of compressor starts.

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 limit. Chilled-water leaving temperature shall be reset based on return-water temperature.
    - c. Current limit and demand limit.
    - d. External water chiller emergency stop.
    - e. Antirecycling timer.
    - f. Automatic lead-lag switching.
  5. Manual-Reset Safety Controls: The following conditions shall shut down water 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. Building Automation System Interface: Factory-installed hardware and software to enable building automation system to monitor, control, and display water chiller status and alarms.
    - a. ASHRAE 135 (BACnet) communication interface with building automation system shall enable building automation system operator to remotely control and monitor the water chiller from an operator workstation. Control features and monitoring points displayed locally at water chiller control panel shall be available through building automation system.
- L. Insulation:
1. Material: Closed-cell, flexible elastomeric, thermal insulation complying with ASTM C 534, Type I, for tubular materials and Type II, for sheet materials.
  2. Thickness: 3/4 inches.
  3. Thermal conductivity: 0.26 at 75 Deg F.
  4. Factory-applied insulation over cold surfaces of water chiller components.
    - a. Adhesive: As recommended by insulation manufacturer and applied to 100 percent of insulation contact surface. Seal seams and joints.
  5. Apply protective coating to exposed surfaces of insulation.
- M. Accessories:
1. Factory-furnished, chilled-water flow switches for field installation.
  2. Individual compressor suction and discharge pressure gages with shutoff valves for each refrigeration circuit.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Before water chiller installation, examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, and electrical connections to verify actual locations, sizes, and other conditions affecting water chiller performance, maintenance, and operations.
  - 1. Water chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 WATER CHILLER INSTALLATION**

- A. Equipment Mounting: Install water chiller on concrete bases. Comply with requirements in Division 3 Section "Cast-in-Place Concrete."
  - 1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Maintain manufacturer's recommended clearances for service and maintenance.
- C. Charge water chiller with refrigerant if not factory charged and fill with oil if not factory installed.
- D. Install separate devices furnished by manufacturer and not factory installed.

#### **3.3 CONNECTIONS**

- A. Comply with requirements in Division 15 Section "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to chiller to allow service and maintenance.
- C. Connect each drain connection with a union and drain pipe and extend pipe, full size of connection, to a location as directed by Owners representative in field. Provide a shutoff valve at each connection if required.

#### **3.4 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to perform startup service.
- B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.
- C. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
  - 1. Verify that refrigerant charge is sufficient and water chiller has been leak tested.
  - 2. Verify that pumps are installed and functional.

3. Verify that thermometers and gages are installed.
4. Operate water chiller for run-in period.
5. Check bearing lubrication and oil levels.
6. Verify proper motor rotation.
7. Verify static deflection of vibration isolators, including deflection during water chiller startup and shutdown.
8. Verify and record performance of chilled-water flow and low-temperature interlocks.
9. Verify and record performance of water chiller protection devices.
10. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

- D. Prepare a written startup report that records results of tests and inspections.

### 3.5 DEMONSTRATION

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

END OF SECTION