

SECTION 23 64 51 – AIR COOLED SCROLL CHILLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes packaged, air-cooled, electric-motor-driven, scroll water chillers with multiple compressors.

1.3 SUBMITTALS

- A. Product Data: For each type of chiller.
 - 1. Include refrigerant, rated capacities, operating characteristics, and furnished specialties and accessories.
 - 2. Performance at AHRI standard conditions and at conditions indicated.
 - 3. Performance at AHRI standard unloading conditions.
 - 4. Minimum evaporator flow rate.
 - 5. Fluid capacity of evaporator.
 - 6. Characteristics of safety relief valves.
- 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. Diagrams for power, signal, and control wiring.
 - 6. Installation instructions.
- C. Start-up reports.
- D. Sample Warranty: For special warranty.
- E. Operation and Maintenance Data: For each water chiller to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Unit shall be rated in accordance with AHRI Standard 550/590, latest edition and all units shall be ASHRAE 90.1 compliant.

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- B. Unit construction shall comply with ASHRAE 15 Safety Code, UL latest edition, and ASME applicable codes.
- C. Unit shall be manufactured in a facility registered to ISO 9001 Manufacturing Quality Standard.
- D. Unit shall be full load run tested at the factory.
- E. ANSI/ASHRAE 15 – Safety Code for Mechanical Refrigeration.
- F. ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
- G. Factory Run Test: Chiller shall be pressure-tested, evacuated and fully charged with refrigerant and oil, and shall be factory operational run tested with water flowing through the vessel. Provide test results

1.5 DELIVERY, STORAGE, AND HANDLING

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

1.6 WARRANTY

- A. All equipment, material and labor provided under this specification section shall be warranted for a period of one year from the date of substantial completion.
- B. Chiller Warranty: Chiller manufacturer agrees to repair or replace components of water chillers that fail in materials or workmanship within specified warranty period of 5 years from date of Substantial Completion. The warranty shall include the cost of a complete refrigerant charge when necessary.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide air-cooled scroll chillers manufactured by Carrier. Subject to review, equipment meeting the full requirements of the specifications and project installation limitations (i.e. size, weight electrical requirements) chillers manufactured by the following will be considered:
 - 1. The Trane Co.
 - 2. York \ Johnson Controls.
- B. Manufactures other the basis of design manufacturer shall carefully review the contract drawings, prior to bidding to verify the equipment will meet all requirements, including installation clearances, electrical power, and structural support. Any change in cost required for alternate bid manufacturers shall be included in the alternate bid price.

2.2 MANUFACTURED UNITS

- A. Factory-assembled, single-piece air-cooled liquid chiller. Contained within the unit cabinet shall be all factory wiring, piping, controls, refrigerant charge, and special features required prior to field start-up.
- B. Materials of Construction:

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1. The base rail shall be 11 ga structural quality (Grade 50, Class 2), hot-dipped, zinc-coated, minimized spangle sheet steel (with Magni-coated screws).
2. Cabinet shall be galvanized steel casing with a baked enamel powder or pre-painted finish.
3. Painted parts shall withstand 1000 hours in constant neutral salt spray under ASTM B117 conditions with a 1 mm scribe per ASTM D1654. After test, painted parts shall show no signs of wrinkling or cracking, no loss of adhesion, and no evidence of blistering, and the mean creepage shall not exceed 1/4 in. (Rating ≥ 4 per ASTM D1654) on either side of the scribe line.

C. Fans:

1. Condenser fans shall be direct-driven, 9-blade airfoil cross-section, reinforced polymer construction, shrouded-axial type, and shall be statically and dynamically balanced with inherent corrosion resistance.
2. Air shall be discharged vertically upward.
3. Fans shall be protected by coated steel wire safety guards.
4. Fan blades shall have serrated edges to minimize the sound that is produced.

D. Compressor/Compressor Assembly:

1. Fully hermetic scroll type compressors.
2. Direct drive, 3500 rpm (60 Hz), protected by motor temperature sensors, suction gas cooled motor.
3. External vibration isolation rubber-in-shear.
4. Each compressor shall be equipped with crankcase heaters to minimize oil dilution.

E. Shell and Tube Evaporator:

1. Evaporator shall be rated for a refrigerant working-side pressure of 445 psig (3068 kPa) and shall be tested for a maximum water-side pressure of 300 psig (2068 kPa) or 150 psig (1034 kPa)
2. Shell-and-tube evaporator shall be provided (brazed plate type will not be approved).
3. Shell shall be insulated with 3/4 in. (19 mm) closed-cell, polyvinyl-chloride foam with a maximum K factor of 0.28.
4. Shall incorporate 2 independent refrigerant circuits.
5. Unit shall be provided with a factory-installed flow switch.
6. All connections shall use standard Victaulic® -type fittings.
7. Evaporator shall be equipped with freeze protection heaters providing protection down to -20°F (-29°C) ambient temperature.

F. Condenser:

1. Coil shall be air-cooled Novation® heat exchanger technology with microchannel (MCHX) coils and shall have a series of flat tubes containing a series of multiple, parallel flow microchannels layered between the refrigerant manifolds. Coils shall consist of a 2-pass arrangement. Coil construction shall consist of aluminum alloys for fins, tubes, and manifolds, in combination with a corrosion-resistant coating.
2. Tubes shall be cleaned, dehydrated, and sealed.
3. Assembled condenser coils shall be leak tested and pressure tested at 656 psig (4522 kPa).
4. To plan the chiller installation and for ease of maintenance/coil removal, all refrigerant piping entering and leaving the condenser coils shall be located on only one side of the chiller so the coils can be removed (when needed) from the side free of piping. This is important to consider because removing the coils from the header side, although possible, involves extra labor due to extra bending and brazing of the coil headers.

G. Refrigeration Components:

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1. Refrigerant circuit components shall include replaceable core filter drier, moisture-indicating sight glass, electronic expansion device, discharge service valve and liquid line service valves, and complete operating charge of both refrigerant and compressor oil.
- H. Provide vibration isolators to eliminate all vibration through the chiller supports. Isolators to be selected by the chiller manufacturer.

2.3 CHILLER CONTROLS

- A. Unit controls shall include the following minimum components:
 1. Microprocessor with non-volatile memory. Battery backup system shall not be accepted.
 2. Separate terminal block for power and controls.
 3. Control transformer to serve all controllers, relays, and control components.
 4. ON/OFF control switch.
 5. Replaceable solid-state controllers.
 6. Pressure sensors installed to measure suction and discharge pressures. Thermistors installed to measure evaporator entering and leaving fluid temperatures.
- B. Unit controls shall include the following functions:
 1. Automatic circuit lead/lag.
 2. Hermetic scroll compressors are maintenance-free and protected by an auto-adaptive control that minimizes compressor wear.
 3. Capacity control based on leaving chilled fluid temperature and compensated by rate of change of return fluid temperature with temperature set point accuracy to 0.1°F (0.05°C).
 4. Limiting the chilled fluid temperature pull-down rate at start-up to an adjustable range of 0.2°F to 2°F (0.1 to 1.1°C) per minute to prevent excessive demand spikes at start-up.
 5. Seven-day time schedule.
 6. Leaving chilled fluid temperature reset from return fluid and outside air temperature.
 7. Chilled water pump start/stop control and primary standby sequencing to ensure equal pump run time.
 8. Chiller control for parallel chiller applications without addition of hardware modules and control panels (requires thermistors).
 9. Timed maintenance scheduling to signal maintenance activities for strainer maintenance and user-defined maintenance activities.
 10. Low ambient protection to energize evaporator heaters.
 11. Periodic pump start to ensure pump seals are properly maintained during off-season periods.
 12. Single step demand limit control activated by remote contact closure.
 13. Nighttime sound mode to reduce the sound of the machine per a user-defined schedule.

2.4 CHILLER DIAGNOSTICS

- A. The control panel shall include, as standard, a display:
 1. Color touch screen display with stylus.
 2. Display shall allow a user to navigate through menus, select desired options, and modify data.
- B. Features of the display shall include:
 1. Multiple connection ports for USB, Ethernet, or BACnet™ IP, Modbus1-RTU (Remote Terminal Unit), LEN (local equipment network), and Carrier Comfort Network® (CCN) connections.
 2. NOTE: BACnet IP may require additional programming.

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3. Automatic reporting of alarms over email.
4. Ability to graphically plot trends of system performance and conditions over time.
5. Graphical summary display of current chiller operation and water conditions.
6. Display shall allow access to configuration, maintenance, service, set point, time schedules, alarm history, and status data.
7. Three levels of password protection against unauthorized access to configuration and maintenance information, and display set up parameters.
8. Full compatibility with the Carrier Comfort Network® (CCN) system to provide email alarm notification and to provide network capability to fully monitor and control chiller.
9. Display shall be capable of displaying the last 50 alarms, with clear full text description and time and date stamp, and will store a snapshot of operating conditions before and after the 10 most recent alarms.
10. Display run hours and number of starts for machine and individual compressors.
11. The control system shall allow software upgrade without the need for new hardware modules.

2.5 Safeties:

- A. Unit shall be equipped with thermistors and all necessary components in conjunction with the control system to provide the unit with the following protections:
 1. Reverse rotation.
 2. Low chilled fluid temperature.
 3. Motor overtemperature.
 4. High pressure.
 5. Electrical overload.
 6. Thermal overload.
 7. Loss of refrigerant charge.
- B. Condenser fan motors shall have internal overcurrent protection.

2.6 Operating Characteristics:

- A. Standard tier units, without modification, shall be capable of starting and running at outdoor ambient temperatures from 0°F (-17.8°C) to 125.6°F (52°C) for units employing variable speed condenser fans and from 32°F (0°C) to 120°F (48.9°C) for units that do not employ variable speed condenser fans.
- B. Compact tier units shall be capable of starting and running at outdoor ambient temperatures from 32°F (0°C) to 115°F (46.1°C).
- C. Unit shall be capable of starting up with 95°F (35°C) entering fluid temperature to the evaporator.
- D. After power restoration, and with the Capacity Recovery™ feature enabled, unit shall be capable of full capacity recovery in less than 4 minutes provided the required chilled water flow is available and no safety/control manual reset items or alarms are in effect.

2.7 Motors:

- A. Condenser fan motors shall be totally enclosed, air over, 3-phase type with permanently lubricated bearings and Class F insulation. Fans shall be 8-pole for fixed speed units and 6-pole for variable speed units.

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2.8 Electrical Requirements:

- A. Unit primary electrical power supply shall enter the unit at a single location (all chiller voltage/ size combinations shall have the ability to accommodate 2 power supplies to meet job specific requirements).
- B. Primary electrical power supply shall be rated to operate up to 125.6°F (52°C) ambient temperature for all models.
- C. Unit shall operate on 3-phase power at the voltage shown in the equipment schedule.
- D. Control points shall be accessed through terminal block.
- E. Unit shall be shipped with factory control and power wiring installed.
- F. Unit shall have a standard SCCR (short circuit current rating) value of 10 kA for all voltages.

2.9 Chilled Water Circuit:

- A. Chilled water circuit shall be rated for 300 psig (2068 kPa). Units with optional pump package are rated for 150 psig (1034 kPa) working pressure.
- B. Thermal dispersion proof of flow switch shall be factory installed and wired.

2.10 Chiller Features to be provided:

- A. High-Efficiency Variable Condenser Fans:
 - 1. All fans on the unit shall have variable speed fan motors to provide higher part load efficiency and reduced acoustic levels. Each fan circuit shall have a factory-installed, independent, variable speed drive with display. Variable speed drives are UL Listed. The use of this option, with the addition of antifreeze in the evaporator circuit and wind baffles, shall allow running with outdoor ambient temperatures down to -20°F (-29°C) (may be different for compact units). Variable speed condenser fans also allow the chiller to operate at ambient temperatures as high as 125.6°F (52°C) and starting as low as -13°F (-25°C).
- B. Unit-Mounted Non-Fused Disconnect:
 - 1. Unit shall be supplied with factory-installed, non-fused electrical disconnect for main power supply. This option is included with the high SCCR option.
- C. Hot Gas Bypass:
 - 1. Unit shall be equipped with factory or field-installed, microprocessor-controlled, hot gas bypass shall permit unit operation down to a minimum of 10% capacity (varies with unit size).
- D. Energy Management Control Module:
 - 1. A factory or field-installed module shall provide the following energy management capabilities: 4 to 20 mA signals for leaving fluid temperature reset, cooling set point reset, or demand limit control; 2-step demand limit control (from 0% to 100%) activated by a remote contact closure.
- E. Condenser Coil Trim Panels:

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1. Unit shall be equipped with factory or field-installed coil covers, which provide protection for the coil headers.
- F. Security Grilles (Sides) and Hail Guard (Ends):
1. Unit shall be equipped with a factory or field-installed option consisting of louvered panels on the ends of the machine and security grilles on the sides of the machine. These coverings shall firmly fasten to the machine frame and provide coverage from the top to the bottom of the unit. This option also provides the functionality of a wind baffle.
- G. Suction Line Insulation:
1. Insulation shall be tubular closed-cell insulation. This option shall be required on applications with leaving fluid temperatures below 30°F (−1.1°C) and recommended for areas with high dewpoints, where condensation may be a concern.
- H. Compressor Enclosure and Blankets:
1. Unit shall be equipped with factory-installed compressor enclosure as well as sound blankets on each compressor to reduce unit sound levels.
- I. High SCCR (Short Circuit Current Rating):
1. The optional high SCCR (short circuit current rating) device shall allow the chiller to tolerate a 65-kA short circuit current for all voltages except 575-v (25 kA for 575-v) for a brief period of time while protecting downstream components. The high SCCR option shall provide a higher level of protection than the standard unit. This option includes the unit-mounted non-fused disconnect option.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 CHILLER INSTALLATION

- A. Install chiller in accordance with manufacturer's instructions. Install piping adjacent to chiller to allow service and maintenance.
- B. Install chillers on structure steel as noted and /or indicated. Coordinate steel dimensions. Where required provide supplementary structural steel for chiller support. Supplementary steel shall be primed and painted.
- C. Install each chiller on vibration isolators with neoprene pads located under the spring isolators and attached with neoprene washer bushings.

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3.3 PIPING CONNECTIONS

- A. Comply with requirements in Section 232110 Hydronic Piping. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to chillers, allow space for service and maintenance.
- C. Evaporator Fluid Connections:
 - 1. Connect to evaporator inlet with shutoff valve, strainer, flexible connector, thermometer, and plugged tee with pressure gauge.
 - 2. Connect to evaporator outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with pressure gage, flow meter, and drain connection with valve.
- D. Connect each drain connection with a drain valve, full size of drain connection.
- E. Connect each chiller vent connection with a manual vent, full size of vent connection.

3.4 CONTROLS CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring between chillers and other equipment to interlock operation as required to provide a complete and functioning system.

3.5 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.
- D. Visually inspect chiller for damage before starting. Repair or replace damaged components, including insulation. Do not start chiller until damage that is detrimental to operation has been corrected.
- E. Prepare a written startup report that records results of tests and inspections.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water chillers. Provide not less than eight hours of on-site training.

END OF SECTION 23 64 51