

SECTION 15684
CENTRIFUGAL WATER CHILLERS

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. Chiller package.
- B. Charge of refrigerant and oil.
- C. Controls and control connections.
- D. Chilled water connections.
- E. Condenser water connections.
- F. Auxiliary water connections.
- G. Starters.
- H. Electrical power connections.

1.2 REFERENCES

- A. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.
- B. ANSI/ASHRAE 90A - Energy Conservation in New Building Design.
- C. ANSI/ASME SEC 8 - Boiler and Pressure Vessel Code.
- D. ANSI/UL 465 - Central Cooling Air Conditioners.
- E. ARI 550 - Centrifugal or Rotary Water - Chilling Packages.

1.3 SUBMITTALS

- A. Submit shop drawings under provisions of Section 01300.
- B. Submit shop drawings indicating components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate equipment, piping and connections, valves, strainers, and thermostatic valves required for complete system.
- C. Submit product data under provisions of Section 01300.
- D. Submit product data indicating rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.
- E. Submit written certification that components of package not furnished by manufacturer have been selected in accordance with manufacturer's requirements.
- F. Submit manufacturer's installation instructions under provisions of Section 01300.
- G. Submit performance data indicating energy input versus cooling load output from 0% to 100% of full load at specified and minimum condenser water temperature.

1.4 OPERATION AND MAINTENANCE DATA

- A. Submit operation data under provisions of Section 01700.
- B. Include start-up instructions, maintenance data, parts lists, controls, and accessories. Include trouble-shooting guide and installation manual. Provide expanded breakdown of machine including parts list and number, factory generated service repair manuals and complete as-built wiring diagram of machine and controls.
- C. Submit maintenance data under provisions of Section 01700.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in the manufacture of the products specified in this Section with minimum five years documented experience.

1.6 REGULATORY REQUIREMENTS

- A. Conform to ARI 550 code for testing and rating of centrifugal chillers.
- B. Conform to ANSI/UL 465 code for construction of centrifugal chillers.
- C. Conform to ANSI/ASME SEC 8 Boiler and Pressure Vessel Code for construction and testing of centrifugal chillers.
- D. Conform to ANSI/ASHRAE 15 code for construction and operation of centrifugal chillers.
- E. Provide certification of inspection for conforming authority having jurisdiction approval.
- F. Mechanical equipment rooms where chiller components containing refrigerant are located shall meet all requirements of the FBC-M, Chapter 11, including but not limited to design, installation, construction, ventilation, refrigerant detection with alarms, safety equipment, system pressure testing and refrigerant leak testing.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 01600.
- B. Store and protect products under provisions of Section 01600.
- C. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- D. Protect units from physical damage. Leave factory-shipping covers in place until installation.

1.8 WARRANTY

- A. Provide five-year warranty under provisions of Section 01700.
- B. Warranty coverage is for complete chiller package as manufactured and delivered to site including materials and labor.

1.9 MAINTENANCE SERVICE

- A. Furnish service and maintenance of chillers for period of one year from Date of Substantial Completion in accordance with manufacturer's instructions.
- B. Provide factory generated start-up reports to Owner upon commissioning of each chiller, along with manufacturer's recommended periodic service reports.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Trane
- B. Carrier
- C. York
- D. Engineer and Owner approved equal.

2.2 MANUFACTURED UNITS

- A. Provide factory assembled and tested, packaged, water cooled, liquid chillers consisting of centrifugal compressors, compressor motor, condenser, evaporator, refrigeration accessories, instrument and control panel including gages and indicating lights, all optional auxiliary

components and accessories, and motor starters. Construction and ratings shall be in accordance with ARI 550.

- B. Units shall have Energy Efficiency Rating (EER) not less than prescribed by ANSI/ASHRAE 90A.
- C. The Engineer should refer to FPL Commercial/Industrial HVAC Trade Ally Program Standards and select chillers with KW/ton or EER ratings that qualify for incentive rebate payments from FPL.
 - 1. For cooling loads exceeding 600 tons of refrigeration the engineer shall design the central chiller plant to facilitate stable 1 to 3 hour operation at partial loads ranging from 3.6% to 18% of the total design cooling load. The alternatives may include two or three water-cooled centrifugal and/or screw compressor chillers. The use of one air-cooled chiller in the three-chiller alternative is allowed. For air-cooled chillers refer Section 15680 and for rotary (screw compressor) chillers refer to Section 15686.
- D. Design chiller plant to deliver chilled water at temperature not exceeding 44°F. Use chilled water-fouling factor of not less than 0.00025 for condenser water EWT at 85°F with condenser fouling factor of not less than 0.00025.

2.3 COMPRESSORS

- A. Compressor Casing: Cast iron, horizontally or vertically split with machined passages, leak tested with refrigerant trace gas to 45 psig. Provide sight glass for monitoring compressor rotation and oil level.
- B. Impellers: Direct drive multi-stage, in-line design, fully shrouded, statically and dynamically balanced, over speed tested to 20% over operating speed, mounted on heat treated forged or rolled steel shaft, nonferrous, labyrinth seals between stages.
- C. Guide Vanes: Modulating radial blade dampers, with externally mounted operator, suitable for capacity reduction to 10% of specified load without hot gas bypass when supplied with design entering water quantity and design temperature of water entering condenser.
- D. Bearings: Roller bearings, self-aligning, pressure lubricated.
- E. Motor: Hermetically sealed, single speed, low slip induction type. 3,600 rpm max.
- F. Lubrication: Direct drive, positive displacement oil pump, with oil cooler, pressure regulator, oil filters, thermostatically controlled oil heater, and motor controls ¼ HP minimum motor. Interlock to start before chiller motor and run after motor is shut down. Provide sight glass for monitoring oil level. Provide cut off valves before and after oil filter.
- G. Refrigerant: The unit shall be factory pre-charged and all chillers in the chiller plant shall use the same EPA approved refrigerant.
- H. Compressor motor shall be rated 3-phase 480 Volt

2.4 EVAPORATOR

- A. Provide condensers of shell and tube type, seamless or welded steel construction with cast iron or fabricated steel heads, seamless copper tubes or red brass tubes with integral fins, rolled into tube sheets. Space tube support sheets approximately 2.5'. Smooth bore tubes, extra thick.
- B. Design and stamp refrigerant side for working pressure, test refrigerant side at design pressure. Test and stamp water side for 150 psig working pressure in accordance with ANSI/ASME SEC. 8.
- C. Provide baffles to ensure even distribution of incoming gas and to concentrate non-condensable gases.
- D. Epoxy coat tube sheets and end bells.
- E. Construction and materials shall conform to ANSI/ASME SEC 8.

2.5 CONDENSERS

- A. Provide condensers of shell and tube type, seamless or welded steel construction with cast iron or fabricated steel heads, seamless copper tubes or red brass tubes with integral fins, rolled into tube sheets. Space tube support sheets approximately 2.5'. Smooth bore tubes, extra thick.
- B. Design and stamp refrigerant side for 45 psig working pressure, test refrigerant side at; design, test and stamp water side for 150 psig working pressure; in accordance with ANSI/ASME SEC. 8.
- C. Provide baffles to ensure even distribution of incoming gas and to concentrate non-condensable gases.
- D. Epoxy coat tube sheets and end bells.
- E. Construction and materials shall conform to ANSI/ASME SEC 8.

2.6 PURGE SYSTEM

- A. Provide high efficiency purge system consisting of motor driven compressor, electrically heated oil separator, and baffled drum, to automatically remove non-condensable and water vapor.
- B. System shall automatically discharge non-condensable. Provide for manual blow-off of water vapor. Provide sight glass for monitoring purge condenser drum.

2.7 CONTROLS - by chiller manufacturer including translator/interface module compatible with Owner's Energy Management Control System (EMCS) hardware and software. For details refer to design drawings with controls schematics and sequence of operations.

- A. On or near chiller, mount steel control panel containing solid state, fully automatic operating and safety controls.
- B. Provide the minimum shown but not limited to safety controls arranged so that operating any one will shut down machine and require manual reset:
 - 1. High refrigerant (condenser) pressure.
 - 2. Low refrigerant (evaporator) temperature.
 - 3. Low refrigerant (evaporator) pressure.
 - 4. High bearing temperature.
 - 5. Motor winding temperature.
 - 6. Motor overload.
 - 7. Low chilled water temperature.
 - 8. Low oil pressure (differential pressure switch).
- C. Provide the following safety controls arranged so that operating any one will shut down machine and automatically reset:
 - 1. Chilled water flow switch.
 - 2. Condenser water flow switch.
 - 3. Phase protection and delay start.
- D. Provide the following devices on control panel face, each chiller.
 - 1. Machine off-auto switch.
 - 2. Machine selector switch to allow load, unload, hold or automatic operation.
 - 3. Sequential start pilot light.
 - 4. Operating pilot light.
 - 5. Condenser pressure gage.
 - 6. Evaporator pressure gage.
 - 7. Oil pressure gage.
 - 8. Oil pump pilot light.
 - 9. Oil pump switch (manual or automatic).
 - 10. Purge drum pressure gage.

11. Purge pump pilot light.
 12. Purge pump switch (manual-off-auto).
 13. Purge oil separator heater pilot light.
 14. Purge oil separator heater switch.
 15. Evaporator low temperature cutout pilot light.
 16. Evaporator low-pressure cutout pilot light.
 17. Condenser high-pressure cutout pilot light.
 18. Demand limit switch.
 19. Motor driven elapsed run time meter.
 20. Start counter.
- E. Provide the following operating controls:
1. Solid state, chilled water temperature controller which controls electronic guide vane operator within throttling range setting of 0.8°F and features adjustable load rate. Locate temperature sensor in leaving chilled water.
 2. Adjustable thirty minute off timer prevents compressor from short cycling.
 3. Demand limit device to manually set maximum current infinitely between 40% and 100% of full load amperes.
 4. Provide condenser water temperature sensor.
- F. Provide self-diagnostic digital display module with microprocessor to indicate faults.

2.8 STARTER

- A. Provide unit mounted steel NEMA 1 type enclosure, containing Star Delta closed transition starter, factory wired and tested.
- B. Enclosure shall be designed for bottom cable entry with front access. Door, interlocked with circuit breaker, shall accommodate padlock.
- C. Mount the following devices within enclosure:
1. Disconnect switch on line side with fuses.
 2. High interrupting capacity circuit breaker with ground fault protection.
 3. Pilot relays to start and stop compressor on signal from chiller control panel.
 4. Electronic overload provides overload protection, protects compressor motor from distribution system irregularities, phase protection with manual or automatic reset, and provides motor current signal to chiller capacity control module.
 5. Control power transformer.
 6. Fused control circuits for control circuit, oil pump motor, oil heater, and purge control unit.
 7. Contactor interlocks for communication between starter and control panel.
 8. Capacitors, one per phase, to correct power factor to minimum 95%.
 9. Fused disconnect and starter for oil pump.
- D. Provide the following devices on starter door:
1. Starter fault trip indicator and reset.
 2. Overload trip indicator and reset.
 3. Distribution fault trip indicator and reset.
 4. Ground fault trip indicator and reset.
- E. Provide chiller sequencing panel
1. For optimizing multiple chiller operation.
 2. Chiller manufacturer shall make panel.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide for connection to electrical service. Include for connection of oil pump to separately fused circuit.
- C. Provide for connection of electrical wiring between starter and chiller control panel, oil pump, and purge unit.
- D. Align chiller on concrete foundations, sole plates, and sub-bases. Level, grout, and bolt in place.
- E. Install units in vibration isolation.
- F. Provide evaporator connections to chilled water piping. On inlet, provide thermometer well for temperature controller, thermometer well and thermometer, strainer, 1½" threaded weld-o-let for flow switch, flexible stainless steel corrugated pipe connector, pressure gage, and shut-off valve, ball valve type. On outlet, provide thermometer well and thermometer, corrugated stainless steel flexible pipe connector, pressure gage, and shut-off valve.
- G. Furnish and install necessary auxiliary water piping for oil cooling units and purge condensers with strainers and cut-off valves.
- H. Insulate Evaporator and any other cold surfaces in accordance with manufacturer's instructions. Insulation materials shall meet Quality Assurance requirements of Section 15260.
- I. Provide condenser connection to condenser water piping. On inlet, provide thermometer well and temperature limit controller, thermometer well and thermometer, strainer, 1¼" (minimum) weld-o-let and flow switch, flexible pipe connector, pressure gage, and shut-off valve. On outlet, provide thermometer well and thermometer, flexible pipe connector, pressure gage, and shut-off valve.
- J. Arrange piping for easy dismantling and clearance to permit tube cleaning and removal.
- K. Provide piping from chiller rupture disc to outdoors. Size as recommended by manufacturer, with removable flexible connection at disc.
- L. Locate chillers to align with exterior doors for tube pull.
- M. A minimum clearance of 3' must be maintained between chiller and nearest external system component and 6' between any two chillers or manufacturer's commendations which ever is greater.
- N. Provide clearance above the top of chiller highest component as recommended by unit's supplier.
- O. Provide a trolley I-beam lifting structure built over chillers. Chiller supplier shall specify the recommended clearances and trolley lifting capacity to allow service and removal of heaviest chiller components.
- P. Locate control panels facing each other for dual chillers. Three or more chiller panels will face same direction.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Prepare and start systems under provisions of Section 01600.
- B. Provide services of factory trained representative to leak test, refrigerant pressure test, evacuate, dehydrate, charge, start-up, calibrate controls, and instruct Owner on operation and maintenance to Owner's satisfaction.
- C. Supply initial charge of refrigerant and oil.

3.3 DEMONSTRATION

- A. Provide systems demonstration.
- B. Start-up and demonstrate system operation and verify specified performance. Refer to Section 15990.
- C. Provide equipment schedule on the drawings to include the following data:
 - 1. Manufacturer
 - 2. Model Number

3. Cooling Capacity
4. Refrigerant
5. Unit EER
6. Evaporator
 - a. Water Flow
 - b. Entering Water Temperature
 - c. Leaving Water Temperature
 - d. Pressure Drop
 - e. Fouling Factor
7. Condenser
 - a. Water Flow
 - b. Entering Air Temperature
 - c. Leaving Water Temperature
 - d. Pressure Drop
 - e. Fouling Factor
8. Heating Recovery Condenser (if applicable)
 - a. Water Flow
 - b. Entering Water Temperature
 - c. Leaving Water Temperature
 - d. Pressure Drop
 - e. Fouling Factor
9. Compressor
 - a. Maximum Power Input
 - b. Starter Type

END OF SECTION