

The School District of Palm Beach County

Project Name:

SDPBC Project No.:

SECTION 23 64 26
ROTARY-SCREW 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. ASHRAE 15 - Safety Code for Mechanical Refrigeration Systems
- B. ASHRAE 90.1 - Energy Standard for Buildings Except Low Rise Residential Buildings
- C. ASME BPVC SEC 8 - Boiler and Pressure Vessel Code
- D. UL 1955 - Heating and Cooling Equipment
- E. AHRI 550/590 - Standard for Performance Rating of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle

1.3 SUBMITTALS

- A. Submit shop drawings under provisions of Section 01 33 00.
- B. Submit shop drawings indicating components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections.
 - 1. Indicate equipment, piping and connections, valves, strainers, and thermostatic valves required for complete system.
- C. Submit product data under provisions of Section 01 33 00.
- D. Submit product data indicating rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.
- E. Submit written certification that non-manufacturer supplied components of package are in accordance with manufacturer's requirements.
- F. Submit manufacturer's installation instructions under provisions of Section 01 33 00.
- 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 01 77 00.
- B. Include start-up instructions, maintenance data, parts lists, controls, and accessories.
 - 1. Include trouble-shooting guide and installation manual.
 - 2. 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 01 77 00.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in the manufacture of the products specified in this Section with minimum 5-years documented experience.

1.6 REGULATORY REQUIREMENTS

- A. Conform to AHRI 550/590 code for testing and rating of centrifugal or rotary chillers.

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- B. Conform to UL 1955 code for construction of centrifugal or rotary chillers.
- C. Conform to ASME BPVC SEC 8 for construction and testing of centrifugal or rotary chillers.
- D. Conform to ASHRAE 15 code for construction and operation of centrifugal or rotary 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 01 60 00.
- B. Store and protect products under provisions of Section 01 60 00.
- 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 10-year warranty under provisions of Section 01 77 00.
- B. Include warranty coverage for complete chiller package as manufactured and delivered to site including materials and labor.

1.9 COMMISSIONING

- A. Commissioning of a system or systems specified in this section is part of the construction process.
- B. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Authority.
 - 1. The chiller shall be factory performance tested in accordance with AHRI 550/590 at design conditions.
 - 2. A certified test report showing full load efficiency and capacity shall be submitted to the contracting officer prior to project completion.
- C. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure. Refer to Section 01 77 00 - Contract Closeout, for substantial completion details.
- D. Refer to Section 01 91 00, Commissioning, for detailed commissioning requirements

1.10 MAINTENANCE SERVICE

- A. Furnish service and maintenance of chillers for period of 1-year from Date of Substantial Completion in accordance with manufacturer's instructions.
- B. Provide factory generated start-up reports to Owner upon commissioning air conditioning system, along with manufacturer's recommended periodic service reports.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Trane (Rotary Screw)
- B. Carrier (Rotary Screw)
- C. York (Rotary Screw)
- D. Daikin (Rotary Screw)

2.2 MANUFACTURED UNITS

- A. Provide factory assembled and tested, packaged, water cooled, liquid chillers consisting of rotary 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.

1. Construction and ratings shall be in accordance with AHRI 550/590.
2. The chiller must be capable of evaporator flow rate change of 30% per minute without shutdown of the machine in variable primary flow applications.

B. Units shall have Energy Efficiency Rating (EER) not less than prescribed by ASHRAE 90.1.

C. The Engineer shall 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, and the Contractor shall supply and install units meeting these minimum requirement.

1. For cooling loads, exceeding 600 tons of refrigeration and for high schools 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.
2. The alternatives may include two or three water-cooled centrifugal and/or screw compressor chillers.
3. For air-cooled chillers refer to Sec 23 64 10 and for centrifugal chillers refer to Sec 23 64 16.

D. Provide screw type rotary water chiller, having minimum capacity of 360 tons.

1. Use chilled water-fouling factor of not less than 0.001 when supplied with 3-GPM/ton of condenser water at 85°F EWT with condenser fouling factor of not less than 0.001.

E. Design chiller plant to deliver chilled water at temperature not exceeding 44°F.

2.3 COMPRESSORS

A. Compressor shall be semi-hermetic, direct drive, 3600 RPM, rotary screw type with capacity control system loading and unloading the chiller through adjustment of the compressor slide valve, integral single stage economizer, oil sump heater and differential pressure refrigerant oil flow system.

1. Four pressure lubricated rolling element-bearing groups shall support the rotating assembly.

B. Motor shall be a liquid refrigerant cooled, hermetically sealed, two-pole, squirrel cage induction type.

C. Compressor motor shall be 3-phase 480 Volt rated.

2.4 EVAPORATOR AND CONDENSER

A. Shells shall be carbon steel plate.

1. Design evaporator and condenser, then test and stamp in accordance with ASME Code for refrigerant side working pressure of 300 psig.

B. All tube sheets shall be carbon steel.

1. Evaporator and condenser tubes shall be individually replaceable.
2. Provide standard tubes externally finned internally enhanced seamless copper with lands at the tube sheets.
3. Mechanically expand tubes into tube sheets.
4. Mechanically fasten condenser tubes to tube supports.
5. Condenser baffle shall prevent direct impingement of compressor discharge gas upon the tubes.

C. All water pass arrangements shall be available in either flat-faced flange 150 psig waterside.

1. All connections shall be as detailed on drawings.
2. Hydrostatically test waterside at 1½ times design pressure, but not less than 225 psig.

D. Equipment manufacturer shall provide epoxy coating of tube sheets and end bells.

1. Use one of the following two-pack high solids epoxy phenolic or high molecular weight reactive polymer coating materials:

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- a. Heresite CSE 6100
 - b. Jotamastic 80
 - c. Belzona 1321
 2. All above products have common characteristics:
 - d. They are manufactured and stored as two components to be mixed prior to application, component A (base as a powder or paste material) and component B (solvent, curing agent/solidifier or highly reactive polymer).
 - e. Can apply by spray or brush or by immersion to obtain prescribed coverage and dry film thickness (6 to 15 mills or 150 to 375 microns).
 - f. Coating materials solidify and cure within 24 hours from application.
 - g. Equipment manufacturer shall include a 10-year warranty for the coating materials to provide high corrosion resistance to Water Treatment chemicals.
 - i) See specification 23 25 00, protection against galvanic corrosion and erosion damage of the coated substrate metals.
- 2.5 REFRIGERANT CIRCUIT
- A. A multiple orifice system shall consist of an electronically controlled expansion valve and a fixed orifice, to maintain proper refrigerant flow.
 - B. The unit shall be factory pre-charged and all chillers in the chiller plant shall use the same EPA approved refrigerant.
- 2.6 PURGE SYSTEM
- A. Purge system, where applicable shall consist of motor driven compressor, electrically heated oil separator, and baffled drum, to automatically remove non-condensibles and water vapor.
 - B. System shall automatically discharge non-condensable.
 1. Provide for manual blow-off of water vapor.
 2. Provide sight glass for monitoring purge condenser drum.
- 2.7 CONTROLS – Provided by the chiller manufacturer including translator/interface module compatible with Owner’s Energy Management Control System (EMCS) hardware and software, see design drawings with controls schematics and sequence of operations for details.
- 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.

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1. Machine off, auto switch
 2. A 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 temperature within setting of 0.8°F and features adjustable load rate.
 - a. Locate temperature sensor in leaving chilled water.
 2. Adjustable thirty minute off timer prevents compressor from short cycling.
 3. A demand limit device allowing for manual setting of maximum current infinitely between 40% and 100% of full load amperes.
 4. Provide condenser water-temperature sensor.
 - a. Installation shall include a condenser-water temperature control system to enable starting and stable operation of the rotary chiller.
- F. Provide self-diagnostic digital display module with microprocessor to indicate faults.
- 2.8 STARTER
- A. On or near chiller, mount steel NEMA 1 type enclosure, containing wye-delta starter or variable speed drive, manufactured in accordance with chiller manufacturer's specifications and factory tested.
- B. Design the enclosure for bottom cable entry with front access.
1. Door, interlocked with circuit breaker, shall accommodate padlock.
- C. Mount the following devices within enclosure:
1. Disconnect switch on line side with fuses.
 2. A 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.

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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 control.
 2. Overload trip indicator and reset control.
 3. Distribution fault trip indicator and reset control.
 4. Ground fault trip indicator and reset control.
 - E. Provide chiller sequencing panel:
 1. For optimizing multiple chiller operation.
 2. The Chiller Manufacture shall manufacture the panel.
- 2.9 REFRIGANT MONITOR
- A. Monitor system shall meet ASHRAE 15
 - B. Monitor shall have minimum sensitivity of 1ppm
 - C. Monitor shall have minimum of 4 sensing ports with locations determined by the Engineer.
 - D. Monitor shall be capable of sensing more than one type of refrigerant during operation.
 - E. Monitor shall be capable of initiating required alarms.
 - F. Monitor shall sample continuously.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide for connection to electrical service.
 1. Refer to Section 26 05 19.
 2. 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, refer to Section 26 05 19.
- D. Align chiller on concrete foundations, sole plates, and sub-bases. Level, grout, and bolt in place.
- E. Install units in vibration isolation; refer to Section 23 21 13.
- F. Provide evaporator connections to chilled water piping.
 1. Refer to Section 23 21 13.
 2. 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.
 3. 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.
 1. Insulation materials shall meet Quality Assurance requirements of Section 23 07 19.
 2. Minimum 1.25" thick closed cell insulation k value=0.28.
- I. Provide condenser connection to condenser water piping.
 1. Refer to Section 23 21 13.
 2. 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 shutoff valve.

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3. On outlet, provide thermometer well and thermometer, flexible pipe connector, pressure gage, and shutoff valve.
 - J. Arrange piping for easy dismantling and clearance to permit tube cleaning and removal.
 - K. Provide piping from chiller rupture disc to outdoors.
 1. Size as recommended by manufacturer, with removable flexible connection at disc.
 - L. Locate chillers to align with exterior doors for tube pull.
 - M. Maintain a minimum clearance of 3' between chillers and nearest external system component and 6' between any two-chillers or manufacturer's commendations whichever is greater.
 - N. Provide 5' clearance above top of chiller highest component.
 - O. Provide a trolley I-beam lifting structure built over chillers.
 1. Chiller supplier shall specify the recommended trolley lifting capacity to allow service and removal of heaviest chiller components.
 - P. Locate control panels facing each other for dual chillers.
 1. Three or more chiller panels will face same direction.
- 3.2 MANUFACTURER'S FIELD SERVICES
- A. Prepare and start systems under provisions of Section 01 60 00.
 - B. Provide services of factory-trained representative to leak test, refrigerant pressure test, evacuate, dehydrate, charge, startup, calibrate controls, and instruct Owner on operation and maintenance to Owner's satisfaction.
 - C. Supply initial charge of refrigerant and oil.
 - D. Contractors' startup shall be scheduled and documented in accordance with the commissioning requirements.
 1. Refer to Section 01 91 00, Commissioning, for further details
- 3.3 OPERATIONAL DATA
- A. Start-up and demonstrate system operation and verify specified performance, refer to Section 23 08 00.
 - B. 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

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- b. Entering Water Temperature
- c. Leaving Water Temperature
- d. Pressure Drop
- e. Fouling Factor
- 9. Compressor
 - a. Maximum Power Input
 - b. Starter Type

3.4 FUNCTIONAL PERFORMANCE TESTING

- A. System Functional Performance Testing is part of the Commissioning Process.
 - 1. The Contractor shall perform the Functional Performance Testing and the Commissioning Authority shall witness and document the test.
 - 2. Refer to Section 01 91 00, Commissioning, for functional performance tests and commissioning requirements.
- B. Systems Readiness Checklists shall be completed and submitted for each piece of equipment included in this section.
- C. Include the functional performance testing of HVAC pumps as part of the Chilled Water System Functional Performance testing.

3.5 DEMONSTRATION AND TRAINING

- A. Training of the Owner's operation and maintenance personnel is required in cooperation with the Owner's Representative.
 - 1. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
 - 2. Schedule the instruction shall in coordination with the Owner's Representative after submission and approval of formal training plans.
 - 3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.
- B. Provide demonstration and training for all equipment covered by this section installed in this project.

END OF SECTION