

SECTION 23 64 00
PACKAGED WATER CHILLERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Centrifugal water-cooled chillers, complete with accessories.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 23 21 23, HYDRONIC PUMPS.
- D. Section 23 21 13, HYDRONIC PIPING.
- E. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

1.3 DEFINITION

- A. Engineering Control Center (ECC): The centralized control point for the intelligent control network. The ECC comprises of personal computer and connected devices to form a single workstation.
- B. BACNET: Building Automation Control Network Protocol, ASHRAE Standard 135.
- C. Ethernet: A trademark for a system for exchanging messages between computers on a local area network using coaxial, fiber optic, or twisted-pair cables.
- D. FTT-10: Echelon Transmitter-Free Topology Transceiver.
- E. LonMark: An association comprising of suppliers and installers of LonTalk products. The Association provides guidelines for the implementation of the LonTalk protocol to ensure interoperability through Standard implementation.
- F. LonTalk: An open standard protocol developed by the Echelon Corporation that uses a "Neuron Chip" for communication.
- G. LonWorks: Network technology developed by the Echelon Corporation.
- H. SCBA: Self-Contained Breathing Apparatus.

1.4 QUALITY ASSURANCE

- A. Refer to PART 3 herein after and Section 01 00 00, GENERAL REQUIREMENTS for test performance.
- B. Comply with ARI requirements for testing and certification of the chillers.
- C. Provide a 5 year warranty to include coverage for compressors including materials only.
- D. Refer to OSHA 29 CFR 1910.95(a) and (b) for Occupational Noise Exposure Standard.

- E. Refer to 42 CFR—Public Health, Part 84, "Approval of Respiratory Protective Devices," Subpart H—"Self-Contained Breathing Apparatus," 1998.
- F. Refer to ASHRAE Standard 15, Safety Standard for Refrigeration System, for refrigerant vapor detectors and monitor.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Refrigeration Institute (ARI):
 - 550/590-03.....Standard for Water Chilling Packages Using the Vapor Compression Cycle
 - 575-94.....Methods for Measuring Machinery Sound within Equipment Space
- C. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):
 - 15-02.....Safety Standard for Mechanical Refrigeration Systems
 - 3-96.....Guidelines for Reducing Emission of Halogenated Refrigerants in Refrigeration and Air-Conditioning Equipment and Systems
- D. American Society of Testing Materials (ASTM):
 - C 534-03.....Preformed, Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
- E. National Electrical Manufacturing Association (NEMA):
 - 250-03.....Enclosures for Electrical Equipment (1000 Volts Maximum)
- F. National Fire Protection Association (NFPA):
 - 70-05.....National Electrical Code
- G. Underwriters Laboratories, Inc. (UL):
 - 1995-99..... Heating and Cooling Equipment

1.6 SUBMITTALS

- A. Submit in accordance with Specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data.
 - 1. Centrifugal water chillers, including motor starters, control panels, and vibration isolators, following:
 - a. Rated capacity.
 - b. Pressure drop.

- c. Efficiency at full load and part load without applying any tolerance indicated in the ARI 550/590/Standard.
- d. Refrigerant
- e. Accessories.
- f. Installation instructions.
- g. Start up procedures.
- h. Wiring diagrams, including factory-installed and field-installed wiring.
- i. Noise data report. Manufacturer shall provide noise ratings. Noise warning labels shall be posted on equipment.
- j. Self-contained breathing apparatus (SCBA).
- k. Refrigerant vapor detectors and monitors.
- C. Maintenance and operating manuals for each piece of equipment in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
- D. Run test report for all chillers.
- E. Product Certificate: Signed by chiller manufacturer certifying that chillers furnished comply with ARI requirements. The test report shall include calibrated curves, calibration records, and data sheets for the instrumentation used in factory tests.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL AND ROTARY WATER CHILLERS

- A. Unit Description: Provide and install as shown on the plans a factory assembled, charged, and run-tested water-cooled packaged chiller. Each unit shall be complete with two multi-stage, oil-free, magnetic bearing, hermetic centrifugal compressors. Each compressor shall have variable frequency drive operating in concert with inlet guide vanes for optimized unit part load efficiency. The evaporator, condenser, and expansion valve shall be common to both of the compressors. The chiller unit shall be capable of running on one compressor with the other compressor or any of its auxiliaries inoperable or removed.
- B. Applicable Standard: Chillers shall be rated and certified in accordance with ARI Standard 550/590. Chillers with ARI certification program shall be ARI stamped.
- C. General: Provide a complete water-cooled, dual hermetic compressor centrifugal water chiller as specified herein. In general, unit shall consist of two magnetic bearing, completely oil-free, compressors, refrigerant condenser and evaporator, and control systems including variable frequency drive, operating controls and equipment protection controls. Note: Chillers shall be charged with a refrigerant such as

HFC-134a, not subject to phase-out by the Montreal Protocol and the U.S. Clean Air Act.

- D. Performance: Refer to schedule on drawings. The chiller shall be capable of stable operation to ten percent of full load with standard ARI entering condensing water relief without hot gas bypass.
- E. Acoustics: Sound pressure for the unit shall not exceed the following specified levels. Provide the necessary acoustic treatment to chiller as required. Sound data shall be measured according to ARI Standard 575-87 and shall be in dB. Data shall be the highest levels recorded at all load points.

Octave Band							
63	125	250	500	1000	2000	4000	8000 dba

2.2 CHILLER COMPONENTS

A. Compressors

1. The unit shall have two-stage, magnetic bearing, oil-free hermetic centrifugal compressors. The compressor drive train shall be capable of coming to a controlled, safe stop in the event of a power failure.
2. Movable inlet guide vanes, acting together with variable speed, shall provide unloading. A microprocessor controller, dedicated to each compressor shall coordinate the vane and speed control to provide optimum unit efficiency.

B. Refrigerant Evaporator and Condenser

1. Evaporator and condenser shall be of the shell-and-tube type, designed, constructed, tested and stamped according to the requirements of the ASME Code, Section VIII. Regardless of the operating pressure, the refrigerant side of each vessel will bear the ASME stamp indicating compliance with the code and indicating a test pressure of 1.1 times the working pressure but not less than 100 psig. Provide intermediate tube supports at a maximum of 18 inch spacing.
2. Tubes shall be enhanced for maximum heat transfer, rolled into steel tube sheets and sealed with Locktite® or equal sealer. The tubes shall be individually replaceable and secured to the intermediate supports without rolling.
3. Provide sufficient isolation valves and condenser volume to hold full refrigerant charge in the condenser during servicing or provide a separate pumpout system and storage tank sufficient to hold the charge of the largest unit being furnished.
4. The water sides shall be designated for a minimum of 150 psig or as specified elsewhere. Vents and drains shall be provided.

5. Evaporator minimum refrigerant temperature shall be 33°F.
 6. An electronic expansion valve shall control refrigerant flow to the evaporator. Fixed orifice devices or float controls with hot gas bypass are not acceptable because of inefficient control at low load conditions. The liquid line shall have a moisture indicating sight glass.
 7. The evaporator and condenser shall be separate shells. A single shell containing both vessel functions is not acceptable because of the possibility of internal leaks.
 8. Reseating type spring loaded pressure relief valves according to ASHRAE-15 safety code shall be furnished. The evaporator shall be provided with single or multiple valves. The condenser shall be provided with dual relief valves equipped with a transfer valve so one valve can be removed for testing or replacement without loss of refrigerant or removal of refrigerant from the vessel. Rupture disks are not acceptable.
 9. The evaporator, including water heads, suction line, and any other component or part of a component subject to condensing moisture shall be insulated with UL recognized closed cell insulation. All joints and seams shall be carefully sealed to form a vapor barrier.
 10. Provide factory-mounted and wired water flow sensors on each vessel to prevent unit operation with no water flow.
- C. Prime Mover: Permanent-magnet, synchronous motor of the hermetic type, of sufficient size to efficiently fulfill compressor horsepower requirements. Motor shall be liquid refrigerant cooled with internal thermal overload protection devices embedded in the winding of each phase. Motor shall be compatible with variable frequency drive operation.
- D. Variable Frequency Drive (VFD)
1. The chiller shall be equipped with a Variable Frequency Drive (VFD) to automatically regulate each compressor speed in response to cooling load and compressor pressure lift. The chiller control shall coordinate compressor speed and guide vane position to optimize chiller efficiency.
 2. The unit shall be equipped with a line reactor.
- E. Chiller Control
1. The unit shall have distributed microprocessor-based control architecture consisting of a VGA touchscreen operator interface, a controller for each compressor and a unit controller. The touchscreen shall display the unit operating parameters, accept setpoint changes

(password protected) and be capable of resetting faults and alarms. The following trended parameters shall be displayed:

- a. Entering and leaving chilled water temps
 - b. Entering and leaving condenser water temps
 - c. Evaporator saturated refrigerant pressure
 - d. Condenser saturated refrigerant pressure
 - e. Percent of 100% speed (per compressor)
 - f. % rated load amps for entire unit.
2. In addition to the trended items above, other real-time operating parameters are also shown on the touchscreen. These items can be displayed in two ways: by chiller graphic showing each component or from a color-coded, bar chart format. At a minimum, the following critical areas must be monitored:
 3. Complete fault history shall be displayed using an easy to decipher, color coded set of messages that are date and time stamped. The last 25 faults shall be downloadable from the USB port drive.
 4. Automatic corrective action to reduce unnecessary cycling shall be accomplished through pre-emptive control of low evaporator or high discharge pressure conditions to keep the unit operating through abnormal transient conditions.
 5. System specific, chiller plant architecture software shall be employed to display the chiller, piping, pumps and cooling tower. Chiller plant optimization software for up to 3 chillers shall also be available to provide automatic control of: evaporator and condenser pumps (primary and standby), up to 4 stages of cooling tower fans and a cooling tower modulating bypass valve or cooling tower variable frequency drives.
 6. The unit controller shall support operation on a BACnet, Modbus or LonWorks network via a factory-installed communication module.
 7. Factory mounted DDC controller(s) shall support operation on a BACnet, Modbus or LONMARKS network via one of the data link / physical layers listed below as specified by the successful Building Automation System (BAS) supplier.
 - a. BACnet MS/TP master (Clause 9)
 - b. BACnet IP, (Annex J)
 - c. BACnet ISO 8802-3, (Ethernet)
 - d. LonMarks FTT-10A. The unit controller shall be LONMARKS certified.
 8. The information communicated between the BAS and the factory mounted unit controllers shall include the reading and writing data to allow

unit monitoring, control and alarm notification as specified in the unit sequence of operation and the unit points list.

9. For chillers communicating over a LONMARK network, the corresponding LONMARK eXternal Interface File (XIF) shall be provided with the chiller submittal data.
10. All communication from the chiller unit controller as specified in the points list shall be via standard BACnet objects. Proprietary BACnet objects shall not be allowed. BACnet communications shall conform to the BACnet protocol (ANSI/ASHRAE135-2001). A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided along with the unit submittal.

2.3 OPTIONS

- A. The following optional items shall be furnished:
 1. Victaulic connections.
 2. 0.035 tube wall thickness on both evaporator and condenser.
 3. Double insulation, 1-1/2 inch, on evaporator (including heads), suction piping, and motor end-bell.
 4. BAS interface module for the application protocol being used.
 5. Shipping bag.
 6. Refrigerant monitor.
 7. Extended warranties.
 8. ARI certified performance test at full load operating condition.
 9. Single point power connection.

2.4 REFRIGERANT MONITORING AND SAFETY EQUIPMENT

- A. General: Provide refrigerant monitoring sensor/alarm system and safety equipment as specified here. Refrigerant sensor and alarm system shall comply with ASHRAE Standard 15.
- B. Refrigerant monitor shall continuously display the specific gas (refrigerant used) concentration; shall be capable of indicating, alarming and shutting down equipment; and automatically activating ventilation system. On leak detection by refrigerant sensor(s), the following shall occur:
 1. Activate machinery (chiller) room ventilation.
 2. Activate visual and audio alarm inside and outside of machinery room, with beacon light(s) and horn sounds equipment room and outside equipment room door(s). Shut down combustion process where combustion equipment is employed in the machinery room.
 3. Notify Engineering Control Center (ECC) of the alarm condition.
- C. Refrigerant monitor shall be capable of detecting concentration of 1 part per million (ppm) for low-level detection and for insuring the

safety of operators. It shall be supplied factory-calibrated for the apparent refrigerant.

- D. Monitor design and construction shall be compatible with temperature, humidity, barometric pressure, and voltage fluctuations of the machinery room operating environment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, piping and electrical to verify actual locations and sizes before chiller installation and other conditions that might effect chiller performance, maintenance, and operation.
- B. Equipment locations shown on drawings are approximate. Determine exact locations before proceeding with installation.

3.2 EQUIPMENT INSTALLATION

- A. Install chiller on concrete base with isolation pads or vibration isolators.
 - 1. Concrete base is specified in Section 03 30 00, CAST-IN-PLACE CONCRETE
 - 2. Vibration isolator types and installation requirements are specified in Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT
 - 3. Anchor chiller to concrete base according to manufacturer's written instructions.
 - 4. Charge the chiller with refrigerant, if not factory charged.
 - 5. Chillers shall be installed in a manner as to provide easy access for tube pull and removal of compressor and motors etc.
- B. Install refrigerant monitoring and safety equipment in accordance with ASHRAE Standard 15.
- C. Install thermometers and gages as recommended by the manufacturer and/or as shown on drawings.
- D. Piping Connections:
 - 1. Make piping connections to the chiller for chilled water, condenser water, and other connections as necessary for proper operation and maintenance of the equipment.
 - 2. Make equipment connections with flanges and couplings for easy removal and replacement of equipment from the equipment room.
 - 3. Extend vent piping from the relief valve and purge system to the outside.

3.3 STARTUP AND TESTING

- A. Engage manufacturer's factory-trained representative to perform startup and testing service.
- B. Inspect, equipment installation, including field-assembled components, and piping and electrical connections.
- C. After complete installation startup checks, according to the manufacturers written instructions, do the following to demonstrate to the VA that the equipment operate and perform as intended.
 - 1. Check refrigerant charge is sufficient and chiller has been tested for refrigerant leak.
 - 2. Verify proper motor rotation.
 - 3. Verify pumps associated with chillers are installed and operational.
 - 4. Verify thermometers and gages are installed.
 - 5. Verify relief piping is routed outdoor.
 - 6. Operate chiller for run-in-period in accordance with the manufacturer's instruction and observe its performance.
 - 7. Check and record refrigerant pressure, water flow, water temperature, and power consumption of the chiller.
 - 8. Test and adjust all controls and safeties. Replace or correct all malfunctioning controls, safeties and equipment as soon as possible to avoid any delay in the use of the equipment.
 - 9. Prepare a written report outlining the results of tests and inspections, and submit it to the VA.
- D. Engage manufacturer's certified factory trained representative to provide training for 4 hours for the VA maintenance and operational personnel to adjust, operate and maintain equipment.

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