

# 15682 CENTRIFUGAL WATER CHILLERS

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## SPECIFIER:

CSI MasterFormat 2004 number: 236416

An optional keynote to the Drawings follows major product titles, for A/Es using National CAD Standard.

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## PART 1 GENERAL

### 1.1 SUMMARY

#### A. Related Sections:

1. 15240 - Vibration Isolation.
2. 15540 - Pumping Equipment (HVAC).
3. 15711 - Induced Draft Cooling Tower.

### 1.2 REFERENCES

- A. Air-conditioning and Refrigeration Institute (ARI) - Standard 550/590, latest edition, and ARI certification program.

### 1.3 SUBMITTALS

#### A. Shop Drawings and product data in compliance with the chiller performance specifications.

1. Shop Drawings shall contain equipment performance, physical data, piping connections, needed valves, needed strainers, needed external wiring and controls required for a complete system.
2. Shop Drawings shall show chiller's computer operating performance rating to match M-DCPS specific project operating conditions and KW/TON requirements. The computer performance chart shall show compliance with ARI 550/590 Integrated Part Load Value/Non-standard Part Load Value (IPLV/NPLV) over the range of 100 percent load to 25 percent part load.
3. Ratings shall be based on the water temperatures and flow rates as scheduled.
4. Computer rating sheets shall be signed off by an authorized chiller manufacturer representative.
5. Centrifugal water chiller shall be ARI 550 certified and performance rated according to ARI Standard 550-latest edition and stated on the rating sheets.

- B. Provide 2 complete overhaul, service, installation, maintenance, and parts manuals for the chiller. Deliver 1 set to M-DCPS project manager for M-DCPS Document Control and one set to the appropriate M-DCPS Maintenance Satellite Supervisor and receive a letter back stating that manuals were received. Manuals shall be originals only. Photocopies are not allowed.

### 1.4 QUALITY ASSURANCE

- A. Certification: Chiller shall be ARI Certified.

- B. Water Chillers shall be manufactured in a facility registered by Underwriters Laboratories, Inc. (UL) to the International Organization for Standardization ISO 9000 Series Standards for quality.
- C. The entire water chiller assembly shall be leak tested to at least 185 psig with a tracer gas mixture. There shall be no leaks greater than 0.5 oz/year of refrigerant.
- D. If the water chiller compressor has a transmission, the gears shall conform to American Gear Manufacture Association (AGMA) Standard - Quality LL.
- E. The water chiller energy efficiency shall be at least 0.55kW/ton.
- F. In accordance with FBC Energy Conservation Efficiency Requirements.

## 1.5 WARRANTY

- A. Chiller manufacture shall have available local service representative within a 50-mile radius of the job site on a permanent basis and provide 1 year parts, refrigerant, oil, and labor warranty from date of chiller start up. Date of shipment warranty shall not supersede the 1 year start up warranty.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS AND REFRIGERANTS

- A. Centrifugal Water Chiller:
  - 1. Carrier.
  - 2. McQuay.
  - 3. York.
  - 4. Trane.
- B. Refrigerants:
  - 1. HFC - 134A.
  - 2. HFC - 410A.
  - 3. Other M-DCPS accepted HFC refrigerant.

### 2.2 MAINTENANCE

- A. Warranty Period Service and Maintenance: Manufacturer of Chiller shall perform the following:
  - 1. Start up of chiller according to manufacturer's required procedures.
  - 2. A 2-hour running performance test and log signed by the installing contractor and manufacturer's representative.
  - 3. A running log of chiller performance four, eight, and eleven months after start-up.
  - 4. On the eleventh month, a refrigerant leak test, and oil and oil filter change, and a complete test of all testable controls for calibration and operation.

5. The manufacturer shall change oil filter free of charge immediately after any oil pressure drop that occurs during warranty period due to metal filings and other trash left in chiller during manufacturing.
6. Manufacturer shall be responsible for refrigerant loss during the 1-year warranty period, unless loss is caused by M-DCPS personnel.
7. During all log reading, any loss of performance because of condenser or evaporator tube fouling, strainer being plugged, cooling tower performance, or pump performance shall be reported to M-DCPS Project Manager for correction.

### 2.3 WATER CHILLER

- A. Chiller manufacture shall protect all required areas of chiller with insulation to ensure that there is no condensate dripage from any chiller surface.
  1. All areas where condensation could occur shall be protected with insulation.
  2. Insulation design shall allow for service access and removal of all covers for servicing.
  3. Insulation shall be minimum 1-1/2" thick Armaflex elastomeric thermal insulation.
  4. Insulation shall have a maximum thermal conductivity K value of 0.26 BTY in/hr-ft<sup>2</sup>-degree F, meeting ASTM C177 or C518.
  5. Insulation material shall comply with UL 94, classification 94HBF, NFPA-90A and NFPA-90B
  6. Insulation shall be resistant to:
    - a. Fungi growth per ASTM G21/C1338.
    - b. Bacterial growth per ASTM G22.
    - c. Mold growth per UL181.
  7. For chillers exposed to the exterior, insulation shall have a UV and weather resistant exterior cladding a minimum of 12 mils thick.

### 2.4 WATER CHILLER DESIGN AND INCLUDED ITEMS

- A. Furnish the cooler having a minimum capacity as shown on the Construction Document schedule.
  1. Cooling water of 45.0 degrees F. when supplied with condenser water at 85.00 degrees F. at full load power, input shall not exceed the maximum KW/TON requirements as noted.
  2. The KW/TON shall comply with FPL Commercial/Industrial Energy Conservation Program Standards.
  3. The cooler shall be 2-pass selected for 0.0001 fouling factor and a maximum liquid pressure drop of 15.0 feet.
  4. Waterside shall be designed for 150 psig working pressure.
  5. The condenser shall be 2-pass selected for 0.00025 fouling factor and maximum liquid pressure drop of 20.0 feet.
  6. Power shall be supplied to the compressor motor at 480 volts/3 phase/60 cycle and controls at 115 volts/1 phase/60 cycle or as derived from chiller motor control center.
- B. Unit shall be completely factory packaged including evaporator, condenser, compressors, lubrication system, refrigerant metering system, microprocessor control center, factory mounted and wired started and all interconnecting unit piping and wiring.

1. Unit shall be factory charged with oil.
2. Refrigerant shall be shipped inside the unit, fully charged.
3. Water chiller manufacture shall supply the water flow safety pressure differential controls for the cooler and condenser.

## 2.5 COMPRESSORS

- A. The packaged chiller shall be furnished with a centrifugal compressor.
- B. Compressor shall include an oil sump, oil filter, and a forced feed oil pump.
  1. The oil temperature shall be controlled during operation to maintain proper oil temperature throughout the lubrication system.
  2. An electric oil heater shall be supplied to maintain oil temperature during shut down period.
- C. Compressor shall be equipped with a variable-inlet guide-vanes at the inlet to the impeller and shall provide capacity modulation from 100 percent to 25 percent capacity.
  1. The compressor motor may be a variable frequency drive.
  2. If the compressor motor provided is an open type, additional water chiller room ventilation shall be provided to insure the room temperature does not exceed 104 degrees F.
- D. The package chiller shall be equipped with a drop oil return system from the evaporator to each compressor. Chiller compressor shall have a positive means of oil equalization.
- E. Compressor impellers shall be dynamically balanced and over-speed tested by the manufacturer at a minimum of 115 percent design operating speed.
- F. Compressor assembly shall be run tested at the factory.
  1. Vibration shall not exceed 1.0 mil at the compressor housing.
  2. The compressor shall operate without surging from 100 percent load to 25 percent load.

## 2.6 STANDARD CHILLER FITTINGS

- A. Standard fittings to be provided are:
  1. Check valve on vapor injection line.
  2. Cooler sight glasses for checking refrigerant charge.
  3. Manual ball valve on condenser inlet and outlet for charge isolation.
  4. Oil return jet-pump (eductor).
  5. Oil return filter drier.
  6. Valves to isolate compressors for repair.
  7. Compressor discharge line check valves.
  8. Refrigerant metering system to evaporator.

## 2.7 COMPRESSOR MOTOR STARTERS

- A. Motor starter shall be a reduced voltage wye-delta, a solid-state, or a solid-state variable frequency drive.
  - 1. Starter shall be UL listed or listed by a Nationally Recognized Testing Laboratory (NRTL) approved by OSHA,
  - 2. The starter can be water chiller mounted.
  - 3. Provide a NEMA I enclosure for the starter.
- B. Electrical components provided shall be:
  - 1. Contactors or silicon control rectifiers.
  - 2. Circuit breakers.
  - 3. Single point power connection.
  - 4. 115-volt control transformer if control power is not derived from chiller motor control center.
  - 5. Current transformers for control panel.
  - 6. Three-phase over/under voltage, phase loss/reversal/ imbalance protection.
  - 7. Three-phase voltage meter.
  - 8. Three-phase ammeter.

## 2.8 MICROPROCESSOR CONTROL PANEL

- A. The microprocessor control panel shall have a LED display and compressor manual reset button. The computer system is to do the following functions on centrifugal compressor chillers:
  - 1. Capacity control of compressor (manual or automatic).
  - 2. Staging of compressors based on leaving chilled water temperature.
  - 3. Compressor current limiting.
  - 4. Ramp loading mode.
  - 5. Compressor start delays.
  - 6. Automatic under voltage relay.
  - 7. Anti-recycle delay timer.
  - 8. Low-pressure safety with computer alarm.
  - 9. High-pressure safety with computer alarm.
  - 10. Freeze pressure safety with computer alarm.
  - 11. Solid state compressor motor overloads and temperature protection.
  - 12. High oil temperature protection.
  - 13. Chilled water reset and EMS control interlock. An analog input is to be available for the Board supplied chilled water reset based on a 4 to 20 MA signal. An interlock shall be provided for the Board supplied contacts to control starting and stopping the chiller.
  - 14. A BACnet communication port shall be provided to communicate with the school's EMS.

## 2.9 COOLER

- A. Cooler shall be of the shell and tube, with water side common to all compressors designed for 300 psig working pressure on the refrigerant side and be tested at 450 psig.

1. Fabricate shell from rolled carbon steel plate with fusion welded seams.
2. Use carbon steel tube sheets, drilled and reamed to accommodate the tubes.
3. Provide intermediate tube supports spaced no more than 4 feet apart.
4. The refrigerant side shall be designed, tested, and stamped according to American Society of Mechanical Engineers (ASME) Section VIII - Division 1 code for unfired pressure vessels.
5. Tubes shall be high efficiency, internally enhanced type.
6. Each tube shall be roller expanded into the tube sheets providing a leak-proof seal and be individually replaceable.
7. Water velocity through the tubes shall not exceed 9 fps. Use a fouling factor of 0.0001. Liquid level sight glasses shall be located on the side of the shell to aid in determining proper refrigerant charge.
8. The evaporator shall have a refrigerant relief device to meet the requirements of the ASHRAE 15 Safety Code for Mechanical Refrigeration.

B. Water boxes shall be removable to allow tube cleaning and replacement.

1. Stub-out water connections having Victaulic grooves shall be provided.
2. Water boxes shall be designed for 150 psig design working pressure and be tested at 225 psig.
3. Vent and drain connections with plugs shall be provided on each water box.

## 2.10 CONDENSER

A. Condenser shall be of the shell and tube type, designed for 300 psig working pressure on the refrigerant side and be tested at 450 psig.

1. Shell shall be fabricated from rolled carbon steel plate with fusion welded seams.
2. Use carbon steel tube sheets, drilled and reamed to accommodate the tubes.
3. Provide intermediate tube supports spaced not more than 4 feet apart.
4. The refrigerant side shall be designed, tested, and stamped according to the ASME Section VIII - Division 1 code for unfired pressure vessels.
5. Tubes shall be high efficiency, internally enhanced type.
6. Each tube shall be rolled, providing a leak proof-seal and be individually replaceable.
7. Water velocity through the tubes shall not exceed 9 fps. Use a fouling factor of 0.00025.
8. The condenser shall have a refrigerant relief device to meet the requirements of the ASHRAE 15 Safety Code for Mechanical Refrigeration.

B. Water boxes shall be removable to allow tube cleaning and replacement.

1. Provide stub-out water connections having Victaulic grooves.
2. Water boxes shall be designed for 150 psig design working pressure and be tested at 225 psig.
3. Vent and drain connections with plugs shall be provided on each water box.

## PART 3 EXECUTION

### 3.1 INSTALLATION

A. Unload and install the chiller.

- B. Provide vibration isolators as recommended by the chiller manufacturer.

### 3.2 FIELD QUALITY CONTROL

- A. Training: The water chiller manufacturer shall provide a factory-trained representative to perform instructional training on the maintenance, operation, troubleshooting, and repair on the water chiller including the microprocessor control system.
  - 1. Manufacturer shall provide manuals for start-up, operation, maintenance, and parts manuals and microprocessor computer water chiller program CD for up to 10 technicians. After the classroom instructions are completed, the manuals shall remain with the technicians.
  - 2. Training aids such as a slide presentation and simulator may be required.
  - 3. Training duration shall be 8 hours on the job, "hands-on" training on the installed and operational chiller unit the second day.
  - 4. Training days shall be consecutive.
  - 5. Location of classroom type instruction shall be the delivery address of the chiller unit.
  - 6. The cost of the manuals, program CD, training, and all cost of the training section shall be included in the cost of the water chiller.
- B. Use 2 venturi flow metering devices sized for the specified evaporator and condenser gpm. The accuracy of this venturi shall be +/-1 percent.

### 3.3 TESTING, STARTING, AND ADJUSTING

- A. The water chiller manufacturer shall provide a factory-trained technician:
  - 1. To perform the start-up procedures as outlined in the start-up manual.
  - 2. To troubleshoot and repair as outlined in the operation and maintenance manual.
  - 3. To perform all the tasks of maintenance as specified and as outlined in the operation and maintenance manual.

END OF SECTION