

## SECTION 23 64 16 - CENTRIFUGAL WATER CHILLERS

### PART 1 - GENERAL

#### 1.1 SYSTEM DESIGN REQUIREMENTS

- A. Chillers included in this section are intended for structures that are constructed outside the practical limits of the campus central chilled water system or are chillers utilized to provide chilled water for a specific process.
- B. Do not locate chillers near noise sensitive areas.
- C. Monitor machine room and sound audible alarm if refrigerant concentrations exceed 10 ppm.
- D. Compressors over 100 ton Capacity:
  - 1. Motors and Starters:
    - a. aDual winding, wye-delta design with matching two-step, closed transition, time-delay starting switch gear is preferred. Provide an auxiliary timer in the starting circuit.
    - b. Set timer to limit starts to a minimum of 30 minutes apart or greater.
    - c. An auto-transformer with reduced voltage start is an acceptable alternate starter.
    - d. Provide heat sensors on all motors in the windings for thermal protection.
  - 2. Full-running Protection:
    - a. Specify compressors equipped with high and low pressure safety cut out, external overload protection, thermal protection, and low oil pressure.
    - b. Manual reset type safeties which cause an electrical lock-out of the starting circuit when it has tripped, with an indication of which safety device has operated.
  - 3. Gauges and Lubrication:
    - a. Include gauges, indicating high side, low side and oil pressures. Gauges are not required if unit is equipped with a micro-processor control which shows pressures at control panel.
    - b. Forced-feed lubrication system with filter, cooler, and visual inspection port in the oil reservoir.
  - 4. Heaters:
    - a. Provide crankcase heaters wired on a separate electrical circuit.
    - b. Provide oil pump starter wired on a separate electrical circuit.
  - 5. Refrigerant Transfer: Provide provisions for pump out/down into unit-mounted receiver if application warrants.
  - 6. Pressure Relief: Show on drawings, safety valve pressure relief piping, vented to outdoors in accordance with ASHRAE 15. Provide self-closing, resealing type pressure relief valve.
- E. Compressors of 60 to 100 ton Capacity:
  - 1. Semi-hermetic, reciprocating type, rotary screw, helical rotor or scroll.
  - 2. Full-running Protection:
    - a. Specify compressors equipped with high and low pressure safety cut out, external overload protection, thermal protection, and low oil pressure.
    - b. Manual reset type safeties which cause an electrical lock-out of the starting circuit when it has tripped, with an indication of which safety device has operated.
  - 3. Include gauges, indicating high side, low side and oil pressures. Gauges are not required if unit is equipped with a micro-processor control which shows pressures at control panel.
  - 4. Crankcase heaters.
  - 5. Oil reservoir sight glass.
  - 6. Replaceable refrigerant filter-dryers in liquid line.
  - 7. Hydraulic capacity control by cylinder unloading for adjustments to load fluctuations.
  - 8. Positive unloaded start.
  - 9. Discharge muffler.
  - 10. Internal vibration isolation.

11. Closed transition starting switch-gear. Part-winding is acceptable.
  12. Refrigerant Transfer: Provide provisions for pump out/down into unit-mounted receiver if application warrants. If condenser will hold the full charge, this is an acceptable alternative.
- F. Compressors under 60 but over 15 ton capacity:
1. Hermetic or semi-hermetic, reciprocating type, helical rotor or scroll.
  2. Inherent thermal overload protection for motors.
  3. Include gauges, indicating high side, low side and oil pressures. Gauges are not required if unit is equipped with a micro-processor control which shows pressures at control panel.
  4. Crankcase heaters.
  5. Oil reservoir sight glass.
  6. Replaceable refrigerant filter-dryers in liquid line.
  7. Hydraulic capacity control by cylinder unloading or staging of multiple compressors.
  8. Positive unloaded start.
  9. Discharge muffler.
  10. Internal vibration isolation.
  11. Closed transition starting switch-gear.
  12. Refrigerant Transfer: Provide provisions for pump out/down into unit-mounted receiver if application warrants. If condenser will hold the full charge, this is an acceptable alternative.
- G. Compressors between 7-1/2 and 15 ton capacity.
1. Same requirements as 15 to 60 ton compressors except that cylinder unloading and unloaded start features are not required on the small units.
- H. Compressors below 7-1/2 tons:
1. Same requirements as 7-1/2 to 15 ton compressors except gauges are not required.
- I. Condensers:
1. Select air cooled condensers with sufficient capacity to compensate for altitude deration of 5200 feet and 105 degree F inlet air temperature.
  2. Do not specify vertical blow-type condenser fans for systems that operate during winter.
  3. For winter operation, specify a horizontal blow-type condenser fan with a weather-protecting shroud designed to prevent possible blade icing and unbalance.
  4. Arrange water-cooled condensers so that tubes can be rodded without hindrance from walls, piping, or equipment.
  5. Provide low ambient accessory package to consist of variable speed condenser fan control based upon outside air temperature or refrigerant gas temperature/pressure on air-cooled condensers with intermittent winter cooling requirements down to 40 degree F outside air temperature. Provide thermostatic expansion valves with these systems. Orifice type valves are not permitted.
  6. Provide flooded condenser control with liquid receiver and 3-way head pressure control valves on systems requiring continuous and critical winter cooling operation. Provide electronic expansion valves.
- J. Chillers:
1. Centrifugal chillers with oil coolers, which are cooled with chilled water, should have pressure and temperature gauges installed on inlet outlet of chiller out of the influence of the oil cooler circuit.
  2. Install the following components on all chilled and condenser water systems.
    - a. Chiller Water Temperature Sensors:
      - 1) Supply temperature sensor
      - 2) Return temperature sensor
    - b. Low Water Temperature Cut-out.
    - c. Water Flow Sensors:
      - 1) Chiller water system
      - 2) Condenser water system
    - d. Relief Valves.

3. Install noise and vibration apparatus in accordance with state and federal regulations, and ARI Standard 575-87.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- B. Acceptable Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Centrifugal or Rotary Screw Chillers:
    - a. Carrier.
    - b. McQuay.
    - c. Trane.
    - d. York.

### 2.2 MATERIALS, GENERAL

- A. Centrifugal or Rotary Screw Chillers:
1. Chiller performance rated in accordance with latest edition of ARI 550.
  2. Factory assembled and wired consisting of one or compressors, an evaporator or cooler, an air or water-cooled condenser, safety controls and operational controls.
  3. Refrigerant: R134a; provide full operating charge of refrigerant and oil. Provide refrigerant charging port.
  4. Compressor: Hermetic or semi-hermetic, rebuildable.
  5. Motor: Refrigerant cooled, hermetic or semi-hermetic motor; or open, drip-proof induction motor; with the following features: Overvoltage protection, Undervoltage protection, Single-phasing protection, Current-overload protection.
  6. Evaporator: Shell and tube cooler with refrigerant totally enclosed by shell; water in tubes.
    - a. Shell: Carbon steel plate.
    - b. Cooler Tubes: Seamless copper; expanded into tube sheets; individually replaceable; externally finned.
    - c. 300 psig refrigerant working pressure.
    - d. 150 psig water side working pressure
    - e. Insulation: factory applied, 3/4-inch thick, flexible elastomeric insulation evaporator, suction lines, and other surfaces where condensation might occur.
  7. Water Cooled Condenser: Shell and tube condenser with water enclosed in tubes; refrigerant enclosed by shell.
    - a. Shell: Carbon steel plate.
    - b. Cooler Tubes: Seamless copper; expanded into tube sheets; individually replaceable; externally finned.
    - c. 300 psig refrigerant working pressure.
    - d. 150 psig water side working pressure
    - e. Safety and operating options include the following; pressure relief safety valve, purge valve, subcooler circuit.
  8. Air Cooled Condenser: Factory assembled, wired, and tested; consisting of casing, air-cooled condenser coils, fans, and controls integrated with compressor operation.
    - a. Casing: Weatherproof, constructed of hot-dip galvanized steel with factory-painted finish.
    - b. Fans: Propeller type, statically and dynamically balanced; vertical discharge.
    - c. Fan Motor: Direct drive, weather proof, with bearings permanently lubricated, and having built-in current and thermal overload protection.
    - d. Condenser Coil: Copper tubes with mechanically bonded aluminum fins.
- B. Controls:
1. General: Manufacturer's standard microprocessor-based chiller controls.
  2. Temperature Controls: Modulating slide valve to maintain chilled water temperature set point without hunting within throttling range. Include the following features:
    - a. Throttling Range: Full load to 10 percent of full load.

- b. Chilled water temperature control.
    - c. Chilled water temperature setback.
    - d. Load limit controller.
  - 3. HVAC Controls: Furnish appurtenance to monitor and control chilled water set point, to monitor condenser water set point, and to monitor chiller alarms from building automation system.
  - 4. Safety Controls: Automatic and Manual reset controls to perform the following functions:
    - a. Low evaporator pressure cutout.
    - b. Low chilled water temperature cutout.
    - c. Low oil sump temperature cutout.
    - d. Low oil pressure cutout.
    - e. High oil temperature cutout.
    - f. High condenser pressure cutout.
    - g. Water Flow Interlock: Water flow switch to prevent starting compressor without chilled and condenser water flow.
  - 5. Power Controls: Manufacturer's standard, unit mounted, factory wired, single-point connection, with the following power control options:
    - a. External overload protection.
    - b. Control circuit fuse.
    - c. Power terminal block.
    - d. Lockout restart timer.
    - e. Combination controller and disconnect.
  - 6. Interface to campus BMS?
- C. Refrigerant Monitor:
- 1. UL 2075 refrigerant monitor to continuously monitor mechanical equipment rooms for refrigerant concentrations between 0 and 1000 PPM. Unit enclosed in NEMA 4 cabinet. Monitor shall draw room air through an infrared photo-acoustic sensing device allowing accurate measurement of refrigerant vapors. Unit shall be inherently zero-stable and include sample filters. Monitor shall signal alarm levels at three concentration levels plus a unit "trouble" alarm that indicates internal problems with monitor.
  - 2. Interface Module: Minimum of a backlit, 2 line, and 16-character language display. Module capable of remote mounting.
  - 3. Input: 4-20 mA.
  - 4. Output: 0-10vdc and a 4-20 mA analog output proportional to the displayed refrigerant concentration.
  - 5. Latched alarms re-settable from a remote source via a contact opening.
  - 6. Accessories: Alarm package consisting of 3 flashing lights and audible alarm mounted in one assembly for remote mounting.

## PART 3 - EXECUTION

### 3.1

### 3.2 INSTALLATION, GENERAL

- A. Install chillers on 4-inch thick concrete base, 4 inches larger on each side than base of unit. Anchor chiller and vibration isolators to concrete base.
- B. Maintain manufacturer's recommended clearance for service and maintenance.
- C. Connect piping to chiller with shutoff valves and flanges at each connection.
- D. Label the amount of refrigerant in the system in pounds.

- E. Provide flanges at each condenser and chilled water connection to chiller. Provide removable sections to permit removal for access to tube bundles for cleaning. Pipe sections shall be no longer than 4 feet or shall consist of a removable elbow in order to be removable without heavy equipment.
- F. Place isolation valves on piping to permit removal of sections described above without draining of chilled or condenser water.
- G. Controls:
  - 1. Wire chiller so it cannot start unless chilled water and condenser water circulating pumps are running.
  - 2. Start and stop chillers automatically through the chiller control panel.

### 3.3 TESTING, CLEANING, AND CERTIFICATION

- A. Test each chiller before shipment. Provide certified test report to confirm performance, include capacity test, power consumption test, and Part Load Value at ARI standard conditions.
- B. Complete manufacturer's installation and startup checklist.
- C. Test and adjust controls and safeties.
- D. Flush and clean chillers according to manufacturer's instructions.

### 3.4 COMMISSIONING (DEMONSTRATION)

- A. Provide services of a factory authorized service representative to provide startup services and to demonstrate and train the university's representative. Before start-up, manufacturer shall scope the chiller tubes to ensure they are not damaged or twisted.
- B. Provide 4 hours of instruction to the university's representative. Include operation of chillers including accessories and controls, procedures for startup and shutdown, troubleshooting, servicing, and preventive maintenance. Review data in the maintenance manuals.

**END OF SECTION 23 64 16**