



## **SECTION 23 64 11 - PACKAGED WATER CHILLERS - RECIPROCATING, SCROLL, AND SCREW**

### **PART 1 – GENERAL**

#### **1.1 SUMMARY**

- A. Section includes chiller package, charge of refrigerant and oil, controls and control connections, chilled water connections, condenser water connections, refrigerant connections, auxiliary water connections, starters.
- B. This applies to chillers smaller than 100 tons.

#### **1.2 REFERENCES**

- A. Air-Conditioning and Refrigeration Institute:
  - 1. ARI 550/590 - Water Chilling Packages Using the Vapor Compression Cycle.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
  - 1. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- C. American Society of Mechanical Engineers:
  - 1. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.
- D. National Electrical Manufacturers Association:
  - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

#### **1.3 SUBMITTALS**

- A. Shop Drawings: Indicate components, assembly, dimensions, weights and loads, required clearances, and location and size of field connections. Indicate valves, strainers, and thermostatic valves required for complete system.
- B. Product Data: Submit rated capacities, weights, specialties and accessories, electrical requirements, wiring diagrams, and control diagrams.
- C. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include startup instructions.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements including those furnished but not produced by manufacturer.
- E. Manufacturer's Field Reports: Submit start-up report. Indicate results of leak test and refrigerant pressure test.



#### **1.4 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: Submit start-up instructions, maintenance data, parts lists, controls, and accessories. Include trouble-shooting guide.

#### **1.5 WARRANTY**

- A. Furnish five-year manufacturer warranty to include coverage for complete assembly including materials and labor.

#### **1.6 MAINTENANCE SERVICE**

- A. Furnish service and maintenance of chiller for five years from Date of Substantial Completion.
- B. Examine unit components monthly. Clean, adjust, and lubricate equipment.
- C. Include systematic examination, adjustment, and lubrication of unit, and controls checkout and adjustments. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use parts produced by manufacturer of original equipment.
- D. Perform work without removing units from service during building normal occupied hours.
- E. Provide emergency call back service at all hours for this maintenance period.
- F. Maintain locally, near Place of the Work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.
- G. Perform maintenance work using competent and qualified personnel under supervision and in direct employ of manufacturer or original installer.

#### **1.7 MAINTENANCE MATERIALS**

- A. Furnish two containers of lubricating oil.

### **PART 2 - PRODUCTS**

#### **2.1 PACKAGED WATER CHILLERS**

- A. Manufacturers:
  - 1. **York.**
  - 2. **Carrier.**
  - 3. **Trane.**
- B. Product Description: Factory assembled and tested, packaged, water cooled, liquid chillers consisting of compressors, compressor motor, condenser, evaporator, refrigeration



accessories, instrument and control panel including gauges and indicating lights, auxiliary components and accessories, and motor starters.

- C. Refrigerant shall be R-410A or R-407C.

## **2.2 HERMETIC COMPRESSORS**

### **A. Reciprocating Compressors:**

1. Unit: Hermetically sealed motor-compressor with crankcase heater, suction and discharge service valves, rubber-in-shear isolators, and control panel.
2. Motor: Constant speed 3600 rpm, suction gas cooled with overheating protection.
3. Crankcase Heater: Energize continuously.

### **B. Scroll Compressors:**

1. Unit: Direct drive, hermetic, 3600 RPM, fixed compression, scroll motor-compressor with control panel.
2. Features: Centrifugal oil pump, sump oil heater, oil level sight glass, oil charging valve, two point lubrication for each motor bearing, flooded lubrication for journal and thrust bearings, check valve on scroll discharge port.
3. Motor: Suction gas-cooled, hermetically sealed, squirrel cage induction.
4. Automatic Capacity Reduction: Electronic logic controller and air temperature sensor controls unit and hot gas bypass regulator valve.

## **2.3 SEMI-HERMETIC COMPRESSORS**

### **A. Reciprocating Compressors:**

1. Unit: Serviceable hermetic reciprocating motor-compressor with positive displacement oil pump lubrication system, spring loaded heads and replaceable cylinder liners, crankcase heater, suction inlet screen, discharge service valves, and control panel.
2. Automatic Capacity Reduction Equipment solenoid gas pressure operated. Furnish capability for unloaded compressor start.
3. Motor: Constant speed 1800 rpm, suction gas cooled with electronic overheating protection in each phase, reduced voltage starting.
4. Crankcase Heater: Energize continuously.

### **B. Screw Compressors:**

1. Unit: Direct drive, semi-hermetic 3600 RPM, fixed compression, rotary screw compressor with control panel.
2. Features: Differential refrigerant pressure oil pump, oil heater, oil separator and filter and oil charging valve.
3. Motor: Suction gas-cooled, hermetically sealed, squirrel cage induction.



4. Automatic Capacity Reduction: Continuously variable slide valve with infinitely variable control to 25 percent of full load.

## **2.4 EVAPORATOR**

- A. Shell and tube type, seamless steel construction with fabricated steel, heads, seamless copper tubes with integral fins, rolled into tube sheets. Furnish multiple refrigerant circuits on multiple compressor units.
- B. Design, test, and stamp refrigerant side for 225 psig working pressure and water side for 150 psig working pressure, in accordance with ASME Section VIII.
- C. Insulate with 0.75 inch minimum thick flexible expanded polyvinyl chloride insulation with maximum K factor of 0.26.
- D. Furnish water drain connection and thermometer wells for temperature controller and low temperature cutout.

## **2.5 CONDENSERS**

- A. Shell and tube type, seamless steel construction with fabricated steel heads, seamless copper tubes with integral fins, rolled into tube sheets.
- B. Design, test, and stamp refrigerant side for 450 psig working pressure in accordance with ASME Section VIII.
- C. Furnish integral sub-cooling circuit.
- D. Furnish 450 psig safety relief valve on condenser shell.
- E. Design, test, and stamp water side for 150 psig working pressure in accordance with ASME Section VIII.

## **2.6 CONDENSER COILS, FANS AND MOTORS**

- A. Coils: Copper fins mechanically bonded to seamless copper tubing. Furnish sub-cooling circuits as applicable. Air test under water to 425 psig, and vacuum dehydrate. Seal with holding charge of nitrogen.
- B. Coil Guard: Louvered with lint screens.
- C. Vertical propeller type condenser fans with fan guard on discharge.
- D. Weatherproof motors suitable for outdoor use, with permanent lubricated ball bearings and built-in current and thermal overload protection.

## **2.7 REFRIGERANT CIRCUIT**

- A. Factory furnished and piped.



- B. Furnish for each refrigerant circuit:
  - 1. Liquid line solenoid valve.
  - 2. Filter dryer (replaceable core type).
  - 3. Liquid line sight glass and moisture indicator.
  - 4. Thermal expansion for maximum operating pressure.
  - 5. Charging valve.
  - 6. Insulated suction line.
  - 7. Discharge line check valve.
  - 8. Compressor discharge service valve.
  - 9. Pressure relief device.

## **2.8 CONTROLS**

- A. On or near chiller, mount steel control panel with NEMA 3R (NEMA 4X for outdoors location) enclosure, containing starters, power and control wiring, molded case disconnect switch, factory wired with single point power connection.
- B. For each compressor, furnish part winding starter, non-recycling compressor overload, starter relay, and control power transformer or terminal for control power. Furnish manual reset, current overload protection.
- C. Furnish devices on control panel face:
  - 1. Compressor, run lights.
  - 2. System start-stop switch.
  - 3. Control power fuse or circuit breaker.
  - 4. Compressor lead-lag switch.
  - 5. Demand limit switch.
- D. Furnish safety controls with indicating lights arranged so machine is shut down and requires manual reset:
  - 1. Low chilled water temperature switch.
  - 2. High discharge pressure switch for each compressor.
  - 3. Low suction pressure switch for each compressor.
  - 4. Oil pressure switch.
  - 5. Flow switch in chilled water line.
  - 6. Flow switch in condenser water line.
  - 7. Relay for remote mounted emergency shutdown.
- E. Furnish the following operating controls:



1. Multi-step chilled water temperature controller to cycle compressor and activate capacity controls, with remote thermostat.
  2. Five minute off timer prevents compressor from short cycling.
  3. Part winding start timer.
  4. Periodic pump-out-timer to pump down on chilled water flow and high evaporator refrigerant pressure.
  5. Load limit thermostat to limit compressor loading on high return water temperature.
  6. Three phase monitor to protect unit by stopping compressor on phase loss, phase reversal, phase unbalance, or under voltage.
  7. Hot gas bypass sized for minimum compressor loading, bypasses hot refrigerant gas to evaporator.
  8. Cycle counter and operating hour meter.
- F. Furnish pre-piped gauge board with pressure gauges for suction and discharge refrigerant pressures, and oil pressures.
- G. Furnish alarm package with test button and lights indicating control circuit is energized, compressor is running, and sounds audible alarm and activates indicating light upon detection of compressor malfunction, low chilled water temperature, or evaporator water flow failure.

## **2.9 SOURCE QUALITY CONTROL (AND TESTS)**

- A. Furnish testing of package chillers.
- B. Furnish shop inspection and testing for package chillers.
- C. Make completed chillers available for inspection at manufacturer's factory prior to packaging for shipment. Furnish at least seven days notice before packaging is scheduled.
- D. Allow witnessing of factory inspections and tests at manufacturers test facility by LAWA personnel. Furnish at least seven days notice before inspections and tests are scheduled.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install indoor chiller on concrete housekeeping pad minimum 3-1/2 inches high and 6 inches wider than equipment base on each side. Install packaged outdoor chiller on concrete foundation minimum 6 inches thick and 6 inches wider than equipment base on each side.
- B. Provide seismic restraints as required.
- C. Install the following piping accessories on evaporator chilled water piping connections.
  1. On inlet:



- a. Thermometer well for temperature controller.
  - b. Thermometer.
  - c. Strainer.
  - d. Flow switch.
  - e. Flexible pipe connection.
  - f. Pressure gauge.
  - g. Shut-off valve.
2. On outlet:
    - a. Thermometer.
    - b. Flexible pipe connection.
    - c. Pressure gauge.
    - d. Balancing valve.
- D. Install auxiliary water piping for oil cooling units and purge condensers.
- E. Install the following piping accessories on condenser water piping connections.
1. On inlet:
    - a. Thermometer well for temperature limit controller.
    - b. Thermometer well and thermometer.
    - c. Strainer.
    - d. Flow switch.
    - e. Flexible pipe connection.
    - f. Pressure gauge.
    - g. Shut-off valve.
  2. On outlet:
    - a. Thermometer well and thermometer.
    - b. Flexible pipe connection.
    - c. Pressure gauge.
    - d. Balancing valve.
- F. Arrange piping for easy dismantling to permit tube cleaning.
- G. Install refrigerant piping connections to air-cooled condensing units.
- H. Install piping from chiller safety relief valve to outdoors. Size as recommended by manufacturer.
- I. Install chiller accessories furnished loose for field mounting.



- J. Install electrical devices furnished loose for field mounting.
- K. Install control wiring between chiller control panel and field mounted control devices.
- L. Provide connection to electrical service.

### **3.2 FIELD QUALITY CONTROL**

- A. Furnish cooling season start-up, winter season shutdown service, for first year of operation. When initial start-up and testing takes place in winter and machines are to remain inoperative, repeat start-up and testing operation at beginning of first cooling season.

### **3.3 MANUFACTURER'S FIELD SERVICES**

- A. Furnish services of factory trained representative for minimum of one day to leak test, refrigerant pressure test, evacuate, dehydrate, charge, start-up, calibrate controls, and instruct Owner on operation and maintenance.
- B. Furnish initial charge of refrigerant and oil.

### **3.4 TRAINING**

- A. Train LAWA Maintenance personnel on the system operations and performance to adjust, operate and maintain the system.
- B. Provide minimum of 18 hours each (3 shifts) of classroom and hands on training to LAWA Maintenance personnel.

### **3.5 DEMONSTRATION AND TRAINING**

- A. Demonstrate system operations and verify specified performance. Demonstrate low ambient operation during winter testing for air-cooled condensers.
- B. Training to include minimum of 15 personnel for 40 hours training, 16 hours shall be classroom training and 24 hours shall be hands-on training.
- C. Training shall occur after the system is fully operational.

### **3.6 FACTORY PERFORMANCE TESTS**

- A. Manufacturer shall conduct factory performance test for each chiller in accordance with ARI 550/590, to verify design capacity and part load capacity points indicated on Bid form. LAWA and/or LAWA's representative (2 persons) may elect to witness tests. Notify LAWA and/or LAWA's representative of test date at least 2 weeks in advanced. There will be zero tolerance on capacity and NPLV, other parameters are per ARI 550/590 tolerance.
- B. Before shipment of chillers, all records and certifications approving testing requirements shall be submitted to and approved by LAWA.





- C. Defective work or material shall be replaced or repaired, as necessary, and inspection and test repeated. Repairs shall be made with new materials. Run new performance test in accordance with ARI standard.
- D. If chiller assembly fails to meet design capacity and a minimum of 15% more capacity at lower condenser water temperature, LAWA may elect not to accept delivery until chiller is modified at manufacturer's expense to meet design capacity.
- E. If chiller assembly fails to meet any of part load performance data supplied by manufacturer with his bid, LAWA may elect not to accept delivery until chiller is modified at manufacturer's expense to meet all of design and part load performance data or to assess penalty charge equal to 10 years operating cost differential. This differential is to be determined by using part load data included in bid form and data obtained from performance test, subtracting bid data annual operating cost from test data annual operating cost, and multiplying difference by ten. Penalty charge shall apply to all chillers.
- F. All design conditions and part load performance data shall be evaluated with 480 volt, 3 phase, 60 hertz power supplied to chiller.
- G. Conduct test at approved ARI certified test facility of the manufacturer.
- H. Instrumentation used for testing must be calibrated within 6 months of test date and traceable to National Bureau of Standards. Documentation verifying NBS traceability shall be submitted to LAWA.
  - 1. Performance test shall be two point test for one chiller. Points will be selected at time of test. Points will be selected from submitted performance from 25 to 100% of capacity.

### **3.7 COMMISSIONING**

- A. The manufacturer shall be present during all commissioning events. The anticipated schedule is for commissioning to occur during the least six to eight weeks of construction just prior to the anticipated end of construction date of. Include 40 hours of field time to perform the commissioning requirements.
- B. A factory authorized representative shall perform the startup service.
  - 1. Fill out startup checklists and attach copy with Contractor Startup Report.
- C. Complete installation and startup checks according to manufacturer's written instructions and check for the following items:
  - 1. No physical damage to unit.
  - 2. Unit is level.
  - 3. Chiller vibration isolation and flexible pipe connections are installed.
  - 4. Clearances have been maintained and piping is installed for easy removal for service and tube cleaning.
  - 5. Chilled and condenser water pipes have been connected to correct ports.



6. Labels and safety instructions are clearly visible.
  7. Oil levels are as recommended by manufacturer.
  8. Refrigerant charge is sufficient and chiller has been leak tested.
  9. Shipping skids, blocks and straps are removed.
  10. Refrigerant pressure relief is vented to outside.
  11. Thermometers and pressure gauges are installed.
  12. Controls and safety interlocks are installed and connected.
  13. Pumps are installed, connected and operational.
- D. Check and record performance of chiller protection devices.
- E. Check and record performance of chilled and condenser water flow and low temperature interlocks.
- F. Operate chiller for run in period as recommended by manufacturer.
- G. Check static deflection of vibration isolators, including deflection during chiller startup and shutdown.
1. Check refrigerant charge. Check oil level.

### **3.8 CLEANING**

- A. After completion of system installation, start up, testing and prior to commissioning, completely and thoroughly clean up the chillers from any foreign material and construction dirt and dust.

END OF SECTION 23 64 11