**PART 1 – GENERAL**

**1.01 SUMMARY**

A. Section Includes: Air-cooled rotary screw packaged chillers.

B Related Requirements:

1. Division 01: General Requirements.

2. Section 22 10 00: Plumbing.

3. Section 23 05 00: Common Work Results for HVAC.

4. Section 23 05 13: Basic HVAC Materials and Methods.

5. Section 23 07 00: HVAC Insulation.

6. Section 23 09 00: HVAC Instrumentation and Controls.

7. Section 23 20 13: Above Ground HVAC Piping.

8. Section 23 20 16: Underground HVAC Piping.

9. Section 23 25 00: HVAC Water Treatment.

10. Section 23 65 00: Cooling Towers.

11. Section 31 23 23: Excavation and Fill for Utilities.

**1.02 QUALITY ASSURANCE**

A. Installers and Manufacturer's Qualifications: Comply with provisions stated in Section 23 0500: Common Work Results for HVAC.

1. Regulatory Requirements:
2. ANSI/ASHRAE STANDARD 15 - Safety Standard for Refrigeration Systems.
3. ANSI/ASHRAE/IESNA 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.
4. ASME - Boiler and Pressure Vessel Code, Section VIII.
5. UL 1995 - Heating and Cooling Equipment.
6. ANSI/AHRI 270 – Standard for [Sound Rating of Outdoor Unitary Equipment](http://webstore.ansi.org/RecordDetail.aspx?sku=ARI+270-95).
7. ANSI/AHRI 370 – Standard for [Sound Rating of Large Air-Cooled Outdoor Refrigerating and Air-Conditioning Equipment](http://webstore.ansi.org/RecordDetail.aspx?sku=ARI+370-2001).
8. ANSI/AHRI STANDARD 550/590 - Standard for Performance Rating of Water Chilling Packages Using the Vapor Compression Cycle.
9. ANSI/AHRI 575 - Method of Measuring Machinery Sound Within An Equipment Space.
10. ANSI/ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings. Bearings must have life of not less than 200,000 hours.
11. ASHRAE STANDARD 34 - Designation and Safety Classification of Refrigerants.
12. Chiller shall be designed and constructed to meet UL or ETL requirements and have labels appropriately affixed.

**1.03 SUBMITTALS**

A. Provide submittals in accordance with Division 01 and Section 23 05 00: Common Work Results for HVAC.

B. Manufacturer’s Data:

1. Complete list of items proposed to be furnished and installed under this Section. Material lists, which do not require performance data, shall include manufacturer’s names, types, and model numbers for usages indicated.

2. Manufacturer's specifications and data required to demonstrate compliance with specified requirements. Literature shall include descriptions of equipment, types, models and sizes proposed, capacity tables or curves marked to indicate performance characteristics, electrical requirements, options selected, space requirements (including allowances for servicing if indicated) and data necessary to ensure compliance with requirements of these Specifications and performance indicated on Drawings. Data shall also include name and address of nearest service and maintenance organization that regularly stocks repair parts. Listings of items that function as parts of an integrated system shall be furnished at one time.

3. Shop Drawings indicating methods of installation of equipment and materials, sizes, and schedules of piping, and details of supports. Items to be indicated shall include but are not limited to, the following:

a. Layout of proposed, piping and equipment drawn to scale, to establish that equipment will fit into allotted spaces with clearance for installation and maintenance. Indicate proposed details for attachment, anchoring to, and hanging from structural framing of building. Indicate vibration isolation units, foundations and supports, and openings for passage of pipes.

b. Drawings indicating locations and sizes of sleeves and prepared openings for pipes.

c. Typical details of supports for equipment and piping.

* 1. Submit drawings indicating components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate equipment, piping and connections, valves.
  2. Submit product data indicating rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.
  3. Submit manufacturer’s installation instructions.
  4. Submit performance data indicating energy input versus cooling load output from 10 (or minimum turn down) to 100 percent of full load.

**1.04 PRODUCT HANDLING**

A. Protection, Replacements, Delivery and Storage: Comply with provisions stated in Section 23 0500: Common Work Results for HVAC.

B. Deliver chillers to the job site completely assembled and charged with refrigerant and oil by the manufacturer.

C. Comply with manufacturers instructions for rigging and handling.

**1.05 COORDINATION**

A. Coordinate related and adjacent activities in accordance with provisions of Section 01 3113: Project Coordination.

**1.06 WARRANTY**

A. Compressors shall carry five year parts only warranty.

B. One year parts and labor warranty on entire unit including controls and refrigerant.

**PART 2 – PRODUCTS**

**2.01 EQUIPMENT**

A. Cooling and heating capacities, electrical characteristics, outdoor sound levels and operating conditions shall be as indicated on the Drawings.

B. Capacities of equipment and material shall be not less than those indicated on Drawings. Capacities of refrigerating equipment as indicated on Drawings are net rated output as required, based on load and ambient air temperature condition at the Project site. Ambient air temperature indicated for rating purposes is standard in manufacturer's tables.

C. Unit Description:

1. Provide and install as shown on the plans, factory assembled, factory charged with R-134a, and factory run-tested, air-cooled, rotary screw compressor packaged chillers in the quantity and size specified. Each chiller shall consist of multiple semi-hermetic screw compressors, direct expansion evaporator, air-cooled condenser section, control system and all components necessary for protected and controlled unit operation.

D. Chiller shall be constructed and rated in accordance with AHRI 550/590. Chiller shall conform to ASHRAE 15. Chiller shall be designed and constructed to meet UL or ETL requirements and have labels properly affixed.

1. Manufacturer: McQuay, Carrier, Trane, York, or equal.

2. Capacity: As indicated on drawings.

3. Quality Assurance: Design, construction, testing and installation shall comply with the following standards as applicable:

a. ASHRAE/IESNA 90.1.

b. Sound Level: AHRI Standard 575.

4. Energy Efficiency: As indicated on drawings.

**2.02 DESIGN REQUIREMENTS**

A. General: Provide a complete rotary screw packaged chiller as specified herein and as shown on the drawings. The unit shall be in accordance with the standards referenced in Article 1.02.

B. Performance: Refer to the schedule of performance on the drawings. . The unit shall be capable of operating to 35 degrees F (4.4 degrees C) ambient temperature.

C. The unit shall provide ventilation in the controller to provide operation above 100 degrees F (38 degrees C) up to 125 degrees F (51 degrees C) ambient air temperatures.

D. Acoustics: Manufacturer must provide both sound power and sound pressure data in decibels. Sound pressure data per AHRI 370 must be provided in 8 octave band format at full load. In addition, A-weighted sound pressure at 30 feet should be provided at 100 percent, 75 percent, 50 percent and 25 percent load points to identify the full operational noise envelope. Sound power must be provided in 1/3 octave band format to highlight any tonal quality issues. If manufacturer cannot meet scheduled noise levels, sound attenuation devices or barrier walls must be installed to meet this performance level.

**2.03 CHILLER COMPONENTS**

A. Compressors: The compressors shall be field serviceable, semi-hermetic, single-rotor screw type with one central helical rotor meshing with two opposing gate rotors. The gate rotor contact element shall be constructed of engineered composite material, dimensionally stable up to 1500 degrees F and wear resistant for extended life. Compressors shall be vibration isolated from the frame by neoprene compression mounts. Each compressor shall be equipped with a suction service shutoff valve.

B. Electric motors: Motors shall be high torque, two pole, semi-hermetic, and squirrel cage induction type with inherent thermal protection on all three phases and cooled by suction gas.

C. Solid-State Compressor Motor Starters: Each starter shall be designed using the current generation of reliable solid-state technology. Each starter shall provide controlled motor acceleration and deceleration, and shall provide protection for the following conditions: ground faults, phase rotation, electronic thermal overload, over/under current, stalled motor, single phase, high load current and current unbalance. Acceptable solid-state starter manufacturers are GE, Cutler-Hammer, Benshaw, Reliance Electric, or equal. The solid state starters shall be capable of self-diagnostics, metering, and have an LED display to include the following operating and fault messages:

1. Operating Messages:

a. Line voltage not present.

b. Voltage present, starter ready.

c. Motor accelerating.

d. Motor at full speed.

e. Motor at full speed, ramp time expired.

f. Stop command received, motor decelerating.

g. Thermal overload has reached 90 percent to 99 percent.

h. Thermal overload at 100 percent, motor stopped.

i. Thermal overload reduced to 60 percent, motor can restart.

j. Passcode enabled.

k. Passcode disabled.

l. Thermal overload content in percentage.

2. Fault Messages:

a. System power not three phase.

b. Phase sequence incorrect.

c. Line frequency less than 25 Hz.

d. Line frequency more than 72 Hz.

e. Excessive current unbalance.

f. Operating parameters lost.

g. No current after “Run” command.

h. Undercurrent trip occurred.

i. Overcurrent trip occurred.

j. Control power too low.

k. Motor stalled during acceleration.

l. External fault.

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| **EDIT NOTE: ITEMS 3, 5 AND 6 BELOW ARE OPTIONS, DELETE IF NOT USED,** |

3. Variable Frequency Drive (VFD): Each compressor shall be equipped with a VFD providing compressor speed control as a function of the cooling load. Each VFD shall provide controlled motor acceleration and deceleration, and shall provide protection for the following conditions: electronic thermal overload, over/under current, stalled motor, input and output phase loss, high load current, and current unbalance. The drive shall be equipped with DC reactors. Compressors used in VFD controlled units must have electrically insulated, coated bearings to mitigate bearing or lubricant damage from stray electric current passage. The unit controller shall display the following data:

a. Output Frequency.

b. Output Current.

c. Output Voltage.

d. Output Power.

e. Fault Code.

4. The unit controller shall display the following alarms and faults:

a. Over Current-Hold.

b. Over Current-Unload.

c. Over Current-Alarm.

d. Overheat-Hold.

e. Overheat-Unload.

f. Overheat-Alarm.

g. Communication Fault.

5. The unit shall be equipped with factory-installed EMI filters.

6. The unit shall be equipped with ground fault protection.

D. Evaporator: The evaporator shall be of the direct expansion type with single pass on the refrigerant and water side for high efficiency counterflow heat transfer and low pressure drops, carbon steel shell, and high efficiency finned copper tubes rolled into steel tubesheets. The evaporator shall be designed, inspected, and stamped in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, requirements. It shall be heated with a thermostatically controlled electric heater to help freeze protection to -20 degrees F (-29 degrees C). The evaporator shall be insulated with ¾-inch (19 mm) closed cell polyurethane insulation

1. Chilled water flow switch to be field mounted in the chilled water line and field wired to terminals in the control panel.

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| **EDIT NOTE: ITEMS 2, 3, AND 4 BELOW ARE OPTIONS, DELETE IF NOT USED.** |

2. Double evaporator insulation for low chilled fluid applications.

3. Right-hand evaporator connections on two-compressor units, when looking at the unit control panel. Left-hand connections are standard.

4. Chilled water thermal dispersion flow switch to be factory mounted in the chilled water outlet nozzle and factory wired to terminals in the control panel to prevent unit operation with no flow.

E. Condenser:

1. The condenser coils shall have seamless copper tubes mechanically bonded into aluminum fins with factory applied protective coating or Microchannel type with factory applied protective coating.
2. The fins shall have full drawn collars to completely cover the tubes. A sub cooling coil shall be an integral part of the main condenser coil. Condenser fans shall be propeller type arranged for vertical air discharge and individually driven by direct drive fan motors. Each fan shall be housed in its own compartment to eliminate condenser air cross flow during fan cycling and shall be equipped with a heavy-gage close-meshed PVC coated fan guard. The
3. Fan motors shall be weather protected, three-phase, direct-drive, (850rpm for 60Hz) TEAO, totally enclosed air-over motors with class F insulation or better. ODP motors are not acceptable.

F. Refrigerant Circuit: The unit must have refrigerant circuits completely independent of each other with one compressor per circuit. Each circuit shall include an electronic expansion valve, liquid line shutoff valves, replaceable core filter-driers, sight glass with moisture indicator and combination discharge check and shutoff valve. Unit shall be equipped with a liquid line solenoid valve.

G. Unit casing and all structural members and rails shall be fabricated of steel and painted to meet ASTM B117 500-hour salt spray test. The control enclosure and unit panels shall be corrosion resistant painted before assembly. Unit shall have condenser coil louvers and base frame louvers.

H. Advanced microprocessor based control system:

1. Control Panel: A NEMA Type 3R weatherproof control panel shall contain the unit control system, control interlock terminals and field-power connection points. Hinged control panel access doors shall be tool-lockable. Barrier panels shall be provided to protect against accidental contact with line voltage when accessing the control system.

a. Factory-supplied power components shall include: individual contactors and circuit breakers for fan motors, circuit breakers and factory mounted transformers for each control-circuit, unit power terminal blocks for connection to remote disconnect switch, and terminals for power supply to the evaporator heater circuit. Fan motors shall have inherent overload protection and compressor motors shall have three-phase motor overload protection.

b. A 10.0 amp, 115-volt convenience outlet shall be mounted inside the control panel on all 60-Hz units.

c. Single-Point Connection to Disconnect Switch.

d. Control system starting components shall include solid-state start timer.

1. The control logic shall be designed to maximize operating efficiency and equipment life with protections for operation under unusual conditions and to provide a history of operating conditions. The system shall intelligently stage the unit to sustain leaving water temperature precision and stability while minimizing compressor cycling.

3. Equipment protection functions controlled by the microprocessor shall include high discharge pressure, loss of refrigerant, loss of water flow, freeze protection, and low refrigerant pressure.

4. User controls shall include auto/stop switch, chilled water set-point adjustment, anti-recycle timer, and digital display with water temperature and setpoint, operating temperatures and pressures, and diagnostic messages.

5. The following features and functions shall be included:

a. Durable liquid crystal display (LCD) screen type, having minimum four 20-character lines with 6 key input pad conveniently mounted on the unit controller. Default language and units of measure shall be English and I-P respectively. Messages shall be in plain English. Coded messages, LED indicators and LED displays are not acceptable.

b. Separate control section and password protection for critical parameters.

c. Remote reset of chilled water temperature using a 4-20mA signal.

d. Soft-load operation, protecting the compressor by preventing full-load operation during the initial chilled fluid pull-down period.

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e. BAS communication flexibility through modular plug-in LonTalk, Modbus, and BACnet.

f. Non-volatile program memory allowing auto-restart after a power failure.

g. Recording of safety shutdowns, including date-and-time stamp, system temperatures and pressures. A minimum of six previous occurrences shall be maintained in a revolving memory.

h. Start-to-start and stop-to-start cycle timers, providing minimum compressor off time while maximizing motor protection.

i. Lead-lag compressor staging for part-load operation by manual selection or automatically by circuit run hours.

j. Discharge pressure control through intelligent cycling of condenser fans to maximize efficiency.

k. Pro-active compressor unloading when selected operating parameters exceed design settings, such as high discharge pressure or low evaporator pressure.

l. Diagnostic monitoring of unit operation, providing a pre-alarm signal in advance of a potential shutdown, allowing time for corrective action.

I. Start-up and Training: Provide start-up and customer training for the supplied equipment. The chiller manufacturer shall provide a factory-trained representative to perform the start-up and training. After startup provide a period of instruction not to exceed 40 hours to instruct the owner's personnel in the proper operation and maintenance of the chiller.

**PART 3 – EXECUTION**

**3.01 INSTALLATION**

A. Install equipment as indicated on Drawings and in compliance with manufacturers’ recommendations, with vibration isolation, mounting pads or foundations and flexible connectors.

B. Inspect areas under which Work of this Section will be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

1. Provide for connection of electrical wiring between starter and chiller control panel.
2. Arrange piping for easy dismantling to permit tube cleaning without disturbing piping.
3. Install pressure relief system in compliance with governing regulations to vent refrigerant in case of over pressurization. Provide piping from chiller pressure relief system or rupture disc to outdoors. Size as determined per ASHRAE 15.
4. Provide emergency shutoff switch at each entrance to the chiller room to shut down all equipment in chiller room and a separate switch for emergency exhaust of the room in accordance with code provisions.
5. Coordinate electrical requirements with Division 26 prior to ordering. Report any discrepancies to the Architect for resolution.

**3.02 EQUIPMENT FOUNDATIONS**

A. Equipment foundations, where indicated, shall be of sufficient size and weight and of proper design to preclude shifting of equipment under operating conditions, or under abnormal conditions which could be imposed upon equipment. Foundations shall meet requirements of equipment manufacturer, and when required by the Architect, obtain from equipment manufacturer approval of foundation design and construction for equipment furnished. Equipment vibration shall be maintained within the limits as required by the manufacturer.

**3.03 EQUIPMENT DESIGN AND INSTALLATION**

A. Uniformity: Unless otherwise specified, equipment of same type or classification shall be product of same manufacturer.

B. Application: No equipment shall be installed in an application or in such a manner that is not recommended by the manufacturer.

C. Design: Equipment shall be designed in accordance with applicable ASME, UL or other required technical standards.

1. Pressure vessels shall be ASME Boiler and Pressure Vessel Code, Section VIII, construction and shall be so stamped.

D. Equipment Installation: Equipment installation shall be strictly in accordance with these Specifications, and installation instructions of manufacturers. Equipment installed on concrete foundations shall be grouted before piping is installed. Piping shall be installed in such a manner as not to place a strain on any equipment. Flanged joints shall be provided and adequately extended before installation. Piping shall be graded, anchored, guided and supported, without low pockets.

1. Install equipment properly aligned, leveled, and adjusted for satisfactory operation.

2. Install equipment so connecting and disconnecting of piping and accessories can be readily accomplished, and so those parts are easily accessible for inspection, service, and repair.

**3.04 NOISE AND VIBRATION**

A. Operation of Equipment: Mechanical equipment and piping systems shall operate at lowest vibration and noise levels possible.

B. Corrective Measures: If objectionable noise and vibration occur, provide necessary or required changes to furnish satisfactory results.

**3.05 MANUFACTURER’S FIELD SERVICES**

* 1. Manufacturer shall furnish a factory trained service engineer without additional charge to start the unit(s). Representatives shall provide leak testing, evacuation, dehydration, and charging of the unit(s). Chiller manufacturers shall maintain service capabilities no more than 100 miles from the jobsite.
  2. A start-up log shall be furnished by the manufacturer to document the chiller’s start-up date and shall be signed by the owner or his authorized representative prior to turn over of the chillers.
  3. Provide a minimum of eight hours of factory training at a time selected by the Owner which is to be videotaped. Provide the Owner with two copies of the videotape.

**3.06 FIELD TESTS AND INSPECTION**

A. Perform field inspections, field tests and trial operations as spe­cified in Section 23 0500: Common Work Results for HVAC. Provide labor, equipment and incidentals required for testing. The Project Inspector will witness field tests and trial operations as specified in Section 23 0500: Common Work Results for HVAC.

B. Equipment and Material: Equipment and material certified as having been successfully tested by manufacturer, in accordance with referenced Specifications and standards, will not require re-testing before installation. Equipment and material not tested at place of manufacture will be tested before or after installation, as applicable, or where required to determine compliance with Specifications and standards.

C. Start-Up and Operational Test: System shall be started up and initially operated with all components operating. During this time, various strainers shall be periodically cleaned until no further accumulation of foreign material occurs. Exercise care to ensure that minimum loss of water occurs when strainers are cleaned. Adjust safety and automatic control instruments as necessary to provide proper operation and sequence. Refer to Section 23 0500: Common Work Results for HVAC.

D. Extent of Field Tests: After installation and before Substantial Completion, Work of this Section shall be subjected to required field tests, including those specified, and listed in Section 23 0500: Common Work Results for HVAC.

E. Operation and Maintenance Data: Provide required operation and maintenance data as specified in Section 23 0500: Common Work Results for HVAC.

**3.07 PROTECTION**

A. Protect the Work of this Section until Substantial Completion.

**3.08 CLEANUP**

A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

**END OF SECTION**