



**TRANE**

## Guide Spec Summary

**Date:** 05/22/2001  
**Time:** 10:36:52 AM  
**Job Name:** EarthWise Helical Rotary Chiller – Full Spec  
**Location:** Any Town, Earth  
**Prepared by:**  
**Phone Number:**  
**Prepared for:**

### Option List

SUBMITTALS	Submittals
PERFORMANCE CERTIFICATION	Factory Witness Test
PERFORMANCE CERTIFICATION	ARI Certified Selection
ANSI/UL 1995 - REQUIREMENTS	.
WARRANTIES	Warranties
GEAR-DRIVEN COMPRESSOR WARRANTY	Gear-driven compressor warranty
MANUFACTURERS - REQUIREMENTS	Open specification
MANUFACTURERS - REQUIREMENTS	Base Bid Trane
ROTARY SCREW OR CENTRIFUGAL COMPRESSOR	Rotary screw or centrifugal compressor
SEMIHERMETIC COMPRESSOR	Semihermetic Compressor
EVAPORATOR/CONDENSER - MAXIMUM WORKING PRESSURE	150
HEAT EXCHANGER TUBES	Enhanced copper tubes
ADAPTIVE CONTROL	Adaptive Control
RESET TYPE	retrun water temperature
MOTOR STARTER - TYPE	wye-delta closed transition
STARTER TYPE	Unit mounted starter
STARTER TYPE	Solid State starter
STARTER COMPONENTS	Starter components
STARTER COMPONENTS	Starter components
DISCONNECT DEVICE	Circuit breaker
OIL PUMP - CONNECTIONS	emergency power.

SECTION 15620

CENTRIFUGAL OR ROTARY-SCREW WATER CHILLERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Chiller package.
- B. Charge of refrigerant and oil.
- C. Controls and control connections.
- D. Chilled water connections.
- E. Condenser water connections.
- F. Starters.
- G. Electrical power connections.

1.02 RELATED SECTIONS

- A. Section 15510 - Hydronic Piping.
- B. Section 15535 - Refrigeration Piping and Specialties.
- C. Section 15900 - Controls and Instrumentation.
- D. Section 16180 - Equipment Wiring Systems.

1.03 REFERENCES

- A. ANSI/ASHRAE STANDARD 15-1992 - Safety Code for Mechanical Refrigeration.
- B. ANSI/ASHRAE 90.1 - Energy Efficient Design of New Buildings.
- C. ANSI/ASME SEC VIII - Boiler and Pressure Vessel Code.
- D. ANSI/ASME B31.S-1983 ASME Code for Pressure Piping and Refrigeration Piping.

- E. ANSI/UL 1995 - Central Cooling Air Conditioners.
- F. UL 984 - Safety Standards for Hermetic Motor Compressors.
- G. ANSI/ARI 550/590-98 - Standard for Water Chilling Packages using the Vapor Compression Cycle.
- H. ARI STANDARD 575-87 - Method of Measuring Machinery Sound Within Equipment Rooms.

1.04 SUBMITTALS

- A. Submit drawings indicating components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate equipment, piping and connections, valves, strainers, and thermostatic valves required for complete system.
- B. Submit product data indicating rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.
- C. Submit manufacturer's installation instructions.

1.05 OPERATION AND MAINTENANCE DATA

- A. Include start-up instructions, operation data, maintenance data, controls, and accessories. Include trouble-shooting guide.

1.06 VERIFICATION OF CAPACITY AND EFFICIENCY

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 Choose only one of the following OR paragraphs:  
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- A. The chiller (one of each size) shall be factory performance tested under full load conditions in an ARI certified test facility. The manufacturer shall supply a certified test report to confirm performance as specified. Proper ARI certification documents for the test loop shall be made available upon request from the manufacturer for inspection. The performance test shall be conducted in accordance with ARI Standard 550/590-98 procedures and tolerances.

1. The performance test shall be run with clean tubes in accordance with ARI Standard 550/590-98 to include the following:
  - a. A downward temperature adjustment per Section A7.3 shall be made to the design leaving evaporator water temperature to adjust from the design fouling to the clean tube condition.
  - b. An upward temperature adjustment per Section A7.3 shall be made to the design entering condenser water temperature to adjust from the design fouling to the clean tube condition.
  - c. Test temperature adjustments can be verified prior to test by the Vice President, Engineering, ARI. There shall be no exceptions to conducting the performance test with clean tubes and with temperature adjustments in (1) and (2). The manufacturer shall clean tubes, if necessary, prior to test to obtain a test fouling factor of .0000 hr. sq. ft. F/BTU.
2. The factory test instrumentation shall be per ARI Standard 550/590-98, and the calibration of all instrumentation shall be traceable to the National Institute of Standards and Technology (formerly NBS).
3. The owner or his representative shall be notified 14 days in advance to witness the factory performance test. If the owner or his representative desires to witness the performance test, all travel expenses will be the owner's responsibility.
4. A certified test report of all data shall be submitted to the Contracting Officer prior to completion of the project. The factory certified test report shall be signed by an officer of the manufacturer's company. Preprinted certification will not be acceptable; certification shall be in the original.
5. The equipment will be accepted if the test

procedures and results are in conformance with ARI Standard 550/590-98. If the equipment fails to perform within allowable tolerances, the manufacturer will be allowed to make necessary revisions to his equipment and retest as required. The manufacturer shall assume all expenses incurred by the owner or his representative to witness the retest. In the event that these revisions do not achieve submitted performance, the following penalties will be imposed:

- a. CAPACITY TEST: For each ton below the allowable capacity as set forth in ARI Standard 550/590-98 of the design capacity, five hundred dollars per ton will be deducted from the contract price. Allowable capacity = (1-tolerance) x design capacity; tolerance per ARI Standard 550/590-98, Section 5.5.
- b. POWER CONSUMPTION TEST: The power consumption penalty for all load points shall be based upon the tolerances set forth in ARI Standard 550/590-98. The power consumption penalty (P.C.P.) will be calculated based upon the following formula:  
P.C.P. = [Measured KW - (Measured Tons x Allowable KW/Ton\*)] x \$1000/KW \*Allowable KW/Ton = (1 + Tolerance) x design KW/Ton; tolerance per ARI Standard 550/590-98, Section 5.5.
- c. TOTAL PERFORMANCE PENALTY: The total performance penalty will be the sum of CAPACITY PENALTY AND POWER CONSUMPTION PENALTY, times the number of typical chillers, regardless if tested.

- 6. Equipment manufacturer shall not invoice for the chillers(s) until successful completion of the performance test or acceptance of penalty deduction from the contract.

\*\*\*\*\* OR \*\*\*\*\*

- A. All proposals for chiller performance must include an ARI approved selection method. Verification of date and version of computer program selection or

catalog is available through the Vice President,  
Engineering, ARI (703) 524-8800.

1.07 REGULATORY REQUIREMENTS

- A. Conform to ARI Standard 550/590-98 for rating and certified testing of Water Chilling Packages using the Vapor Compression Cycle.
- B. Conform to ANSI/UL 1995 - Standard for Heating and Cooling Equipment, Safety Standard .
- C. Conform to ASME SECTION VIII Boiler and Pressure Vessel Code for construction and testing of unfired pressure vessels.
- D. Conform to ANSI/ASHRAE STANDARD 15-1992 safety code for mechanical refrigeration.

1.08 HANDLING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Protect units from physical damage. Leave factory shipping covers in place until installation.

1.09 WARRANTY

- A. A parts warranty for one year from date of start-up or 18 months from date of shipment, whichever comes first, shall be provided at no additional cost.
- B. A 5-year Motor/Transmission/Compressor Warranty shall be provided based upon the RPM of the compressor as follows:

Compressor RPM	Warranty Term
0-5000	1 year from start-up
5001 - 10,000	5 years from start-up
10,001 and above	5 years plus annual oil an

1.10 MAINTENANCE SERVICE

- A. Preventive maintenance procedures must be adhered to, including required periodic inspections as prescribed in the manufacturers published operation

and maintenance literature. Records of these procedures and inspections must be retained and The Trane Company reserves the right to audit or examine the records at any time.

PART 2 PRODUCTS

2.01 SUMMARY

- A. The contractor shall furnish and install rotary screw or centrifugal water chillers as shown and scheduled in the plans. The units shall be installed in accordance with this specification and produce the specified tonnage per the scheduled data in accordance with ARI Standard 550/590-98. The unit shall be ARI certified as applicable.

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Choose only one of the following OR paragraphs:  
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- B. Approved manufacturers:

- 1. Trane: MODEL RTHC
- 2. Carrier: MODELS 23XL, 19XL
- 3. York: MODELS YS, YT

\*\*\*\*\* OR \*\*\*\*\*

- B. Base bid shall be Trane Series R with approved alternate being Carrier, York. Alternates must still comply with the performance and features as called for in this specification. Job awarded on basis of specified machine. Alternate will be considered after the job is awarded.

2.02 COMPRESSOR AND MOTOR

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Reciprocating Compressors and Open Drive Motors do not equally compare to the high reliability of a semihermetic direct-drive rotary screw compressor.  
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- A. The compressor shall be rotary screw or centrifugal type. Compressor shall be semihermetic and utilize twin rotor design.

- B. Chiller should be able to unload to 25 percent of full load tonnage with constant entering condenser water temperature.
- C. The motor shall be semihermetic and either suction gas or liquid refrigerant cooled. Hot gas motor cooling is not acceptable. Open drives are not acceptable in positive pressure refrigerant systems (HCFC-22 or HFC-134a) due to the possibility of oil and refrigerant leaks at the shaft seal between the open motor and the compressor.
- D. Manufacturers with speed increasing transmissions that exceed 10,000 RPM compressor speeds shall annually inspect the gears and bearings. A report shall be forwarded to the owner each year over the first five years to confirm completion.
- E. The impellers shall be fully shrouded and made of a high strength aluminum alloy. Impellers shall be dynamically balanced and over-speed tested at 1.25 times impeller shaft speed. Rotors shall be of high grade steel alloy.

#### 2.03 EVAPORATOR AND CONDENSER

- A. The evaporator and condenser shall be built in accordance with ANSI/ASHRAE 15- Safety Code for Mechanical Refrigeration. Water boxes shall be designed for 150 psig maximum working pressure and shall be flanged and gasketed for easy removal and access to the tubes. The water boxes shall have grooved type water connections for easy field chilled water and condenser water connections.
- B. Evaporator and Condenser tubes shall be internally enhanced and externally finned to achieve maximum efficiency. The nominal tube wall thickness shall be .028 inches for both evaporator and condenser tubes.
- C. Adjustable or float type refrigerant metering devices and thermal expansion valves (TXV) shall be inspected and adjusted by the manufacturer annually for the first five years of operation to assure equivalent reliability to an electronic expansion valve (EXV) system. A written report shall be

forwarded to the owner each year over the first five years to confirm completion of calibration.

- D. Units with multi-stage compressors shall incorporate an interstage flash vessel economizer in the refrigerant cycle.
- E. Factory insulation will be 3/4" foam insulation and cover all low temperature surfaces to include the evaporator and water boxes, suction line, and motor housing.

#### 2.04 PURGE OR PUMP-OUT SYSTEM

- A. The manufacturers of low pressure chillers (HCFC-123) must provide a separate purge system that operates independently of the unit and can be operated while the machine is shut down. A purge pressure gauge, number of starts counter, and hour meter shall be included on the purge system.
- B. Units operating with refrigerant having positive pressure at 75 F (HCFC-22 and HFC-134a) shall have the capability of storing the entire refrigerant charge in the condenser or shall have a pump-out system for each machine complete with a separate transfer pump, condensing unit and tank constructed in accordance with ASME Code for unfired pressure vessels bearing the National Board stamp. Pumpout systems shall be supplied and warranted by the centrifugal machine manufacturer. Pump-outs shall comply with the following:
  - 1. Pump-out tank(s) with ASME stamp capable of holding refrigerant charge when 80 percent full at 90F.
  - 2. Separate charging connections for liquid and gas refrigerant.
  - 3. Piping and valves between pumpout and chiller to be supplied and installed by installing contractor. Contractor shall provide all piping, electrical equipment, and wiring required. Refrigerant piping shall be Type K hard-drawn copper with wrought copper fittings. Valves shall be packless type suitable for refrigerant

use.

## 2.05 CONTROLS

- A. The chiller(s) shall be controlled by a stand-alone direct digital control (DDC) system. A dedicated chiller control panel with a clear language display is to be supplied with each chiller by the chiller manufacturer. The controller shall provide chiller capacity control in response to the leaving chilled water temperature.
- B. The chiller control panel shall utilize an PID based microprocessor which will automatically take action to prevent unit shutdown due to abnormal operating conditions associated with: evaporator refrigerant temperature, high condensing pressure and motor current overload.
- C. In all of the above cases, the chiller will continue to run, in an unloaded state, and will continue to produce some chilled water in an attempt to meet the cooling load. However, if the chiller reaches the trip-out limits, the chiller controls will take the chiller off line for protection, and a manual reset is required. Once the "near trip" condition is corrected, the chiller will return to normal operation and can then produce full load cooling.
- D. The chiller control panel shall provide control of chiller operation and monitoring of chiller sensors, actuators, relays, and switches. The panel shall be a complete system for stand-alone chiller control and include controls to safely and efficiently operate the chiller.
- E. Eleven(11) or more step leaving chilled water temperature controller which cycles compressors and activates cylinder unloaders or slide valve based on PI algorithms. If manufacturer is unable to provide at least 11 steps of unloading, providing HGBP shall be required.
- F. The chiller control panel is to be provided with the following digital type pressure readouts:
  - 1. Evaporator refrigerant pressure

- 2. Condenser refrigerant pressure
- G. The front of the chiller control panel shall be capable of displaying the following in clear language as standard:
- 1. Entering and leaving evaporator water temperature
  - 2. Entering and leaving condenser water temperature
  - 3. Chilled water setpoint
  - 4. Electrical 3 phase current limit and percent RLA setpoint
  - 5. Electrical 3 phase amp draw
  - 6. Chiller operating mode
  - 7. Condenser refrigerant temperature
  - 8. Elapsed time and number-of-starts counter
  - 9. Chiller compressor run status relay
  - 10. Diagnostics with time and date stamp
  - 11. Last 20 diagnostics with time and date stamp  
\*\*\*\*\* AS OPTIONAL \*\*\*\*\*
- \*\*\*\*\*
- The following items are optional for Trane and must be specified if desired on the chiller.
- \*\*\*\*\*
- 12. External chilled water setpoint input 2-10VDC/4-20mA
  - 13. External current limit setpoint input 2-10VDC/4-20mA
  - 14. Voltage readout
  - 15. Percent RLA output 2-10VDC
- H. The chiller control panel shall provide a relay

output to start the condenser water pump and/or enable the cooling tower temperature controls.

- I. The chiller control panel shall provide an alarm relay output that shall energize whenever a fault requiring manual reset is detected by the panel.
- J. The chiller control panel shall provide a limit relay output that shall energize whenever the unit is operating in a limit mode (for extended time periods).
- K. The chiller control panel shall provide a programmable soft load to prevent the chiller from achieving full capacity during the pulldown period by imposing a ramped current limit, or a temperature pulldown rate. Either can be adjusted to limit how fast the chiller can load after an initial startup.
- L. The chiller control panel shall provide a chilled water pump output relay that closes when the chiller is given a signal to start.
- M. The chiller control panel shall provide control of leaving chilled water setpoint with a minimum variation of chiller capacity.
- N. The chiller control panel shall provide an RS-232 for printer interface to a printer. (As Optional)
- O. The chiller control panel shall provide leaving chilled water temperature reset based upon retrain water temperature
- P. The chiller shall have factory mounted and tested controls that provide dual chilled water setpoint control for ice-making application. (As Optional)
- Q. The chiller control panel shall provide input for leaving chilled water temperature setpoint based upon a 4-20ma or 0-10 VDC signal from a building automation system. (As Optional)
- R. The chiller control panel shall provide input for chiller current limit setpoint based upon a 2-10VDC or 4-20mA signal from a building automation system. [As Optional]

2.06 STARTERS (LOW VOLTAGE)

- A. The motor starter shall be a wye-delta closed transition. Motor starter shall have NEMA 1 gasketed enclosure. Enclosure shall be constructed of 12 gauge steel minimum with the exception of doors which shall be 14 gauge steel minimum.

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Choose only one of the following OR paragraphs:  
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- B. Starter shall be unit mounted with ventilating louvers.

\*\*\*\*\* OR \*\*\*\*\*

- B. Solid State Starters shall be unit mounted and have bypass contactors or have the ability to bypass the Silicone Control Rectifiers (SCR's). After bypass, motor shall run connected across-the-line by an electro-mechanical contractor(s).

- C. Motor starters shall include incoming line provisions for the number and size cables shown on the drawings. Incoming line lugs shall be aluminum mechanical type. Connection directly to the contactors is not permissible.

\*\*\*\*\*  
Choose only one of the following OR paragraphs:  
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- D. Contactors shall be sized properly to the chiller full load and locked rotor currents. Contactors shall have double break main contacts with weld resistant silver cadmium faces. Auxiliary interlocks that interface with the control panel shall be low resistance having palladium silver contacts.

\*\*\*\*\* OR \*\*\*\*\*

- D. Solid state starter SCR's shall be sized properly to the chiller full load and locked rotor currents. Auxiliary interlocks that interface with the control panel shall be low resistance having palladium silver contacts.

- E. Each motor starter shall include a control power transformer with fused primary and secondary. Current transformers of the proper size, ratio and burden capacity shall be provided to provide a signal to the control panel and optional devices. Control relays shall be provided within the motor starter to interface with the control panel.
- F. Power wiring within the starter shall be type MTW copper stranded 90 degree C. Power wire bends shall show no evidence of nicking or insulation degradation. Control wire shall be type MTW copper stranded 90 degree C 14 gauge minimum.
- G. Starter shall include an advanced motor protection system incorporating electronic three phase overloads and current transformers. This electronic motor protection system shall monitor and protect against the following conditions:
  - 1. Three phase overload protection
  - 2. Overload protection during start-up
  - 3. Phase imbalance
  - 4. Phase loss
  - 5. Phase reversal
  - 6. Low voltage
  - 7. Distribution fault protection consisting of three-phase, current sensing devices that monitor the status of the current. Distribution faults of 1-1/2 electrical cycle duration's shall be detected and the compressor motor shall be disconnected within six electrical cycles.
  - 8. Under/over voltage protection (optional)
- H. Alternately the advanced motor protection system can be furnished in the chiller control panel.
- I. The starter/control shall be designed and able to operate in temperatures up to 122 F (50 C).

- J. All field supplied wires, bus bars, and fittings shall be copper only.
- K. The following optional starter options shall be provided:
  - 1. Circuit Breaker - Starter shall contain a circuit breaker capable of breaking currents up to its interruption capacity of [\_\_\_\_] amperes. The disconnect handles, both internal and external, shall be capable of being padlocked in the off position.
  - 2. Amps (standard) and volts (optional) shall be displayed at the control panel or ammeters and voltmeters provided. Three ammeters shall be provided, one per phase. Ammeters shall be calibrated to indicate the inrush current. Three voltmeters shall be provided, each reading a phase-to-phase voltage.
- L. If solid state starter is provided a Shunt-Trip Circuit Breaker shall be provided. Starter shall contain circuit breaker with shunt trip device capable of breaking currents up to its interruption capacity of [\_\_\_\_]. Operating handle shall be located on the starter panel. The disconnect handles, both internal and external, shall be capable of being padlocked in the off position.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide for connection to electrical service. If oil pump is electric include the connection of the oil pump to emergency power.
- C. Provide Neoprene Isolation Pads to reduce vibration transmittion.
- D. On units without unit mounted starters provide for connection of electrical wiring between starter and

chiller control panel, oil pump, and purge unit.

- E. Furnish and install necessary auxiliary water piping for oil cooling units and purge condensers.
- F. Arrange piping for easy dismantling to permit tube cleaning.
- G. Provide piping from chiller relief valve to outdoors. Size as recommended by manufacturer.

### 3.02 MANUFACTURER'S FIELD SERVICES

- A. 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) as required. Chiller manufacturers shall maintain service capabilities no more than \_\_\_\_\_ miles from the jobsite.
- B. 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 commissioning the chillers.
- C. The manufacturer shall furnish an alternate price for:
  - 1. Extended parts warranty for five years.
  - 2. Extended parts and labor warranty for five years.
- D. The manufacturer shall furnish complete submittal wiring diagrams of the chiller(s) starter(s) and associated components like cooling towers, pumps, interlocks, etc. as applicable.

### 3.03 SCHEDULES

Drawing Code	CCH-1	CCH-2	CCH-3
Location:			
Manufacturer:			
Model Number:			
Cooling Capacity:			
Evaporator			

- Flow Rate:
- Entering Fluid Temp.:
- Leaving Fluid Temp.:
- Type Glycol:
- Fluid Concentration:
- Pressure Drop:
- Fouling Factor:

Condenser

- Flow Rate:
- Entering Fluid Temp.:
- Leaving Fluid Temp.:
- Pressure Drop:
- Type Glycol:
- Fluid Concentration:
- Pressure Drop:
- Fouling Factor:

Compressor

- Maximum Power Input:
- Voltage:
- Rated Load Amps:

Starter Type:

- Max. Inrush Amps:33%

PART 4 SEQUENCE OF OPERATIONS

END OF SECTION