



TRANE

Guide Spec Summary

Date: 05/22/2001
Time: 10:19:16 AM
Job Name: EarthWise Centrifugal Chiller – Full Spec
Location: Any Town, Earth
Prepared by:
Phone Number:
Prepared for:

Option List

SUBMITTALS/PRODUCT DATA	Submittals/Product Data
SELECTION REFRIGERANT	ARI Selection Method for R123, R122, R134a
CONDENSER TEMP SPECIFICATION	With Constant Entering condenser Water Temperature
LOAD STABILITY	20 Percent Load Stability
UL LABELING	.
WARRANTY	Warranty
WHOLE UNIT EXTENDED PARTS WARRANTY	Whole Unit Extended Parts Warranty
PARTS WARRANTY DURATION	2-7th years
EXTENDED REFRIGERANT WARRANTY	Extended Refrigerant Warranty
REFRIGERANT WARRANTY DURATION	2-7th years
MAINTENANCE PERIOD	one year
LIFE CYCLE COST ANALYSIS	Life Cycle Cost Analysis
APPROVED MANUFACTURERS	Approved Manufactures/Models
APPROVED MANUFACTURERS	Base Bid Trane
CENTRIFUGAL COMPRESSOR	Centrifugal Compressor
CONSTANT COND TEMP MINIMUM LOAD	10 percent
HERMETIC OR OPEN MOTORS	Hermetic Or Open Motors
MRU COOLING AHU	10
MRU COOLING TONS	10
EVAP/COND TUBE TYPES	Internally Enhanced Tubes
MIN EVAP TUBE WALL THICKNESS	0.025 inch
MIN COND TUBE WALL THICKNESS	0.28 inch
WATER BOX DESIGN PRESSURE	150 psig
MARINE WATER BOX CONNECTIONS	condenser and evaporator
INDEPENDENT PURGE OPERATION	Independent Purge Operation
REFRIGERANT MONITOR UL 2075 LISTING	Refrigerant Monitor UL 2075 Listing
STARTER TYPE	Medium Voltage Starter
MEDIUM VOLTAGE STARTER TYPE	X-Line
STARTER TYPE	Low Voltage Starter
LOW VOLTAGE STARTER SCWR	Low Voltage Starter SCWR
CIRCUIT BREAKER	Circuit Breaker
MANUFACTURER SERVICE AVAILABILITY	100

CHILLER SYSTEM CONTROL PROVIDED BY CHILLER MFG. Chiller System Control Provided
by Chiller Mfg.

SECTION 15625

CENTRIFUGAL WATER CHILLER

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. Auxiliary water connections.
- G. Starters.
- H. Electrical power connections.
- I. Heat recovery.

1.02 RELATED SECTIONS

- A. Section 15510 - Hydraulic Piping.
- B. Section 15535 - Refrigeration Piping and Specialties.
- C. Section 15950 - Controls and Instrumentation.
- D. Section 16180 - Equipment Wiring Systems.

1.03 REFERENCES

- A. ANSI/ASHRAE STANDARD 15-1994 - Safety Code for Mechanical Refrigeration.
- B. ANSI/ASHRAE 90A - Energy Conservation in New Building Design.
- C. ASME SEC VIII - Boiler and Pressure Vessel Code.

- D. ANSI/UL 465 - Central Cooling Air Conditioners.
- E. ARI STANDARD 550/590-98 - Centrifugal, Helical rotary, scroll, and reciprocating water chillers.
- F. ARI Standard 575-94 Sound
- G. AFBMA 9 - Load Ratings and Fatigue Life of Roller Bearings.
- H. ASHRAE STANDARD 34 - Number Designation and Safety Classification of Refrigerants

1.04 SUBMITTALS

- A. All proposals for chiller performance must include an ARI approved selection method for the specified refrigerants. Verification of date and version of computer program selection or catalog is available through the Vice President, Engineering, ARI (703) 524-8800.
- B. Submit drawings indicating components, assembly, dimensions, weights and loading, required clearances, and location and size of field connections. Indicate equipment, piping and connections, valves, strainers, and thermostatic valves required for complete system.
- C. Submit product data indicating rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.
- D. Submit manufacturer's installation instructions.
- E. Submit performance data indicating energy input versus cooling load output from 100 to 20 percent of full load With Constant Entering condenser Water Temperature.
- F. Submit load stability data with constant entering condenser water temperature down to 20 Percent Load Stability.
- G. Submit product data in table form indicating impeller speed (RPM), number of bearings, type of bearings, high speed impeller shaft RPM, sound level

per ARI 575-94 (dB), number of stages, number of sets of inlet guide vanes, amount of refrigerant charge (lbs.), and amount of oil required (lbs.).

1.05 OPERATION AND MAINTENANCE DATA

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

1.06 REGULATORY REQUIREMENTS

- A. Conform to ARI Standard 550/590-98 code for rating and testing of water chillers.
- B. Conform to ANSI/UL 465 for construction of centrifugal chillers .
- C. Conform to ANSI/ASME SECTION VIII Boiler and Pressure Vessel Code for construction and testing of centrifugal chillers as applicable.
- D. Conform to ANSI/ASHRAE STANDARD 15-1994 code for construction and operation of centrifugal chillers.
- E. Unit shall bear the ARI Certification Label for Water Chillers as applicable.

1.07 HANDLING AND EQUIPMENT ROOM REQUIREMENTS

- 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.
- C. Equipment Room Requirements
 - 1. Follow minimum standards for refrigeration systems as required by ANSI/ASHRAE Standard 15-1994 paying special attention to requirements for air monitoring, ventilation, self-contained breathing apparatus, for leak detection and

insuring the safety of chiller plant operating personnel.

2. Install local exhaust at relief device discharge headers and purge units. Route exhaust to the outside of the building and away from all air intakes.
3. Install a refrigerant monitor that can be calibrated for appropriate refrigerant, capable of detecting concentrations of ten ppm for low level leak detection and for insuring the safety of operators.
4. Refrigerant Monitor concentration output shall be integrated into the chiller control panel.
5. Install suitable alarms that activate well below the Acceptable Exposure Level (AEL) of the refrigerant and alert persons inside and outside of the equipment room that a leak condition exists.

1.08 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. Provide Whole Unit Parts warranty (less refrigerant) for the duration of 2-7th years.
- C. Provide Refrigerant warranty for the duration of 2-7th years.

1.09 MAINTENANCE SERVICE

- A. Furnish service and maintenance of chillers for period of one year from Date of Substantial Completion.
- B. A minimum of one inspection is required the first year with two inspections for each subsequent year.

1.10 LIFE CYCLE COST

- A. COST COMPARISON IS THE SELLING PRICE FOR EACH

CHILLER AT SPECIFIED FULL LOAD KW-TON SUBTRACT NET
PRESENT VALUE OF ENERGY COST SAVINGS EQUALS THE
COMPARITIVE COST.

1. .60 \$_____ - Savings_____ = Comparative Cost
2. .59 \$_____ - Savings_____ = Comparative Cost
3. .58 \$_____ - Savings_____ = Comparative Cost
4. .57 \$_____ - Savings_____ = Comparative Cost
5. .56 \$_____ - Savings_____ = Comparative Cost
6. .55 \$_____ - Savings_____ = Comparative Cost
7. .54 \$_____ - Savings_____ = Comparative Cost
8. .53 \$_____ - Savings_____ = Comparative Cost
9. .52 \$_____ - Savings_____ = Comparative Cost
10. .51 \$_____ - Savings_____ = Comparative Cost
11. .50 \$_____ - Savings_____ = Comparative Cost

PART 2 PRODUCTS

2.01 SUMMARY

- A. The contractor shall furnish and install centrifugal water chillers as shown and scheduled in the plans and specifications. The units shall produce the specified tonnage per the scheduled data in accordance with ARI 550/590-98. The unit shall bear the ARI certification label as applicable.

Choose only one of the following OR paragraphs:

- B. Approved Manufacturers:

1. Trane
2. Carrier
3. York

***** OR *****

- B. Base bid shall be Trane CenTraVac with approved alternate being Carrier, York. Job awarded on basis of specified machine. Alternate will be considered after the job is awarded.

2.02 COMPRESSOR AND MOTOR

- A. The compressor shall be centrifugal or screw.
- B. Low pressure refrigerant machines shall be provided when available.
- C. Chiller should be able to unload to 10 percent of design tonnage with constant entering water temperature. The machine shall be modified to include hot gas bypass if the minimum load cannot be met.
- D. Compressor assembly shall be run-tested at the factory. Vibration shall not exceed 0.15 inches per second. The test data shall be recorded and provided to the customer in report form for approval.
- E. Open motor chiller bids shall include the provision and installation of a 10 ton chilled water AHU to serve maintain the mechanical equipment room environment per ASHRAE Standard 15-1994 Section 8.13.5. This unit must be completely operational and include all wiring and ATC. In addition, the chiller size must be increased by 10 tons.

2.03 EVAPORATOR AND CONDENSER

- A. The evaporator and condenser shall be built in accordance with ANSI/ASHRAE 15-1994 Safety Code for Mechanical Refrigeration. The water piping connections shall be victaulic.
- B. Evaporator and condenser tubes shall be internally enhanced. The minimum evaporator tube wall thickness shall be 0.025 inch. The minimum condenser tube wall thickness shall be 0.28 inch

- C. Supply and return head water boxes shall be designed for a working pressure of 150 psig and shall be factory hydrostatic pressure tested at 150 percent of the design pressure. Provide drain and vent connections in water boxes.
- D. If marine water boxes are required, side connections of the condenser and evaporator shall be provided such that the water piping of both the entering and leaving sides shall not be disconnected for mechanical cleaning. The water piping connections shall be in a direction perpendicular to the shells to allow full unblocked access to the tubes.
- E. Insulation will be 3/4" insulation and cover all low temperature surfaces to include the evaporator, water boxes, and suction elbow. Economizer and motor cooling lines are insulated with 3/8" and 1/2" insulation respectively.

2.04 PURGE SYSTEM

- A. The manufacturers of low pressure machines, must provide a purge system. Acceptable purges shall include:
 - 1. York Skyguard Purge (Turboguard Purge not acceptable)
 - 2. Trane Purifier Purger
- B. The purge efficiency must meet ASHRAE Guideline 3-1996 paragraph 4.4.1.1.
- C. The purge shall be capable of operating when the chiller is idle in accordance with ASHRAE Guideline 3-1996, paragraph 4.4.1.2.

2.05 REFRIGERANT MONITOR

- A. Acceptable Models:
 - 1. Refrigerant monitors shall comply with applicable sections of ASHRAE Guideline 3-1996 and ASHRAE Standart 15-1994.
 - 2. Must be UL 2075 listed.

3. Trane TruSense Model Refrigerant Monitor is acceptable
4. Mine Safety Appliances, Model "Chillgard RT" is acceptable

2.06 CONTROLS

- A. General - The chiller shall be controlled by a stand-alone direct Digital Control (DDC) System. A dedicated chiller microprocessor control panel is to be supplied with each chiller by the chiller manufacturer. The chiller control panel shall provide control of chiller operation and monitoring of chiller modules, sensors, actuators, relays and switches and shall include controls to safely and efficiently operate the chiller.

Not to Engineer: For systems that vary the chilled water flow through the chiller evaporator control accuracy is very important to the operating reliability of the system. Acceptable temperature control under dynamic conditions must be assured.

- B. Accuracy - The chiller shall control the leaving evaporator water temperature to + or - 1 degree F of setpoint with water flow variations of ten percent (10%) per minute or less.
- C. Responsiveness - The chiller shall be able to withstand evaporator fluid flow changes as high as thirty percent (30%) without shutting down a compressor on a manual or automatic reset diagnostic.
- D. Safeties - the chiller control panel shall monitor the following safeties: start and running time between compressor/motor starts, low chilled water temperature, low evaporator refrigerant temperature or pressure, high condenser refrigerant pressure, evaporator and condenser water flow status, low oil pressure, low oil temperature, high oil temperature, high motor winding temperatures, sensor faults, and proper operation of unit controls.

1. To monitor bearing temperatures, all of the compressor and motor bearings, (including high speed, low speed, and thrust bearings) shall have factory installed separate temperature sensors installed in the bearing or the oil return lines of each bearing. If any oil temperature reaches or exceeds a set value, the chiller control panel shall shut down the chiller, display the diagnostic, and light the front panel alarm LED.
 2. The chiller control panel shall incorporate advanced motor protection to safeguard the motor throughout the starting and running cycles from the adverse affects of:
 - a. Phase loss
 - b. Phase imbalance
 - c. Phase reversal
 - d. Under voltage
 - e. motor overload
 - f. motor overload protection incorrectly set
 - g. momentary power loss protection with auto restart consisting of three-phase current sensing devices that monitor the status of the current
 - h. starter contactor fault protection
 - i. starter transition failure
 3. Alternately, the advanced motor protection system can be furnished in the starter.
- E. The chiller control panel shall be capable of displaying system data in English or Metric units.
- F. The chiller control panel is to be provided with a starts counter and running time counter.
- G. The front of the chiller control panel shall display the following in clear language, without the use of codes, look-up tables, or gauges:
1. Entering and leaving evaporator water temperatures
 2. Entering and leaving condenser water temperatures

3. Compressor Motor Winding Temperature 1,2,3
 4. Saturated evaporator and condenser refrigerant temperatures
 5. Evaporator and condenser refrigerant pressure
 6. Oil Temperature
 7. Oil Tank pressure
 8. Oil pump discharge pressure
 9. Differential oil pressure
 10. Compressor motor starts and running hours
 11. Compressor motor current, by phase
 12. Compressor motor percent RLA
 13. Purge compressor suction temperature
 14. Purge pumpout rate
 15. Purge pumpout time last or current cycle
 16. Total Purge pumpout time
 17. Total Purge run time
 18. Chilled water set point and set point source
 19. Electrical current limit set point and set point source
 20. Current chiller operating mode
 21. Equipment room refrigerant monitor ppm levels
 22. Chiller diagnostics including a time and date of occurrence (minimum 20 historical diagnostics stored in non-volatile chiller panel memory)
- H. The chiller control panel shall provide evaporator freeze protection and low limit control to avoid low

evaporator refrigerant temperature trip-outs during critical periods of chiller operation. The control shall take action in response to the actual value of the evaporator refrigerant temperature. A diagnostic message shall be automatically displayed at the front panel whenever this control is in effect, and if the condition exists for more than 20 minutes, a limit warning alarm relay shall energize.

- I. The chiller control panel shall provide individual relay outputs to start/stop the evaporator and condenser water pumps. The condenser water pump relay output can be used to enable the cooling tower temperature controls.
- J. The chiller control panel shall provide condenser limit control to include a pressure transducer and interconnecting piping and wiring. This control shall be used to avoid high condenser refrigerant pressure tripouts. The control shall take action in response to the condenser refrigerant pressure. A diagnostic message shall be automatically displayed at the front panel whenever this control is in effect, and if the condition exists for more than 20 minutes, a limit warning alarm relay shall energize.
- K. The chiller control panel shall provide short cycling protection.
- L. The above specified items are required as a minimum. The contractor may select which items are covered by the equipment supplier and which are covered by the controls contractor. A combined submittal will be required where the contractor will identify which items are covered by each supplier.

Choose only one of the following OR paragraphs:

2.07 STARTER (MEDIUM VOLTAGE)

- A. Motor starter shall be a X-Line type.
- B. Isolating switch and contactor assemblies, including current limiting fuses shall be of the component-to-component design without any interconnecting cables or flexible shunts. They shall be easily removed

from the front of the enclosure. Line and load cable terminations shall be completely accessible from the front.

- C. The isolating switch shall be an externally operated manual three pole draw-out, such that in the open position it completely grounds and isolates the starter from the line connectors with a mechanically driven isolating shutter leaving no exposed high voltage. Integral mechanical interlocks shall prevent entry into the high voltage areas while the starter is energized and shall block accidental opening or closing of the isolating switch when the door is open or contactor is closed. The isolating switch handle shall have provision for three padlocks.
- D. Current limiting power fuses shall be of the self-protecting type with visible fuse condition indicators, and with special time/current characteristics for motor service allowing proper coordination with the contactor and overload protection for maximum motor protection. The power fuses shall be vertically mounted permitting easy inspection and replacement without starter disassembly.
- E. The vacuum contactor shall be slide out, with single break high pressure type main contacts with weld-resistant alloy contact faces. For vacuum contactors the contact wear shall be easily checked with the use of a feeler gauge and the bottle gap shall be adjustable. A built-in test circuit shall be included to permit checking of the starter control and pilot circuit with the high voltage de-energized and isolated, with the contactor in its normal position. In the test mode, the control circuit shall be capable of being energized through a polarized plug connector from an external 115 volt supply.
- F. The low voltage control shall be isolated by a barrier from the high voltage area, and provided with a separate low voltage access door. The low voltage panel shall be accessible by sliding the unit out. Control wiring shall be a minimum of # 16 AWG stranded, 90 degrees C MTW or equivalent.

- G. Enclosures for the high voltage starters shall meet ANSI/NEMA ICS-6 enclosure standards and shall be NEMA 1, unless otherwise noted, completely front accessible and allowing free-standing against a wall or back-to-back mounting. Where multiple starter/structure installations are required, horizontal power bus should be used to connect between structures located on the top. Vertical bus to connect tiered starter units shall be insulated and integral to the enclosure.
- H. Starter shall include an advanced motor protection system incorporating electronic three phase overloads and current transformers of the proper size, ratio, and burden capacity. 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 with auto restart consisting of three-phase, current sensing devices that monitor the status of the current. Distribution faults of 1-1/2 electrical cycle duration shall be detected and the compressor motor shall be disconnected within six electrical cycles.
- I. Alternately, the advanced motor protection system can be furnished in the chiller control panel.
- J. The starter shall be able to operate in temperatures up to 120 degrees F.
- K. All wires, bus bars and fittings shall be copper only.

L. Each motor starter shall include a 3 KVA control power transformer with a fused primary and secondary.

M. The following optional starter options shall be provided:

Available on Control Panel

1. Ammeter - A digital display shall be provided with a 1% accuracy. This display shall be dedicated to current readings only. An IQ Data device or equal is acceptable.

Available on Control Panel

2. Voltmeters - A digital display shall be provided with a 1% accuracy. This display shall be dedicated to voltage readings only. An IQ Data device or equal is acceptable.

3. Power Factor Correction Capacitors shall be provided to correct to 93.5-95.5 percent at full load conditions.

***** OR *****

2.07 STARTER - STAR DELTA (LOW VOLTAGE)

A. Motor starter shall be a Star-Delta Closed Transition and shall have a NEMA 1A gasketed enclosure.

B. The starter enclosure shall have a withstand rating of [_____]. If the starter enclosure does not have this withstand rating, then a device shall be provided upstream of the starter to limit the fault current at the starter to be equal or less than the withstand rating of the starter.

C. Motor starters shall include incoming line provisions for the number and size cables shown on the drawings. Incoming line lugs shall be copper mechanical type.

- D. Contactors shall be sized properly to the chiller full load currents.
- E. Each motor starter shall include a 3 KVA control power transformer with fused primary and secondary. Control relays shall be provided within the motor starter to interface with the control panel.
- F. 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. Phase loss
 - 2. Phase imbalance
 - 3. Phase reversal
 - 4. Under voltage
 - 5. Motor overload
 - 6. Motor overload protection incorrectly set
 - 7. Momentary power loss protection with auto restart consisting of three-phase current sensing devices that monitor the status of the current.
 - 8. Starter contactor fault protection
 - 9. Starter transition failure
 - 10. Distribution fault protection.
- G. Alternately the advanced motor protection system can be furnished in the chiller control panel.
- H. The starter shall be able to operate in temperatures up to 120 degrees F.
- I. All field supplied wires, bus bars, and fittings shall be copper only.

J. The following optional starter features shall be provided:

1. Circuit Breaker - Starter shall contain a circuit breaker capable of breaking currents up to its interruption capacity of [_____] amperes. Operating handle and trip indicator shall be located on the door. This handle shall be capable of being padlocked.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide for connection to electrical service. Include for connection of oil pump.
- C. Provide for connection of electrical wiring between starter and chiller control panel, oil pump, and purge unit.
- D. Furnish and install necessary auxiliary water piping for oil cooling units and purge condensers if required.
- E. Arrange piping for easy dismantling to permit tube cleaning.
- F. Provide piping from chiller relief device 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). Chiller manufacturers shall maintain service capabilities no more than 100 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 centrifugal chiller(s) starter(s) and associated components like cooling towers, pumps, interlocks, etc. as applicable.

3.03 SCHEDULE

Drawing Code	CH-1	CH-2	CH-3
Cooling Capacity (Tons			
Compressor			
- Maximum Power Input			
- Voltage:			
- Rated Load Amps:			
Starter Type:			
- Max. Inrush Amps:			
Evaporator			
- Design Flow Rate:			
- Design Pressure Drop			
- Maximum Flow Rate:			
- Minimum Flow Rate:			
- Entering Fluid Temp:			
- Leaving Fluid Temp:			
- Fluid Type (H2O/Glyc			
- Fluid Concentration:			
- Fouling Factor:			
Condenser			
- Design Flow Rate:			
- Design Pressure Drop			
- Entering Fluid Temp:			
- Leaving Fluid Temp:			
- Fouling Factor:			

PART 4 SEQUENCE OF OPERATIONS

4.01 GENERAL

A. Control of the complete chiller system shall be the

responsibility of the chiller manufacturer.

B. The individual chiller control panel(s) shall provide the necessary inputs and interlocks through hardwired or communicated signals to allow the chiller plant control system to safely and efficiently control the complete chiller plant. This shall include as a minimum:

1. Chiller Enable/Disable
2. Leaving Fluid Setpoint
3. Compressor Current Limit
4. Evaporator Pump Enable/Disable
5. Evaporator Flow Proof Interlock
6. Condenser Pump Enable/Disable
7. Condenser Flow Proof Interlock
8. Manual Reset Alarm Output
9. Automatic Reset Alarm Output

END OF SECTION