Series R™ Helical Rotary Liquid Chillers

Model RTHD
175-450 Tons (60 Hz)
125-450 Tons (50 Hz)

Built for Industrial and Commercial Applications

June 2006

RLC-PRC020-EN

Introduction

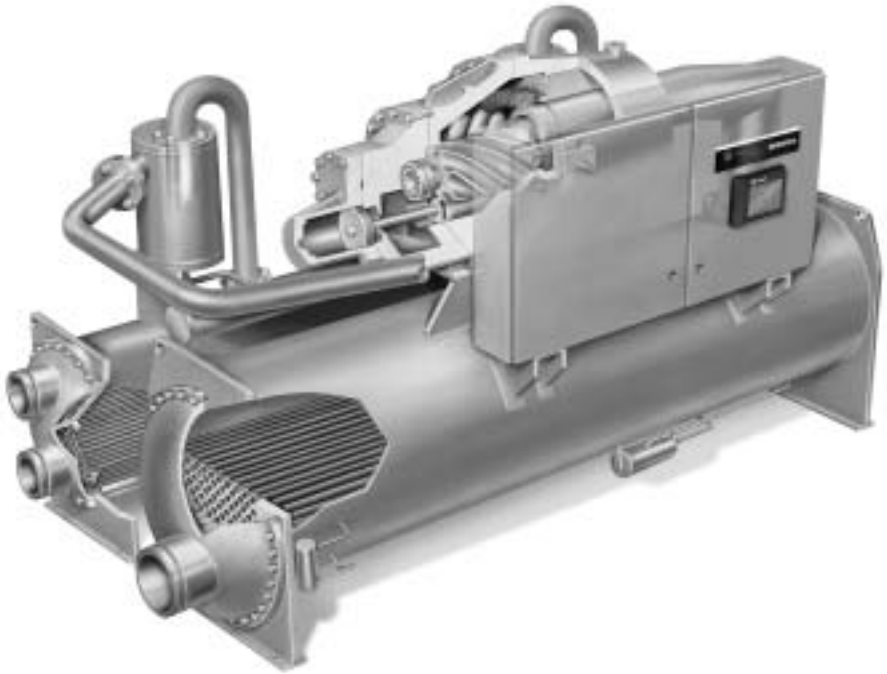
To meet a wide range of applications in the medium-tonnage, water-cooled market, Trane is proud to introduce the model RTHD helical rotary liquid chiller. The introduction of this next-generation chiller an exciting step forward in application versatility, ease of installation, control precision, reliability, energy-efficiency, and operational cost-effectiveness. The new RTHD chiller is designed to deliver proven Series R performance, plus all the benefits of an advanced heat transfer design and a low-speed, direct-drive compressor.

Important Design Advances and New Features

Major design advances include:

- Higher full-load energy efficiency reduces both operating and life-cycle costs.
- CH530 controls enable:
  - scrolling access to inputs and operating information via the LCD touch-screen display;
  - freedom from interoperability concerns with LonMark communications;
  - job-specific communication options that allow greater reporting flexibility.
- Improved startup temperature capabilities and reduced sensitivity to condenser water temperatures alleviate the most common startup concerns.
- Removed Liquid Vapor Separator, providing lighter unit weight and simplified refrigerant piping, for less expensive handling, separation, and installation.

The industrial-grade design of the Series R helical rotary chiller is ideal for both industrial and commercial markets, in applications such as office buildings, hospitals, schools, retail buildings, and industrial facilities. The linear unloading compressor, wide operating temperature range, advanced controls, electronic expansion valve, short anti-recycle timers, and industry-leading efficiencies mean that this latest Trane Series R chiller is the perfect choice for tight temperature control in almost any application temperatures, and under widely varying loads.



Contents

Features and Benefits

Application Versatility and High Performance

- Screw compressor technology and the electronic expansion valve provide reliable performance in an expanded range of operating temperatures.
- Tight water temperature control extends to operation of multiple chillers in parallel or series configurations, offering further system design flexibility for maximum efficiency.
- Advanced design enables chilled water temperature control to +/- 0.5°F (.28°C) for flow changes up to 10 percent per minute, plus handling of flow changes up to 30 percent per minute for comfort cooling.
- Two-minute stop-to-start and five-minute start-to-start anti-recycle timer allows tight chilled water temperature control in constant or transient low-load applications.
- LonMark communications capability provides excellent, trouble-free interoperability.
- Generic Building Automation System points are available for easy access to operational information.
- Extensive information on professional design selection and layout is available in a simple, highly readable electronic format.
- Standard model RTHD configurations are in stock and available for immediate delivery, and Trane offers the fastest ship cycles in the industry for built-to-order units.
- **Industrial / Low Temperature Process Cooling** – Excellent operating temperature range and precise control capabilities enable tight control with single chiller or series configuration.
- **Ice/Thermal Storage** – Specifiers and operators benefit from dual setpoint control and industry-leading temperature, efficiency, and control capabilities, plus outstanding support through partnership with Calmac, a strong Trane partner providing proven installation examples, templates, and references that minimize design time and energy costs.
- **Heat Recovery** – Maximum condenser temperature exceeds those of previous technologies, providing hot water and tight control that minimizes operating costs for the chilled water plant and boiler/hot water heater, and consistent dehumidification.

Simple, Economical Installation

- Compact size makes the model RTHD well suited for the retrofit and replacement market.
- All units fit through standard double-width doors.
- Bolt-together construction makes for fast, easy unit disassembly.
- Small RTHD footprint saves valuable equipment room space and alleviates access concerns for most retrofit jobs.
- Lightweight design simplifies rigging requirements, further reducing installation time requirements and costs.
- Full factory refrigerant or nitrogen and oil charges reduce required field labor, materials, and installation cost.
- Only evaporator and condenser water piping is required; no starter water cooling (with its associated safety concerns) or field piping is necessary.
- Oil cooler and purge system connections have been eliminated.
- Simple power connection simplifies overall installation.
- Standard unit-mounted starter for Wye-Delta and Solid State eliminates additional jobsite installation considerations and labor requirements.
- Trane has conducted extensive factory testing, and also offers options for in-person and/or documented system performance verification.
- CH530 controls easily interface with Tracer Summit™ building automation systems through single twisted-pair wire.

Applications in this catalog specifically excluded from the ARI certification program are:

- Low temperature applications, including ice storage
- Glycol
- 50Hz units below 200 nominal tons

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THE HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.™ 1866 ISO 9000 REGISTRATION

Pueblo Business Unit

ARI PERFORMANCE CERTIFIED™ ARI Standard 550/590 Water Cooled Chillers

Features and Benefits

State-of-the-Art, Precision Control

- Microprocessor-based CH530 controls monitor and maintain optimal operation of the chiller and its associated sensors, actuators, relays, and switches, all of which are factory-assembled and extensively tested.
- Easy interface with computers hosting Tracer Summit™ building automation/ energy management systems allows the operator to efficiently optimize comfort system performance and minimize operating costs.
- PID (proportional integral derivative) control strategy ensures stable, efficient chilled water temperature control, maintaining +/- 1°F (0.56°C) control by proactively reacting to instantaneous load changes of up to 50 percent.
- Adaptive Control™ attempts to maintain chiller operation under adverse conditions, when many other chillers might simply shut down.
- Easy-to-use operator interface displays all operating and safety messages, with complete diagnostics information, on a highly readable panel with a scrolling touch-screen display.
- The RTHD features a complete range of chiller safety controls.
- Over 120 diagnostic and operating points are available, with standard displays including chiller current draw, condenser pressure, and evaporator pressure.

Reliability and Ease of Maintenance

- Direct drive, low-speed compressor – a simple design with only three moving parts – provides maximum efficiency, high reliability, and low maintenance requirements.
- Electronic expansion valve, with fewer moving parts than alternative valve designs, offers highly reliable operation.
- Suction gas-cooled motor stays uniformly cool at lower temperatures for longer motor life.
- The Trane helical rotary compressor is a proven design resulting from years of research and thousands of test hours, including extensive testing under extraordinarily severe operating conditions.
- Trane is the world's largest manufacturer of large helical rotary compressors, with tens of thousands of commercial and industrial installations worldwide demonstrating a reliability rate of greater than 99 percent in the first year of operation.

Operating and Life Cycle Cost-Effectiveness

- Electronic expansion valve enables exceptionally tight temperature control and extremely low superheat, resulting in more efficient full-load and part-load operation than previously available.
- Precise compressor rotor tip clearance ensures optimal efficiency.
- Condenser and evaporator tubes use the latest heat transfer technology for increased efficiency.
- The RTHD includes standard electrical demand limiting.
- Chilled water reset based on return water temperature is standard.
- High compressor lift capabilities and tight chilled water temperature control allow highly efficient system design with minimal operational concerns.

Design capabilities include:

- variable primary flow;
- series chiller arrangements for evaporator and/or condenser;
- low evaporator and condenser flow.

Options

Insulation
All low temperature surfaces are covered with factory installed 3/4 inch (19.05 mm) Armaflex II or equal (k=0.28) insulation, including the evaporator and water boxes, suction line, and motor housing. 3/8" foam insulation is used on the liquid level sensor and gas pump assembly, including piping.

Low-Temperature Evaporator
Addition of an oil cooler to the oil circuit enables evaporator operation down to minimum leaving water temperature of 10°F (-12.2°C).

High-Temperature Condenser
Addition of an oil cooler to the oil circuit enables condenser operation up to maximum leaving water temperature of 114°F (45.6°C).

Smooth-Bore Condenser Tubes
Smooth-bore copper or premium cupro-nickel condenser tubes, 3/4" (19.05 mm) in diameter with .035" (0.889 mm) wall thickness, are available for high fouling water applications.

Refrigerant Isolation Valves
Factory-installed condenser inlet and outlet refrigerant valves allow isolation of the full refrigerant charge in the condenser while servicing the chiller.

Marine Water Boxes
Addition of marine water boxes for the condenser allows tube cleaning without water pipe interference.

300 psig Evaporator and Condenser Water Boxes
Water boxes are designed for 300 psig maximum waterside working pressure, and grooved pipe water connections are provided for ease of installation.

2-Way Condenser Water Regulating Valve
For water regulation, a field-installed, 2-way butterfly-type (lug-style) valve, with integral electrical operator and factory-mounted valve actuator, is available. The single-phase, reversible motor can be factory-wired for 115 VAC, 60 Hz or 220 VAC, 50 Hz; the 2-way valve is field-wired and controlled by the chiller regulating valve control output; valves are available in 6" and 8" (152.4 and 203.2 mm) sizes.

Nitrogen Charge
Unit is shipped with a nitrogen holding charge in lieu of refrigerant.

Seal Kit for Reassembly
Ideal for situations when the bolt-together construction of the RTHD will be separated for installation, this seal kit provides replacement gaskets and rings for reassembly.

Solid State Starter
Solid State Starter is unit-mounted with a NEMA 1 gasketed enclosure. To extend starter life, contactors bypass current from the silicon control rectifiers (SCRs) after startup.

Under/Over-Voltage Protection
Unit receives protection against variations in voltage (current lag and spike protection is standard).

Performance and Witness Tests
ARI-certified RTHD Performance and Witness Tests are available, based on requested operating points, to certify chiller performance before delivery.

Main Power Disconnect Options:

Non-fused Disconnect
A UL-approved non-fused molded case disconnect switch, factory pre-wired with terminal block power connections and equipped with a lockable external operator handle, is available to disconnect the chiller from main power.

Standard Interrupting Capacity Circuit Breaker
A UL-approved **standard interrupting** molded case capacity circuit breaker, factory pre-wired with terminal block power connections and equipped with a lockable external operator handle, is available to disconnect the chiller from main power.

High Interrupting Capacity Circuit Breaker
A UL-approved **high interrupting** molded case capacity circuit breaker, factory pre-wired with terminal block power connections and equipped with a lockable external operator handle, is available to disconnect the chiller from main power.

Ground Fault Circuit Breaker
A UL-approved standard interrupting molded case capacity circuit breaker with **ground fault interrupting capability**, factory pre-wired with terminal block connections and equipped with a lockable external operator handle, is available to disconnect the chiller from main power.

Options

Control Options:

Tracer Summit Communications
Link to factory-installed, tested communication board, via single twisted-pair wiring, adds Tracer Summit communications to the system.

LonTalk LCI-C Interface
LonTalk (LCI-C) communications capabilities are available, with communication link via single twisted-pair wiring to factory-installed, tested communication board.

External Chilled Water Setpoint
External Chilled Water Setpoint is communicated to a factory-installed, tested communication board through a 2-10Vdc or 4-20mA signal.

External Current Limiting
External Current Limit Setpoint is communicated to a factory-installed, tested communication board through a 2-10Vdc or 4-20mA signal.

External Base Loading
External Base Loading is communicated to a factory-installed and tested communication board through a 2-10Vdc or 4-20mA signal.

Ice Making Control
Controls and safeties allow operation with brine temperatures down to 20°F (-6.7°C) , and dual setpoints enable both ice making and daytime comfort cooling.

Programmable Relays
Default-set, factory-installed, programmable relays allow the operator to select four relay outputs from a list of eight. Available relays are: Alarm-Latching, Alarm-Auto Reset, General Alarm, Warning, Chiller Limit Mode, Compressor Running, Head Pressure Relief Request, and Tracer Control.

Chilled Water Reset – Outdoor Air Temperature
Controls, sensors, and safeties allow reset of chilled water temperature, based on temperature signal, during periods of low outdoor air temperature (chilled water reset based on return chilled water temperature is standard).

Condenser-Regulating Valve Control
Chiller applies a Proportional Integrative Control (PID) algorithm to control water regulating valve via 0-10Vdc signal.

Percent of Full Run Load Amps Output
Control system indicates the active chiller percent of full run load amps, based on a 0-10Vdc signal.

Condenser Pressure Output
Control system indicates chiller differential pressure or condenser pressure, based on a 0-10Vdc signal.

Refrigerant Monitor Input
Control system indicates refrigerant monitor status of 0-100 or 0-1000 ppm (user selectable), based on a 2-10Vdc / 4-20 mA signal.

Controls

LCD Touch-Screen Display with Multi-Language Support

The standard DynaView display provided with the CH530 control panel features an LCD touch-screen, allowing access to all operational inputs and outputs. This display supports eleven languages: English, Chinese, Dutch, French, German, Italian, Japanese, Korean, Portugese, Spanish and Thai.

Additional Display Features Include:

- LCD touch-screen with LED backlighting, for scrolling access to input and output operating information
- Weather-proof enclosure for reliable operation in non-standard indoor environments
- Spin value buttons to allow continuously variable setpoints when applicable
- Radio and action buttons for easy, one-time actions and settings
- Single-screen, folder/tab-style display of all available information on individual components (evaporator, condenser, compressor, etc.)
- Automatic and immediate stop capabilities for standard or immediate manual shutdown
- Manual override indication
- Password entry/lockout system to enable or disable display
- Fast, easy access to available chiller data in tabbed format, including:
  - — Modes of operation, including normal cooling and icemaking
  - — Water temperatures and setpoints
  - — Loading and limiting status and setpoints
  - — Average line current
  - — Outdoor air temperature
  - — Start/stop differential timers
  - — Auto/Manual mode for EXV, slide valve, and head pressure control
  - — Pump status and override
  - — Chilled water reset, start point, ratio, and outdoor start point
  - — External setpoints, including:
    - chilled water
    - current limit
    - ice building
    - base loading
  - — Display specifics, including:
    - date
    - format
    - time
    - display lockout
    - display units
    - language setting
    - Reports, listed on a single tabbed screen for easy access, including:
      - ASHRAE, containing all guideline 3 report information
      - Evaporator
      - Condenser
      - Compressor
  - — Evaporator, condenser, and compressor reports containing all operational information on individual components, including:
    - Water and air temperatures
    - Refrigerant levels, temperatures, and approach
    - Oil pressure
    - Flow switch status
    - EXV position
    - Head pressure control command
    - Compressor starts and run-time
    - Line phase percent RLA, amps, and volts
  - — Alarm and diagnostic information, including:
    - Flashing alarms with touch-screen button for immediate address of alarm condition
    - Scrollable list of last ten active diagnostics
    - Specific information on applicable diagnostic from list of over one-hundred
    - Automatic or manual resetting diagnostic types

Controls

Trane Chiller Plant Automation

Trane's depth of experience in chillers and controls makes us a well-qualified choice for automation of chiller plants using air-cooled Series R® chillers®. The chiller plant control capabilities of the Trane Tracer Summit® building automation system are unequaled in the industry. Our chiller plant automation software is fully pre-engineered and tested. It is a standard software application, not custom programming which can prove to be difficult to support, maintain, and modify.

Energy Efficiency
Trane chiller plant automation intelligently sequences starting of chillers to optimize the overall chiller plant energy efficiency. Individual chillers are designated to operate as base, peak, or swing based on capacity and efficiency. Sophisticated software automatically determines which chiller to run in response to current conditions. The software also automatically rotates individual chiller operation to equalize runtime and wear between chillers.

Trane chiller plant automation enables unique energy-saving strategies. An example is controlling pumps, and chillers from the perspective of overall system energy consumption. The software intelligently evaluates and selects the lowest energy consumption alternative.

Regulatory Compliance Documentation
Comprehensive documentation of refrigerant management practices is now a fact of life. Trane chiller plant automation generates the reports mandated in ASHRAE Guideline 3.

Keeping Operators Informed
A crucial part of efficiently running a chiller plant is assuring that the operations staff is instantly aware of what is happening in the plant. Graphics showing schematics of chillers, piping, pumps, and towers clearly depict the chiller plant system, enabling building operators to easily monitor overall conditions. Status screens display both current conditions and upcoming automated control actions to add or subtract chiller capacity. Series R™ and other chillers can be monitored and controlled from a remote location.

Tracer Summit features standard report templates listing key operating data for troubleshooting and verifying performance. Reports for each type of Trane chiller and three and six-chiller systems are also standard. Detailed reports showing chiller runtimes aid in planning for preventative maintenance.

Swift Emergency Response
We understand the importance of maintaining chilled water production while protecting your chillers from costly damage. If no water flow is detected to a chiller's piping, the start sequence is aborted to protect the chiller. The next chiller in the sequence is immediately started to maintain cooling.

In the event of a problem, the operator receives an alarm notification and diagnostic message to aid in quick and accurate troubleshooting. A snapshot report showing system status just prior to an emergency shutdown helps operators determine the cause. If emergency conditions justify an immediate manual shutdown, the operator can override the automatic control.

Integrated Comfort™ Capabilities
When integrated with a Tracer Summit building management system performing building control, Trane chiller plant automation coordinates with Tracer Summit applications to optimize the total building operation. With this system option, the full breadth of Trane's HVAC and controls experience are applied to offer solutions to many facility issues. If your project calls for an interface to other systems, Tracer Summit can share data via BACnet™, the ASHRAE open systems protocol.

LonTalk Chiller Controls

LonTalk is a communications protocol developed by the Echelon Corporation. The LonMark association develops control profiles using the LonTalk communication protocol. LonTalk is a unit level communications protocol, unlike BACNet used at the system level.

LonTalk Communications Interface for Chillers (LCI-C) provides a generic automation system with the LonMark chiller profile inputs/outputs. In addition to the standard points, Trane provides other commonly used network output variables for greater interoperability with any automation system. The complete reference list of Trane LonTalk points is available on the LonMark website. Trane controls or another vendor's system can use the predefined list of points with ease to give the operator a complete picture of how the system is running.

Hardwire Points

Remote devices wired from the control panel are another reliable method of providing auxiliary control to a building automation system. Inputs and outputs can be communicated via a typical 4-20 mA electrical signal (or an equivalent Vdc signal of 0-10 or 2-10) or by utilizing contact closures.

- External Chilled Water Setpoint
- External Current Limit Setpoint
- Condenser-Regulating Valve Control
- Percent of Full Run Load Amps Output
- Condenser Pressure Output
- Refrigerant Monitor Input
- Programmable Relays
  Allows the selection of 4 relay outputs from a list of eight different default settings: Alarm-Latching, Alarm-Auto Reset, General Alarm, Warning, Chiller Limit Mode, Compressor Running, Head Pressure Relief Request, and Tracer Control. These contact closures may be used to trigger jobsite supplied audible or visual alarms
- Ice Making Control
  Provides an interface with ice making control system and safeties, enabling both ice making and daytime comfort cooling
- Chilled Water Temperature Reset
  Supplies controls, sensors and safeties to reset the chilled water temperature setpoint based upon return water temperature (standard) or outdoor air temperature (optional)

Application Considerations

Condenser Water Temperatures
Reduced sensitivity to condenser water startup temperatures is one major enhancement in the newest-generation water-cooled Series R chiller. With the model RTHD chiller, a condenser water control method is necessary only if the unit starts with entering water temperatures below 55°F (12.8°C), or between 45°F (7.2°C) and 55°F (12.8°C), when a temperature increase of 1°F (0.56°C) per minute to 55°F (12.8°) is not possible.

When the application requires startup temperatures below the prescribed minimums, a variety of options are available. To control a 2-way or 3-way valve, Trane offers a Condenser Regulating Valve Control option for the CH530 controls. This option enables the CH530 controls to send a signal for opening and closing the valve as necessary to maintain chiller differential pressure. The 2-way valves are available as a ship-with option. Tower bypass is also a valid control method if the chiller temperature requirements can be maintained.

Trane Series R chillers start and operate successfully and reliably over a range of load conditions with controlled entering condenser water temperature. Reducing the condenser water temperature is an effective method of lowering chiller power input required, but the ideal temperature for optimizing total system power consumption will depend on the overall system dynamics. From a system perspective, some improvements in chiller efficiency may be offset by the increased tower fan and pumping costs required to achieve the lower tower temperatures. *Contact your local Trane systems solution provider for more information on optimizing system performance.*

The minimum acceptable refrigerant pressure differential between condenser and evaporator is 23 psid. The chiller control system will attempt to obtain and maintain this differential at startup, but for continuous operation a design should maintain a 25°F (13.9°C) differential from evaporator leaving water temperature to condenser leaving water temperature.

Variable Evaporator Flow and Short Evaporator Water Loops
Variable evaporator flow is an energy-saving design strategy which has quickly gained acceptance as advances in chiller and controls technology have made it possible. With its linear unloading compressor design and advanced CH530 controls, the RTHD has excellent capability to maintain leaving water temperature control within +/-0.5°F (0.28°C) , even for systems with variable evaporator flow and small chilled water volumes.

Some basic rules should be followed whenever using these system design and operational savings methods with the RTHD. The proper location of the chilled water temperature control sensor is in the supply (outlet) water. This location allows the building to act as a buffer, and it assures a slowly changing return water temperature. If there is insufficient water volume in the system to provide an adequate buffer, temperature control can be lost, resulting in erratic system operation and excessive compressor cycling. To ensure consistent operation and tight temperature control, the chilled water loop should be at least two minutes. If this recommendation cannot be followed, and tight leaving water temperature control is necessary, a storage tank or larger header pipe should be installed to increase the volume of water in the system.

For variable primary flow applications, the rate of chilled water flow change should not exceed 10 percent of design per minute to maintain +/-0.5°F (0.28°C) leaving evaporator temperature control. For applications in which system energy savings is most important and tight temperature control is classified as +/-2°F (1.1°C), up to 30 percent changes in flow per minute are possible. Flow rates should be maintained between the minimum and maximum allowed for any particular chiller configuration.

Application Considerations

Series Chiller Arrangements
Another energy-saving strategy is to design the system around chillers arranged in series, on the evaporator, condenser, or both. The actual savings possible with such strategies depends on the application dynamics and should be researched by consulting your Trane Systems Solutions Representative and applying the Trane System Analyzer program. It is possible to operate a pair of chillers more efficiently in a series chiller arrangement than in a parallel arrangement. It is also possible to achieve higher entering-to-leaving chiller differentials, which may, in turn, provide the opportunity for lower chilled water design temperature, lower design flow, and resulting installation and operational cost savings. The Trane screw compressor also has excellent capabilities for "lift," which affords an opportunity for savings on the evaporator and condenser water loops.

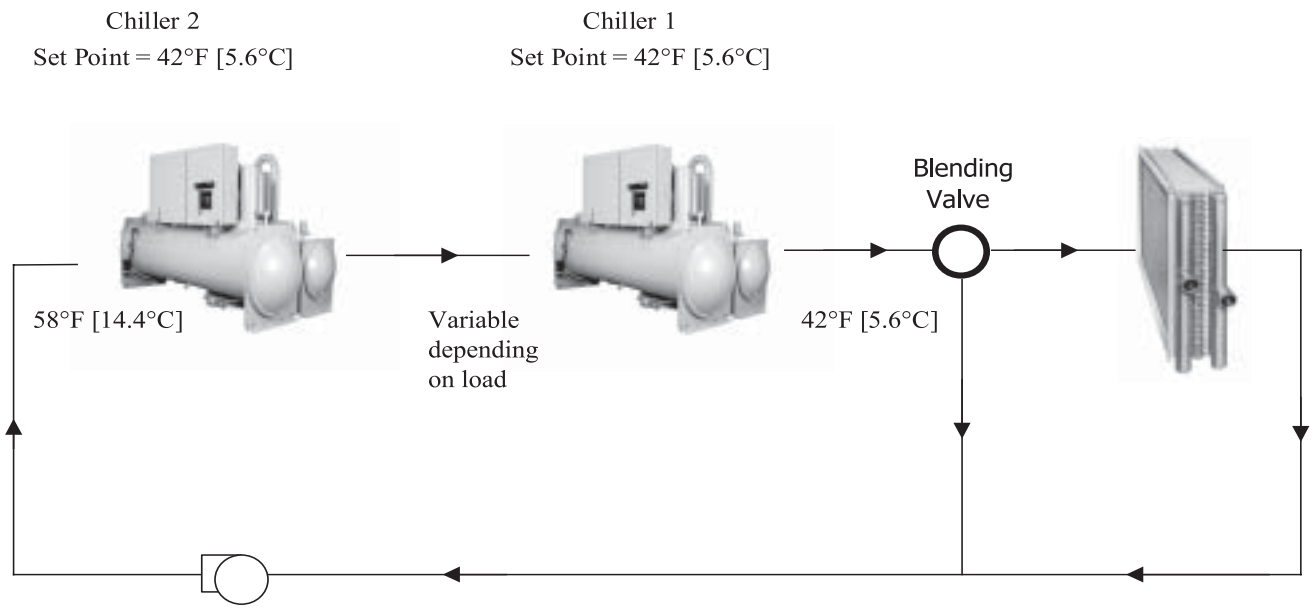
Like series arrangements on the evaporator, series arrangements on the condenser may enable savings. This approach may allow reductions in pump and tower installation and operating costs. Maximizing system efficiency requires that the designer balance performance considerations for all system components; the best approach may or may not involve multiple chillers, or series arrangement of the evaporators and/or condensers. *This ideal balance of design integrity with installation and operating cost considerations can also be obtained by consulting a Trane representative and applying the Trane System Analyzer program.*

Water Treatment
The use of untreated or improperly treated water in chillers may result in scaling, erosion, corrosion, and algae or slime buildup. It is recommended that the services of a qualified water treatment specialist be engaged to determine what treatment, if any, is advisable. Trane assumes no responsibility for the results of using untreated or improperly treated water.

Water Pumps
Where noise limitation and vibration-free operation are important, Trane strongly encourages the use of 1750-rpm (60 Hz), 1450-rpm (50 Hz) pumps. Specifying or using 3600-rpm (60 Hz), 3000-rpm (50 Hz) condenser water and chilled water pumps must be avoided, because such pumps may operate with objectionable levels of noise and vibration. In addition, a low frequency beat may occur due to the slight difference in operating rpm between 3600-rpm (60 Hz), 3000-rpm (50 Hz) water pumps and Series R chiller motors. Important Note: The chilled water pump must not be used to stop the chiller.

Acoustic Considerations
For chiller sound ratings, installation tips, and considerations on chiller location, pipe isolation, etc., refer to *the Trane Water-Cooled Series R Chillers Sound Ratings and Installation Guide*. Using the information provided in this bulletin, contact a certified sound consultant to aid in proper mechanical room design and treatment.

Figure 1. Typical series chiller arrangement



Selection Procedure

Trane Series R chiller performance is rated in accordance with the ARI Standard 550/590-2003 Certification Program. Chiller selection assistance and performance information can be obtained by using the Series R chiller selection program, available through local Trane sales offices.

Performance
The computerized Series R chiller selection program provides performance data for each possible chiller selection at both full-load and part-load design points, as required.

It should be noted that changing the number of water passes or the water flow rates will generally alter the performance of a particular chiller. To attain maximum benefit from the wide range of chiller models and options available, designers are encouraged to first develop performance specifications and then use the chiller selection program to optimize all selections. This will help ensure selection of the compressor-evaporator-condenser combination that most closely meets the job requirements. To optimize system performance, all selections should also be balanced with other system components.

Fouling Factors
ARI Standard 550 includes a definition of clean tube fouling. The recommended standard fouling adjustments are 0.0001 hr-sq ft-deg F/Btu (0.0176 sq m-deg C/kW) for the evaporator and 0.00025 hr-sq ft deg F/Btu (0.044 sq m-deg C/kW) for the condenser, from an increment of 0.0000 "clean." Chiller specifications should be developed using the most current standard fouling factors.

Part Load Performance
Actual air-conditioning system loads are frequently less than full-load design conditions. Depending on the number of chillers on the job and the load profile, chillers may operate at full load a small percentage of the time. With their excellent part-load performance characteristics and highly energy-efficient operation, Series R chillers can provide significant operating savings at these part-load conditions.

System Considerations
Part-load chiller operation is frequently associated with reduced condenser water temperatures. However, rather than focusing only on the chiller, it is important to balance these temperatures to achieve the most efficient system operation possible. At part-load operation, the heat rejected to the cooling tower is less than at full-load operation.

Part-load chiller operation is also typically associated with reduced outside wet bulb temperatures, resulting in improved cooling tower performance. The net result of reduced heat rejection and lower wet bulb temperatures can be cooler condenser water entering the chiller, ultimately improving unit performance. However, this does not improve pump or tower efficiency. To achieve the most efficient system operation possible, it is best to minimize the total power draw of the chiller, tower, and pumps, which may not mean limiting the condenser water temperature to what the tower can provide. To determine specific unit and system part-load performance for chiller selection purposes, use the Series R chiller computer selection program or contact the local Trane sales office.

Selection Procedure

Unit Performance with Fluid Media Other Than Water
Series R chillers can be provided with a wide variety of fluid media other than water, including ethylene glycol and propylene glycol— in the evaporator, condenser or both. Chillers using media other than water are excluded from the ARI 550/590-2003 Certification Program, but are rated in accordance with ARI Standard 550/590-2003. Trane factory performance tests are only performed with water as the cooling and heat-rejection media. When considering selection of media other than water, contact the local Trane sales office for chiller selections and factory performance testing information.

Fluid media other than water lowers the heat transfer coefficient, and therefore reduces chiller performance. In general, it is good practice to hold the percent glycol added to within the minimum allowed by the Trane selection program, based on either (a) unit operating temperatures, or (b) the operating temperatures the evaporator or condenser water will experience under its full range of conditions. Adding more glycol than required for the specific application is equivalent to selecting a less efficient chiller. Lower-viscosity glycols such as ethylene will have less adverse impact on chiller performance than higher-viscosity glycols such as propylene.

Evaporator and Condenser Pressure Drop
Pressure drop data is determined by the Series R chiller computer selection program available through local Trane sales offices.

Dimensional Drawings
Dimensional drawings provided for selection purposes illustrate overall measurements of the unit. The recommended service clearances are those required to easily service the Series R chiller.

All catalog dimensional drawings are subject to change, and current submittal drawings should be referenced for more detailed dimensional information. Dimensional drawings are also available from the selection program. Contact the local Trane sales office for submittal information.

Electrical Data Tables
Compressor motor electrical data is provided in the data section for each compressor size. Rated load amperes (RLA), locked rotor wye amperes (LRA) and expected inrush for the Wye-delta and Solid State Starter configurations are shown.

Although the terms "LRA" and "expected inrush" are often used interchangeably, the distinction applied here is that LRA is the rated inrush for the motor, but expected inrush is that allowed by the starter, based on the specific configuration.

Selecting starters in the Wye-delta or Solid State configuration lowers expected inrush vs. the Delta (or "across-the-line") configuration. A Solid State Starter configuration lowers the expected inrush by approximately 50 percent, while Wye-Delta lowers it by approximately 66 percent.

The RLA is based on the motor's performance when reaching full rated horsepower. The kW rating of the motor will equal or exceed the kW requirement indicated by the Series R computer selection program at design conditions. If motor kW draw at design conditions is less than the kW rating of the motor, the RLA at design conditions is determined by multiplying the motor RLA (at the desired voltage) by this ratio: design kW/motor kW rating. This calculation is performed within the Series R chiller computer selection program, making RLA available as part of the design predictions. Predicted values include power factor variation from point to point.

A voltage utilization range is tabulated for each voltage listed. Series R chillers are designed to operate satisfactorily over a utilization range of ±10 percent of the standard design voltages: (a) 200 V, 230 V, 380 V, 460 V, and 575 V for 60 Hertz, 3-phase, and (b) 380 V, 400 V, 415 V for 50 Hertz, 3-phase.

Model Nomenclature

RTH	D	U	D	2	F	0	A0	U	A	G	3	A	4	L	A	L	G	3	F	2	L	A	L
1,2,3	4	5	6	7	8	9	10,11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27

Digits 01, 02, 03 – Series R™
RTH = Series R

Digit 04 – Dev Sequence
D = 4th Major Development

Digit 05 – Design Control
U = WCBU

Digit 06 – Compressor Frame
B = B Compressor
C = C Compressor
D = D Compressor
E = E Compressor

Digit 07 – Compressor Capacity
1 = Smaller Capacity for Frame
2 = Larger Capacity for Frame
3 = 50Hz Capacity

Digit 08 – Unit Power Supply
A = 200V/60Hz/3Ph power
C = 230V/60Hz/3Ph power
D = 380V/60Hz/3Ph power
R = 380V/50Hz/3Ph power
T = 400V/50Hz/3Ph power
U = 415V/50Hz/3Ph power
F = 460V/60Hz/3Ph power
H = 575V/60Hz/3Ph power

Digit 09 – Specials
X = No specials
C = All specials denoted by digits elsewhere
S = Uncategorized special not denoted by other digits

Digits 10, 11 – Design Sequence
** = First Design, etc. increment when parts are affected for service purposes

Digit 12 – Agency Listing
X = No agency listing
U = C/UL

Digit 13 – Pressure Vessel Code
A = ASME
L = Chinese Pressure Vessel Code

Digit 14 – Evaporator Frame
B = B Frame
C = C Frame
D = D Frame
E = E Frame
F = F Frame
G = G Frame

Digit 15 – Evaporator Capacity
1 = Tube count #1
2 = Tube count #2
3 = Tube count #3
4 = Tube count #4
5 = Tube count #5
6 = Tube count #6

Digit 16 – Evaporator Tube Type
A = Enhanced Fin Copper

Digit 17 – Evaporator Water Pass Configuration
2 = 2 pass
3 = 3 pass
4 = 4 pass

Digit 18 – Evaporator Water Connection
L = Left Hand Evaporator Connection
R = Right Hand Evaporator Connection

Digit 19 – Evaporator Connection Type
A = Standard Grooved Pipe

Digit 20 – Evaporator Waterside Pressure
L = 150 psi
H = 300 psi

Digit 21 – Condenser
B = B Frame
D = D Frame
E = E Frame
F = F Frame
G = G Frame

Digit 22 – Condenser Capacity
1 = Tube count #1
2 = Tube count #2
3 = Tube count #3
4 = Tube count #4
5 = Tube count #5

Digit 23 – Condenser Tube Type
A = Enhanced Fin Copper
B = Smooth Bore Copper
C = Smooth Bore 90/10 CU/NI

Digit 24 – Condenser Passes
2 = 2 Pass

Digit 25 – Condenser Water Connection
L = Left Hand Connection
R = Right Hand Connection

Digit 26 – Condenser Connection Type
A = Standard Grooved Pipe
C = Marine

Digit 27 – Condenser Waterside Pressure
L = 150 psi
H = 300 psi

Model Nomenclature

A	V	X	Q	X	E	X	A	A	B	D	Y	444	D	A	X	A	4	X	X	X	R	X	V	X
28	29	30	31	32	33	34	35	36	37	38	39	40,41,42	43	44	45	46	47	48	49	50	51	52	53	54

Digit 28 – Condenser Leaving Water Temperature
A = Standard

Digit 29 – Refrigerant Specialties
X = No Refrigerant Isolation Valves
V = With Refrigerant Isolation Valves

Digit 30 – Oil Cooler
X = Without Oil Cooler
C = With Oil Cooler

Digit 31 – Thermal Insulation
X = No Insulation
Q = Factory Installed Insulation

Digit 32 – Acoustic Insulation
X = No Insulation
A = Standard Insulation

Digit 33 – Label and Literature Language
C = Spanish
E = English
F = French

Digit 34 – Safety Devices
X = Standard

Digit 35 – Factory Charge
A = Factory Refrigerant Charge (134a)
B = Factory Nitrogen Charge

Digit 36 – Shipping Package
A = No Skid (standard)
B = Shrink Wrap
C = Skid
D = Skid + Shrink Wrap
J = Special

Digit 37 – Flow Switch
X = No Flow Switch
A = Evaporator (NEMA 1)
B = Evaporator and Condenser (NEMA 1)
C = Evaporator (NEMA 4)
D = Evaporator and Condenser (NEMA 4)

Digit 38 – Factory Test
X = Standard Test
C = Witness Test
D = Performance Test

Digit 39 – Starter Type
Y = Wye Delta Closed Transition Starter
A = Solid State Starter

Digits 40, 41, 42 – Design RLA (for starter)
*** = Selection Assigned

Digit 43 – Power Line Connection Type
A = Terminal Blocks
B = Mechanical Disconnect Switch
D = Circuit Breaker
F = High Interrupt Circuit Breaker
H = Ground Fault Circuit Breaker
J = Ground Fault High Interrupt Circuit Breaker

Digit 44 – Enclosure Type
A = NEMA 1

Digit 45 – Under/Over Voltage Protection
X = None
U = With Under/Over Voltage Protection

Digit 46 – Operator Interface Language
A = Dyna-View/English
B = Dyna-View/French
C = Dyna-View/Italian
D = Dyna-View/Spanish
E = Dyna-View/German
F = Dyna-View/Dutch
G = Dyna-View/Traditional Chinese
H = Dyna-View/Simple Chinese
J = Dyna-View/Japanese
K = Dyna-View/Portuguese
L = Dyna-View/Korean
M = Dyna-View/Thai

Digit 47 – Digital Communication Interface
X = None
4 = Tracer Interface
5 = LCI-C (LonTalk)

Digit 48 – External Chilled Water and Current Limit Setpoint
X = None
4 = 4-20mA input
2 = 2-10Vdc

Digit 49 – External Base Loading
X = None
4 = 4-20mA input
2 = 2-10Vdc input

Digit 50 – Icemaking
X = None
A = Icemaking with Relay
B = Icemaking without Relay

Digit 51 – Programmable Relays
X = None
R = With

Digit 52 – Chilled Water Reset
X = Chilled Water Reset – Return Water
T = Chilled Water Reset – Outdoor Air Temperature

Digit 53 – Control Outputs
X = None
V = Condenser Regulating Valve Control & Percent RLA
P = Condenser Pressure (% HPC) & Percent RLA
D = Chiller Differential Pressure & Percent RLA

Digit 54 – Refrigerant Monitor Input
X = None
A = 100 ppm / 4-20mA
B = 1000 ppm / 4-20mA
C = 100 ppm / 2-10Vdc
D = 1000 ppm / 2-10Vdc

General Data

Nominal Data

Nominal Compressor	B1	B2	C1	C2	D1	D2	D3	E3
Tonnage (60 Hz)	175-200	200-225	225-275	275-325	325-400	375-450	N/A	N/A
Tonnage (50 Hz)	125-150	150-175	175-225	225-275	275-325	300-350	325-375	375-450

Notes:
1. Chiller selections can be optimized through the use of the ARI-Certified Series R selection program and by contacting your local Trane sales office.

General Data

Compressor Code	Evaporator Code	Condenser Code	Evaporator Water Storage Gallons	Evaporator Water Storage Liters	Condenser Water Storage Gallons	Condenser Water Storage Liters	Refrigerant Type	Refrigerant Charge lb	Refrigerant Charge kg
B1	B1	B1	41	155	28	106	HFC-134a	410	186
B1	C1	D1	55	208	31	117	HFC-134a	490	222
B2	B2	B2	45	170	29	110	HFC-134a	410	186
B2	C2	D2	58	220	34	129	HFC-134a	490	222
C1	D6	E5	45	170	29	110	HFC-134a	490	222
C1	D5	E4	52	197	32	121	HFC-134a	490	222
C1	E1	F1	82	310	60	226	HFC-134a	525	238
C2	D4	E4	52	197	32	121	HFC-134a	490	222
C2	D3	E3	78	295	47	178	HFC-134a	490	222
C2	F2	F3	107	405	61	231	HFC-134a	625	284
D1	D1	E1	69	261	44	166	HFC-134a	475	216
D1	F1	F2	102	386	57	216	HFC-134a	625	284
D1[1]	G1	G1	136	515	79	299	HFC-134a	---	---
D1[2]	G2	G2	144	545	91	344	HFC-134a	700	318
D2/D3	D2	E2	74	280	47	178	HFC-134a	475	216
D2/D3	F2	F3	107	405	61	231	HFC-134a	625	284
D2/D3[1]	G2	G1	144	545	79	299	HFC-134a	---	---
D2/D3[2]	G3	G3	159	602	97	367	HFC-134a	700	318
E3	D2	E2	74	280	47	178	HFC-134a	475	216
E3	F2	F3	107	405	61	231	HFC-134a	625	284
E3[1]	G2	G1	144	545	79	299	HFC-134a	---	---
E3[2]	G3	G3	159	602	97	367	HFC-134a	700	318

Notes:
1. 50 Hz units only.
2. 60 Hz units only.

General Data Water Flow Rates

Minimum/Maximum Evaporator Flow Rates (Gallons/Minute)

Evaporator Code	Two Pass Min	Two Pass Max	Two Pass Nominal Conn Size (In.)	Three Pass Min	Three Pass Max	Three Pass Nominal Conn Size (In.)	Four Pass Min	Four Pass Max	Four Pass Nominal Conn Size (In.)
B1	253	1104	8	168	736	6	—-	—-	—-
B2	288	1266	8	192	844	6	—-	—-	—-
C1	320	1412	8	213	941	6	—-	—-	—-
C2	347	1531	8	232	1022	6	—-	—-	—-
D1	415	1812	8	275	1206	8	—-	—-	—-
D2	450	1980	8	300	1320	8	—-	—-	—-
D3	486	2131	8	324	1417	8	—-	—-	—-
D4	351	1542	8	234	1028	8	—-	—-	—-
D5	351	1542	8	234	1028	8	—-	—-	—-
D6	293	1287	8	196	860	8	—-	—-	—-
E1	450	1980	8	300	1320	8	—-	—-	—-
F1	563	2478	10	376	1655	8	—-	—-	—-
F2	604	2667	10	404	1780	8	—-	—-	—-
G1	—-	—-	—-	505	2218	10	379	1666	8
G2	—-	—-	—-	550	2413	10	411	1807	8
G3	—-	—-	—-	622	2732	10	466	2050	8

Notes:
1. Minimum flow rates are based on **water only**.
2. All water connections are grooved pipe.

Minimum/Maximum Evaporator Flow Rates (Liters/Second)

Evaporator Code	Two Pass Min	Two Pass Max	Two Pass Nominal Conn Size (mm)	Three Pass Min	Three Pass Max	Three Pass Nominal Conn Size (mm)	Four Pass Min	Four Pass Max	Four Pass Nominal Conn Size (mm)
B1	16	70	200	11	46	150	—-	—-	—-
B2	18	80	200	12	53	150	—-	—-	—-
C1	20	89	200	13	59	150	—-	—-	—-
C2	22	97	200	15	65	150	—-	—-	—-
D1	26	114	200	17	76	200	—-	—-	—-
D2	28	125	200	19	83	200	—-	—-	—-
D3	31	134	200	20	89	200	—-	—-	—-
D4	22	97	200	15	65	200	—-	—-	—-
D5	22	97	200	15	65	200	—-	—-	—-
D6	18	81	200	12	54	200	—-	—-	—-
E1	28	125	200	19	83	200	—-	—-	—-
F1	36	156	250	24	104	200	—-	—-	—-
F2	38	168	250	25	112	200	—-	—-	—-
G1	—-	—-	—-	32	140	250	24	105	200
G2	—-	—-	—-	35	152	250	26	114	200
G3	—-	—-	—-	39	172	250	29	129	200

Notes:
1. Minimum flow rates are based on **water only**.
2. All water connections are grooved pipe.

Minimum/Maximum Condenser Flow Rates (Gallons/Minute)

Condenser Code	Two Pass Min	Two Pass Max	Two Pass Nominal Conn Size (In.)
B1	193	850	6
B2	212	935	6
D1	193	850	6
D2	212	935	6
E1	291	1280	8
E2	316	1390	8
E3	325	1420	8
E4	245	1080	8
E5	206	910	8
F1	375	1650	8
F2	355	1560	8
F3	385	1700	8
G1	444	1960	8
G2	535	2360	8
G3	589	2600	8

Notes:
1. Minimum flow rates are based on **water only**.
2. All water connections are grooved pipe.

Minimum/Maximum Condenser Flow Rates (Liters/Second)

Condenser Code	Two Pass Min	Two Pass Max	Two Pass Nominal Conn Size (mm)
B1	12	54	150
B2	13	59	150
D1	12	54	150
D2	13	59	150
E1	18	81	200
E2	20	88	200
E3	21	90	200
E4	15	68	200
E5	13	57	200
F1	24	104	200
F2	22	98	200
F3	24	107	200
G1	28	124	200
G2	34	149	200
G3	37	164	200

Notes:
1. Minimum flow rates are based on **water only**.
2. All water connections are grooved pipe.

General Data Brine Flow Rates

Minimum/Maximum Evaporator Flow Rates (GPM)

Evaporator Code	Two Pass Min	Two Pass Max	Two Pass Nominal Conn Size (In.)	Three Pass Min	Three Pass Max	Three Pass Nominal Conn Size (In.)	Four Pass Min	Four Pass Max	Four Pass Nominal Conn Size (In.)
B1	303	1104	8	200	736	6	—-	—-	—-
B2	346	1266	8	233	844	6	—-	—-	—-
C1	346	1412	8	254	941	6	—-	—-	—-
C2	375	1531	8	276	1022	6	—-	—-	—-
D1	498	1812	8	330	1206	8	—-	—-	—-
D2	541	1980	8	357	1320	8	—-	—-	—-
D3	584	2131	8	389	1417	8	—-	—-	—-
D4	422	1542	8	281	1028	8	—-	—-	—-
D5	422	1542	8	281	1028	8	—-	—-	—-
D6	352	1287	8	233	860	8	—-	—-	—-
E1	487	1980	8	357	1320	8	—-	—-	—-
F1	676	2478	10	454	1655	8	—-	—-	—-
F2	725	2667	10	487	1780	8	—-	—-	—-
G1	—-	—-	—-	606	2218	10	454	1666	8
G2	—-	—-	—-	660	2413	10	492	1807	8
G3	—-	—-	—-	747	2732	10	557	2050	8

Notes:
1. Minimum flow rates are based on brine solution.
2. All water connections are grooved pipe.

Minimum/Maximum Evaporator Flow Rates (Liters/Second)

Evaporator Code	Two Pass Min	Two Pass Max	Two Pass Nominal Conn Size (mm)	Three Pass Min	Three Pass Max	Three Pass Nominal Conn Size (mm)	Four Pass Min	Four Pass Max	Four Pass Nominal Conn Size (mm)
B1	19	70	200	13	46	150	—-	—-	—-
B2	22	80	200	15	53	150	—-	—-	—-
C1	22	89	200	16	59	150	—-	—-	—-
C2	23	97	200	17	65	150	—-	—-	—-
D1	31	114	200	21	76	200	—-	—-	—-
D2	34	125	200	23	83	200	—-	—-	—-
D3	37	134	200	25	89	200	—-	—-	—-
D4	27	97	200	18	65	200	—-	—-	—-
D5	27	97	200	18	65	200	—-	—-	—-
D6	22	81	200	15	54	200	—-	—-	—-
E1	28	125	200	23	83	200	—-	—-	—-
F1	43	156	250	29	104	200	—-	—-	—-
F2	46	168	250	31	112	200	—-	—-	—-
G1	—-	—-	—-	38	140	250	29	105	200
G2	—-	—-	—-	42	152	250	31	114	200
G3	—-	—-	—-	47	172	250	35	129	200

Notes:
1. Minimum flow rates are based on brine solution.
2. All water connections are grooved pipe.

Minimum/Maximum Condenser Flow Rates (GPM)

Condenser Code	Two Pass Min	Two Pass Max	Two Pass Nominal Conn Size (In.)
B1	230	850	6
B2	255	935	6
D1	230	850	6
D2	255	935	6
E1	350	1280	8
E2	380	1390	8
E3	390	1420	8
E4	295	1080	8
E5	250	910	8
F1	450	1650	8
F2	430	1560	8
F3	460	1700	8
G1	530	1960	8
G2	650	2360	8
G3	710	2600	8

Notes:
1. Minimum flow rates are based on brine solution.
2. All water connections are grooved pipe.

Minimum/Maximum Condenser Flow Rates (Liters/Second)

Condenser Code	Two Pass Min	Two Pass Max	Two Pass Nominal Conn Size (mm)
B1	15	54	150
B2	16	59	150
D1	15	54	150
D2	16	59	150
E1	22	81	200
E2	24	88	200
E3	25	90	200
E4	19	68	200
E5	16	57	200
F1	28	104	200
F2	27	98	200
F3	29	107	200
G1	33	124	200
G2	41	149	200
G3	45	164	200

Notes:
1. Minimum flow rates are based on brine solution.
2. All water connections are grooved pipe.

Electrical Data and Connections

Compressor Motor Electrical Data (60 Hertz)

Compressor Code	Nominal Voltage	200	230	380	460	575
	Voltage Utilization Range	180/220	208/254	342/418	414/506	516/633
B1, B2	Max kW	174	174	174	174	174
	RLA @ Max kW	557	484	291	241	193
	LRAY	970	818	488	400	329
	LRAD	3103	2617	1561	1280	1053
C1, C2	Max kW	249	249	249	249	249
	RLA @ Max kW	812	698	421	349	279
	LRAY	1173	936	558	469	375
	LRAD	3634	2901	1727	1453	1162
D1, D2	Max kW	329	329	329	329	329
	RLA @ Max kW	888	888	549	455	367
	LRAY	1690	1532	850	730	612
	LRAD	5477	4966	2755	2366	1984

Notes:
1. See Selection Procedure Section for details.
2. The RLA @ Max kW is based on the performance of the motor developing full rated horsepower.
3. Electrical component sizing should be based on actual jobsite operating conditions. This factor can be obtained through the use of the Series R chiller selection program available through local Trane sales offices.

Compressor Motor Electrical Data (50 Hertz)

Compressor Code	Nominal Voltage	380	400	415
	Voltage Utilization Range	342/418	360/440	374/457
B1, B2	Max kW	139	145	148
	RLA @ Max kW	233	233	233
	LRAY	391	412	428
	LRAD	1229	1296	1348
C1, C2	Max kW	201	209	213
	RLA @ Max kW	349	349	349
	LRAY	456	480	498
	LRAD	1414	1488	1544
D1, D2, D3	Max kW	271	280	284
	RLA @ Max kW	455	455	455
	LRAY	711	748	776
	LRAD	2303	2424	2515
E3	Max kW	288	301	306
	RLA @ Max kW	488	488	488
	LRAY	711	748	776
	LRAD	2303	2424	2515

Notes:
1. See Selection Procedure Section for details.
2. The RLA @ Max kW is based on the performance of the motor developing full rated horsepower.
3. Electrical component sizing should be based on actual jobsite operating conditions. This factor can be obtained through the use of the Series R chiller selection program available through local Trane sales offices.

Electrical Connections

Starter Panel Connection	Selection RLA	Lug Size L1-L3 (Each Phase)
Terminals Only	000-760	(2) #4-500 MCM
	761-888	(4) 4/0-500 MCM
Main Circuit Breaker or Non-Fused Disconnect Switch	000-185	(1) #4-350 MCM
	186-296	(2) 2/0-250 MCM
	297-444	(2) 3/0-350 MCM
	445-592	(2) #1-500 MCM
	593-888	(4) 4/0-500 MCM

Note:
1. Lug sizes are independent of starter type.

Electrical Data and Connections

NOTES:

1. DASHED LINES INDICATE FIELD WIRING BY OTHERS. PHANTOM LINES INDICATE ALTERNATE CIRCUITRY OR AVAILABLE SALES OPTIONS. CHECK SALES ORDER TO DETERMINE IF WIRING IS REQUIRED FOR SPECIFIC OPTIONS.

2 REQUIRED DEVICE AND/OR CIRCUITRY BY OTHERS.

3 REQUIRED DEVICE AVAILABLE FROM TRANE. FIELD INSTALLED

4 OPENING THE EXTERNAL AUTO-STOP CONTACT WILL INITATE A SHUT DOWN SEQUENCE OF THE CHILLER. CLOSURE OF THE CONTACT WILL ALLOW THE CHILLER TO RETURN TO NORMAL AUTOMATIC OPERATION.

5 AN OPENING OF THE EMERGENCY STOP CONTACT WILL SHUT THE CHILLER DOWN IMMEDIATELY AND TRIGGER AN EMERGENCY STOP INPUT DIAGNOSTIC. CLOSURE OF THE CONTACT AND A MANUAL RESET OF THE UNIT CONTROL DIAGNOSTIC WILL ALLOW THE CHILLER TO RETURN TO NORMAL OPERATION.

GENERAL WIRING REQUIREMENTS AND PROVISIONS

6 THE EIGHT 1/2" CONDUIT KNOCKOUTS LOCATED NEAR THE TOP OF THE RIGHT HAND SIDE OF THE CONTROL PANEL ARE FOR USE WITH LOW VOLTAGE 30 VOLT CIRCUIT WIRING.

7 THE SIX 1/2" CONDUIT KNOCKOUTS AND 4 1-1/4" KNOCKOUTS LOCATED NEAR THE BOTTOM OF THE RIGHT HAND SIDE OF THE CONTROL PANEL ARE FOR USE WITH 115 VOLT CIRCUIT WIRING.

REQUIRED WIRING:

8 CLASS I WIRING ,14 AWG, 600 VOLT CONDUCTORS. 115 VOLT CIRCUIT

9 CLASS 2 WIRING.

10 TRANE TRACER SUMMIT RECOMMENDED WIRE:
TRANE ICS SHIELDED TWISTED PAIR COMMUNICATION CABLE 14-18 AWG, 600V CABLE, 30 VOLT CIRCUIT. THE SUM TOTAL LENGTH OF ALL INTERCONNECTED CABLE SEGMENTS NOT TO EXCEED 5000 FEET. GROUND THE SHIELD AT THE TRACER END ONLY. REFER TO THE IOM FOR COMPLETE CABLE AND INSTALLATION REQUIREMENTS. TRANE TRACER SUMMIT MAY ALSO USE LCI WIRING RECOMMENDED BELOW.

LONTALK COMMUNICATION INTERFACE (LCI) RECOMMENDED WIRE:
22 AWG LEVEL 4 UNSHIELDED COMMUNICATION WIRE RECOMMENDED. THE SUM TOTAL LENGTH OF ALL INTERCONNECTED CABLE SEGMENTS NOT TO EXCEED 4500 FEET. CONNECTION TOPOLOGY SHOULD BE DAISY CHAIN. REFER TO BUILDING AUTOMATION SYSTEM (BAS) COMMUNICATION INSTALLATION LITERATURE FOR END OF LINE TERMINATION RESISTOR REQUIREMENTS.

11 THE FIELD WIRING FOR THE 115V HOT LEG IS TERMINATED TO 1X6 TERMINAL BLOCK. SEE INSTRUCTION LABEL IN CONTROL PANEL FOR WIRE INSERTION INSTRUCTIONS. SPLICE FIELD WIRES TOGETHER AND WIRE TO 1X6.

GENERAL NOTES:

12. CAUTION-DO NOT ENERGIZE THE UNIT UNTIL CHECK OUT AND STARTUP PROCEDURES HAVE BEEN COMPLETED.

13. COMPRESSOR MOTOR IS PROTECTED FROM PRIMARY SINGLE PHASE FAILURE.

14 THESE FEATURES ARE OPTIONAL AND MAY OR MAY NOT BE PROVIDED. CUSTOMER PROVIDED WIRING FOR ALL STANDARD FEATURES AND OPTIONS IS SHOWN ON THIS DIAGRAM. OPTIONAL FEATURES ARE SO NOTED.

WIRING REQUIREMENTS

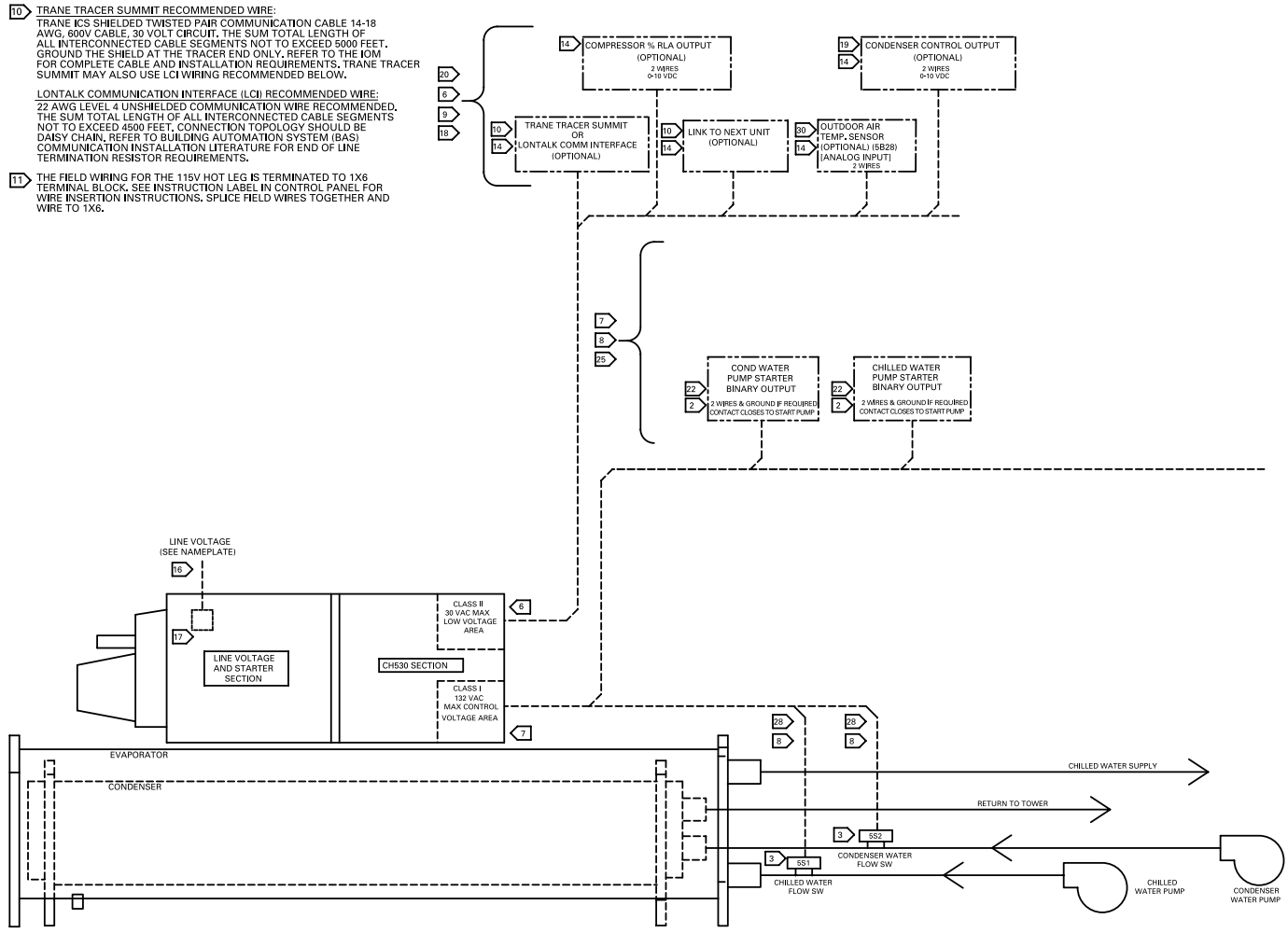
15. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE AND STATE AND LOCAL REQUIREMENTS. EXPORT UNIT WIRING MUST COMPLY WITH LOCAL APPLICABLE CODES.

16 ALL UNIT POWER WIRING MUST BE COPPER CONDUCTORS ONLY AND HAVE A MINIMUM TEMPERATURE INSULATION RATING OF 75 DEGREE C. SEE UNIT NAMEPLATE FOR MINIMUM CIRCUIT AMPACITY AND MAXIMUM FUSE SIZE REQUIREMENTS. USE 600 VOLT COPPER CONDUCTORS ONLY. 200 TO 600 VOLT CIRCUIT, PROVIDE AN EQUIPMENT GROUND IN ACCORDANCE WITH APPLICABLE ELECTRIC CODES.

17 LINE VOLTAGE OPTIONS:

UNIT MOUNTED TERMINAL BLOCK, DISCONNECT OR HACR CIRCUIT BREAKER THE POWER WIRING LUG SIZE PROVIDED ON THE VARIOUS UNITS IS SHOWN IN TABLE 2.

18 ALL CUSTOMER CONTROL CIRCUIT WIRING MUST BE COPPER CONDUCTORS ONLY AND HAVE A MINIMUM INSULATION RATING OF 300 VOLTS. EXCEPT AS NOTED ALL CUSTOMER WIRING CONNECTIONS ARE MADE TO CIRCUIT BOARD MOUNTED BOX LUGS WITH A WIRE RANGE OF 14 TO 18 AWG.



Electrical Data and Connections

19 FIELD SELECTABLE AS: CONDENSER PRESSURE, DELTA PRESSURE OR CONTROL OUTPUT SIGNAL FOR CONDENSER HEAD PRESSURE CONTROL.

20 DO NOT RUN LOW VOLTAGE CONTROL WIRING (30 VOLTS OR LESS) IN IN CONDUIT WITH 110 VOLT OR HIGHER WIRING. DO NOT EXCEED THE FOLLOWING MAXIMUM RUN LENGTHS FOR A GIVEN SIZE: 14 AWG, 5000 FT; 16 AWG, 2000 FT; 18 AWG, 1000FT

21 THE CONTACTS FOR THESE FEATURES ARE JUMPERED AT THE FACTORY BY JUMPERS W1 & W2 TO ENABLE UNIT OPERATION. IF REMOTE CONTROL IS DESIRED REMOVE THE NOTED JUMPERS AND CONNECT TO THE DESIRED CONTROL CIRCUIT.

22 FIELD PROVIDED 115 VOLT 60HZ OR 220 VOLT 50HZ CONTROL POWER SUPPLIES ARE REQUIRED. THE MAX FUSE SIZE FOR ALL FIELD PROVIDED WIRING IS 15 AMPS. GROUND ALL CUSTOMER PROVIDED POWER SUPPLIES AS REQUIRED BY CODE. GREEN GROUND SCREWS ARE PROVIDED IN UNIT CONTROL PANEL.

23 CLOSED CONTACT COMMANDS BASE LOADING OPERATION.

24 ACTUAL BASE LOADING SETPOINT USED IS SETABLE AT FRONT PANEL. REFER TO IOM FOR DETAILS.

CONTACT RATINGS AND REQUIREMENTS

25 UNIT PROVIDED DRY CONTACTS FOR THE CONDENSER/CHILLED WATER PUMP CONTROL, THE UNIT OPERATING STATUS RELAYS AND ICE MAKING STATUS RELAY ARE RATED FOR 7.2 AMPS RESISTIVE, 2.88 AMPS PILOT DUTY, OR 1/3 HP, 7.2 FLA AT 120 VOLTS 60 HZ, CONTACTS ARE RATED FOR 5 AMPS GENERAL PURPOSE DUTY AT 240 VOLTS.

26 CUSTOMER SUPPLIED CONTACTS FOR ALL CLASS 2 CONNECTIONS MUST BE COMPATABLE WITH DRY CIRCUIT 24 VOLTS DC FOR A 12 MA RESISTIVE LOAD. SILVER OR GOLD PLATED CONTACTS ARE RECOMMENDED.

27 FLOW SWITCH & INTERLOCK CONTACTS MUST BE ACCEPTABLE FOR USE IN A 120 VOLT 1 mA CIRCUIT OR A 220 VOLT 2 mA CIRCUIT.

28 CHILLED / CONDENSER WATER PUMP STARTER AUXILIARY CONTACTS TO BE WIRED IN SERIES WITH FLOW SWITCHES.

29 THE FIELD PROVIDED INDICATORS MAY BE RELAYS, LIGHTS OR AUDIBLE DEVICES. EACH FUNCTION IS ASSOCIATED WITH A SPDT RELAY. THE INDICATORS MAY BE CONNECTED TO EITHER OR BOTH OF THE NORMALLY OPEN OR NORMALLY CLOSED RELAY CONTACTS OF EACH OF THE 4 SPDT RELAYS ON THE OPTIONAL UNIT OPERATING STATUS MODULE.
THE FUNCTIONS OF THE OPERATING STATUS MODULE RELAYS ARE PROGRAMABLE. SEE IOM FOR DETAILS. DEFAULT FUNCTIONS ARE SHOWN.
THE NORMALLY OPEN CONTACTS ON EACH RELAY OPERATE AS FOLLOWS:

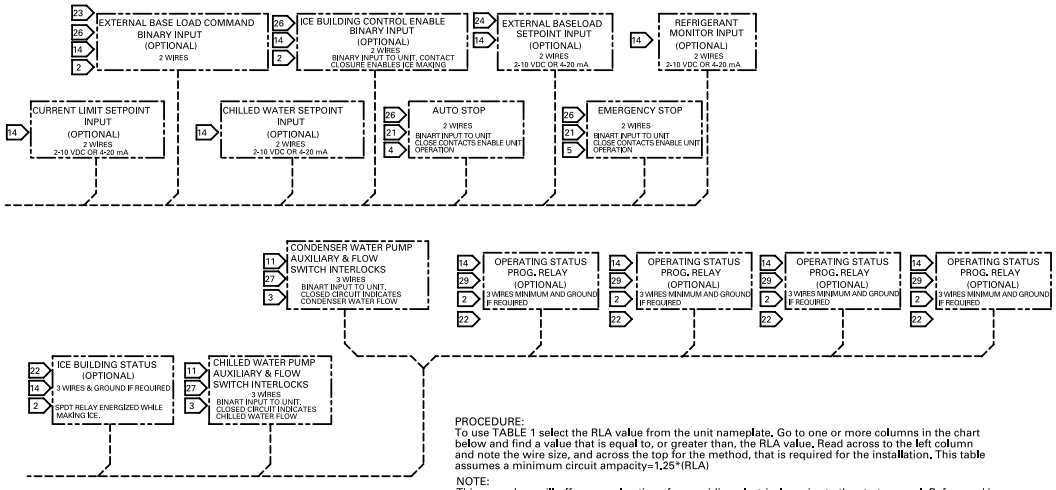
COMPRESSOR RUNNING — THE NO CONTACTS CLOSE WHEN COMPRESSOR STATUS FROM STARTER MODULE IS EITHER STARTING OR RUNNING.

ALARM RELAY — THE NO CONTACTS CLOSE WHEN THERE IS AN DIAGNOSTIC THAT HAS CAUSED A CHILLER SHUTDOWN WITH EITHER A MANUAL RESET REQUIRED OR AN AUTOMATIC RESET POTENTIAL.

CHILLER LIMIT MODE RELAY — THE NO CONTACTS CLOSE WHENEVER THE CHILLER HAS BEEN RUNNING IN ONE OF THE UNLOADING TYPES OF LIMIT MODES (CONDENSER, EVAPORATOR, CURRENT LIMIT OR PHASE IMBALANCE LIMIT) CONTINUOUSLY FOR THE LAST 20 MINUTES.

HEAD PRESSURE RELIEF REQUEST — THE NO CONTACTS CLOSE ANYTIME THE CHILLER IS RUNNING IN ONE OF THE FOLLOWING MODES; ICE MAKING MODE OR CONDENSER PRESSURE LIMIT CONTROL MODE CONTINUOUSLY FOR THE DURATION SPECIFIED BY THE CHILLER HEAD RELIEF RELAY FILTER TIME.

30 WHEN ORDERED THE OUTDOOR AIR TEMP SENSOR ELECTRONICS IS FACTORY MOUNTED INSIDE THE CONTROL PANEL AND THE IPC BUS IS FACTORY WIRED. THE SENSOR IS TO BE FIELD WIRED, RELOCATED EXTERNALLY WITH THE SENSOR LEADS EXTENDED BACK TO THE CONTROL PANEL. THESE WIRES CAN BE SPLICED WITH TWO 14 - 18 AWG 600V WIRES, WITH A MAXIMUM LENGTH OF 1000 FT (305 METERS). SPLICE AT SENSOR END MUST BE WATER TIGHT. REFER TO UNIT IOM FOR DETAILS.



PROCEDURE:
To use TABLE 1 select the RLA value from the unit nameplate. Go to one or more columns in the chart below and find a value that is equal to, or greater than, the RLA value. Read across to the left column and note the wire size, and across the top for the method, that is required for the installation. This table assumes a minimum circuit ampacity=1.25*(RLA)

NOTE:
This procedure will offer several options for providing electrical service to the starter panel. Before making a final selection, review the accompanying TABLE 2 indicating wire ranges for the available lug sizes supplied on the equipment.

TABLE 2

SELECTION RLA	CIRCUIT BREAKER	NON FUSED DISCONNECT SWITCH
0-185	(2) 2/0-250 MCM or (1) 2/0-500 MCM	(1) #4-350 MCM
186-296	(2) 2/0-250 MCM or 2/0-500 MCM	
297-444	(2) 3/0-350 MCM	
445-592	(2) #1-500 MCM	
593-888	(4) 4/0-500 MCM	
	MAIN LUGS ONLY	
000-623	(2)#4-500 MCM	

⚠ WARNING

HAZARDOUS VOLTAGE!

DISCONNECT ALL ELECTRIC POWER INCLUDING REMOTE DISCONNECTS BEFORE SERVICING.

FAILURE TO DISCONNECT POWER BEFORE SERVICING CAN CAUSE SEVERE PERSONAL INJURY OR DEATH.

CAUTION

USE COPPER CONDUCTORS ONLY!

UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT OTHER TYPES OF CONDUCTORS.

FAILURE TO DO SO MAY CAUSE DAMAGE TO THE EQUIPMENT.

TABLE 1

RECOMMENDED WIRE SELECTION TABLE (REF.2002 NEC)
RATED LOAD AMPS (RLA)

MIN WIRE SIZE COPPER 75 C	SUPPLY LEADS FOR ALL STARTER PANELS						
	1 CONDUIT 3 WIRE	1 CONDUIT 6 WIRE	1 CONDUIT 9 WIRE	2 CONDUIT 6 WIRE	2 CONDUIT 12 WIRE	3 CONDUIT 9 WIRE	4 CONDUIT 12 WIRE
	1 wire/ph/co	2 wire/ph/co	3 wire/ph/co	1 wire/ph/co	2 wire/ph/co	1 wire/ph/co	1 wire/ph/co
8	40	**	**	**	**	**	**
6	52	**	**	**	**	**	**
4	68	**	**	**	**	**	**
3	80	**	**	**	**	**	**
2	92	**	**	**	**	**	**
1	104	**	**	**	**	**	**
0	120	192	252	240	384	360	480
00	140	224	294	280	448	420	560
000	160	256	336	320	512	480	640
0000	184	294	386	368	589	552	736
250	204	326	428	408	653	612	816
300	228	365	479	456	730	684	912
350	248	397	521	496	794	744	992
400	268	429	563	536	858	804	1072
500	304	486	638	608	973	912	1216

** Electrical conductors may be connected in parallel only for size 1/0 wire and larger per Nec 310-4.

The unit nameplate will be marked 'Maximum Fuse or Circuit Breaker Size'
The maximum fuse or circuit breaker size is calculated as follows:

Calculated value = 2.25 * (Compressor RLA)

The calculated value is then used to select the fuse or circuit breaker from the standard sizes.

Standard Sizes = 100, 110, 125, 150, 175, 200, 225, 300, 350, 400, 450, 500, 600, 700, 800, 1000, 1200, 1600, 2000.

Maximum Fuse or Circuit Breaker Size = The standard size that is closest to the calculated value without exceeding it.

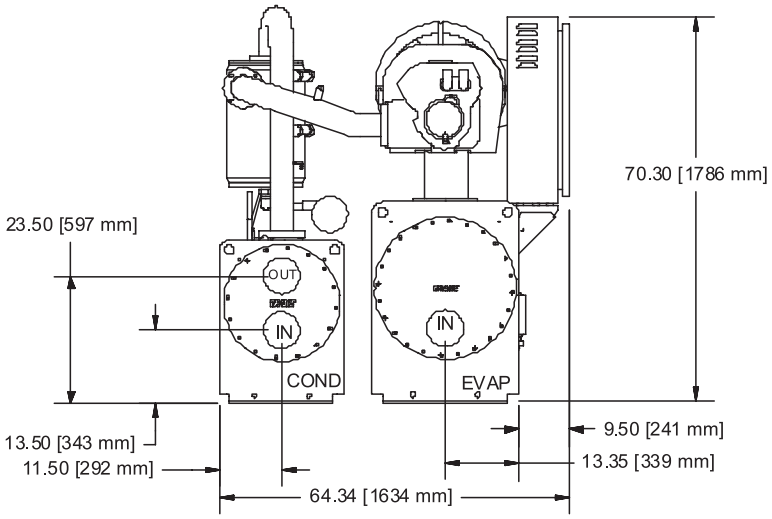
Dimensions and Weights

Shipping and Operating Weights

Compressor Code	Evaporator Code	Condenser Code	Operating Weight (lbs)	Operating Weight (kg)	Shipping Weight (lbs)	Shipping Weight (kg)
B1	B1	B1	9,867	4,476	9,292	4,215
B1	C1	D1	10,554	4,787	9,837	4,462
B2	B2	B2	10,019	4,545	9,402	4,265
B2	C2	D2	10,653	4,832	9,953	4,515
C1	D6	E5	13,397	6,077	12,780	5,797
C1	D5	E4	13,673	6,202	12,973	5,884
C1	E1	F1	15,818	7,175	14,718	6,676
C2	D4	E4	13,672	6,201	12,972	5,884
C2	D3	E3	15,044	6,824	14,002	6,351
C2	F2	F3	17,560	7,965	16,168	7,334
D1	D1	E1	15,385	6,978	14,443	6,551
D1	F1	F2	17,537	7,955	16,187	7,342
D1	G1	G1	20,500	9,299	18,600	8,437
D1	G2	G2	21,065	9,555	19,107	8,667
D2, D3	D2	E2	15,570	7,062	14,562	6,605
D2, D3	F2	F3	18,220	8,264	16,820	7,629
D2, D3	G2	G1	20,700	9,389	18,700	8,482
D2, D3	G3	G3	21,641	9,816	19,508	8,849
E3	D2	E2	15,728	7,134	14,720	6,677
E3	F2	F3	18,356	8,326	16,956	7,691
E3	G2	G1	20,800	9,435	18,800	8,528
E3	G3	G3	21,786	9,882	19,653	8,914

Notes:
1. All weights +- 3%.
2. Shipping weights include standard 150 psig water boxes, refrigerant charge, and oil charge.
3. Operating weights include refrigerant, oil, and water charges.

Dimensions and Weights



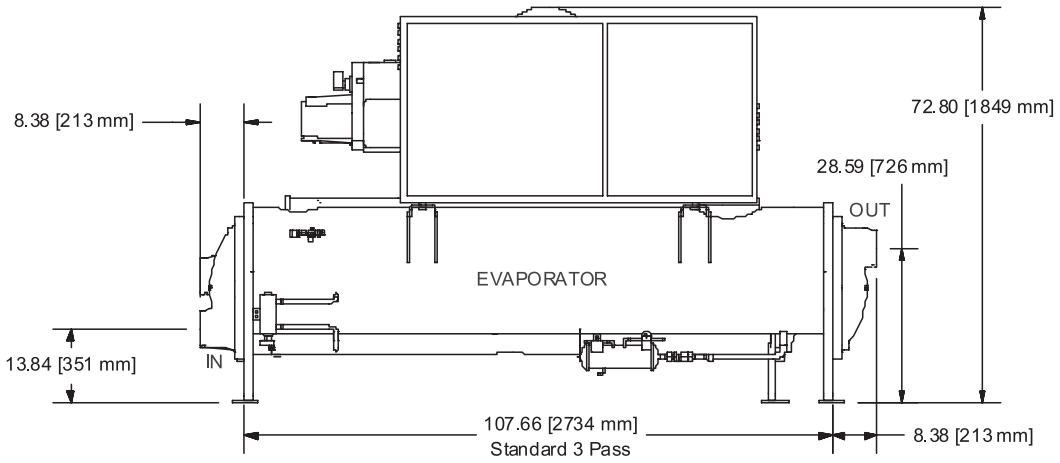
BBB Configuration

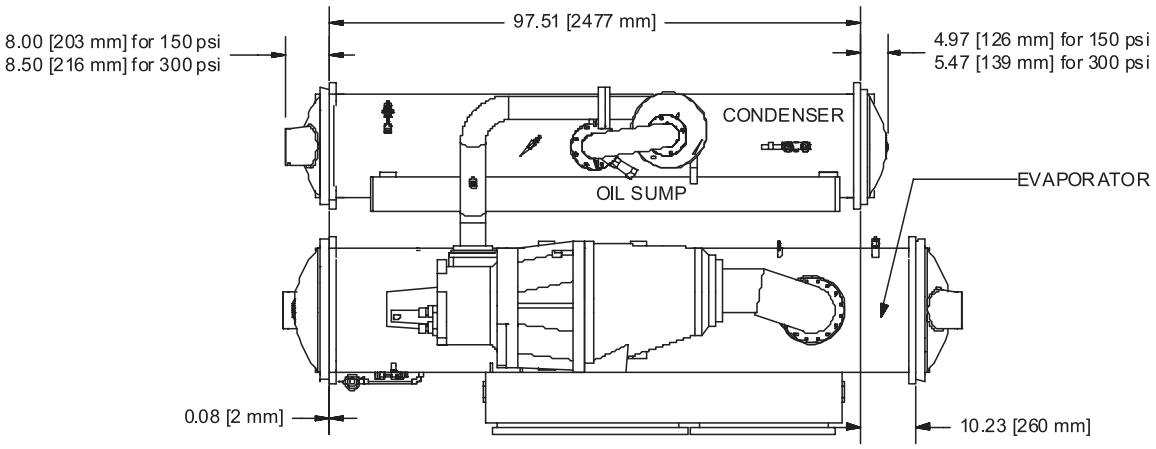
	Recommended Clearances
Front	36" (914 mm)
Back	36" (914 mm)
Either End	36" (914 mm)
Other End*	108" (2743 mm)
Top	36" (914 mm)

* Clearance for tube removal

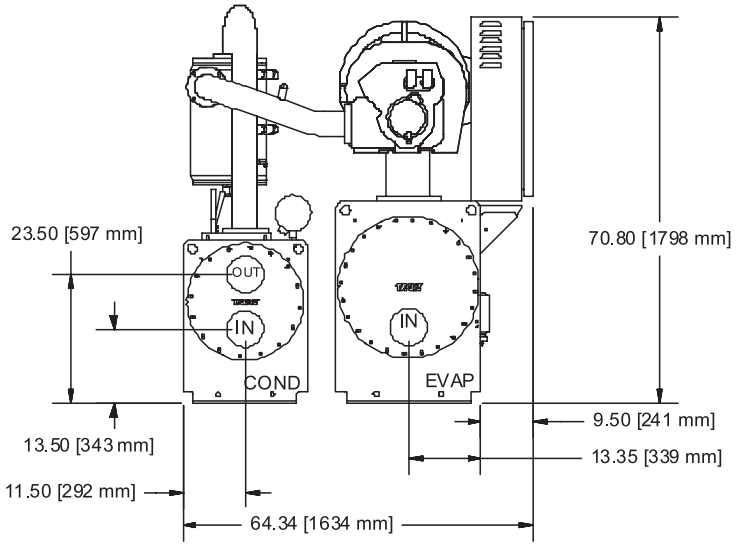
Note:

1. Dimensions are based on 3 Pass Evap / 2 Pass Cond and LH/LH water connections. Refer to submittals for exact configuration.
2. Refer to the Nominal Capacity Data table in the General Data section for capacity ranges of each compressor.





Dimensions and Weights



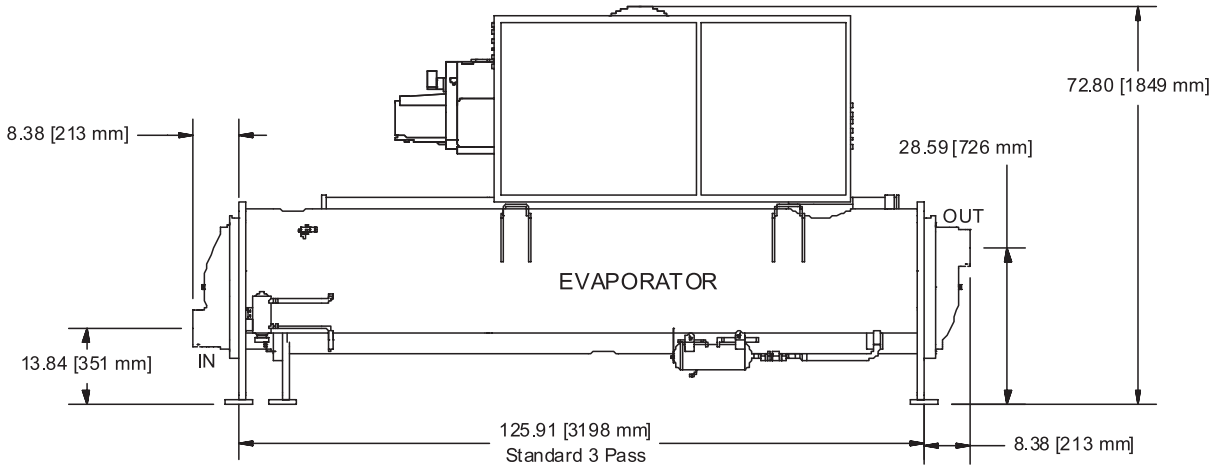
BCD Configuration

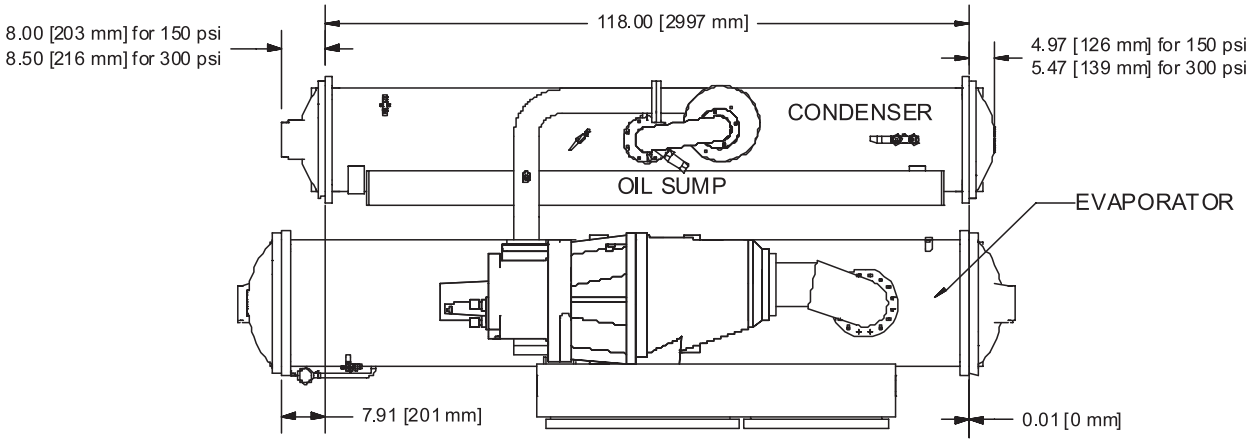
	Recommended Clearances
Front	36" (914 mm)
Back	36" (914 mm)
Either End	36" (914 mm)
Other End*	126" (3200 mm)
Top	36" (914 mm)

* Clearance for tube removal

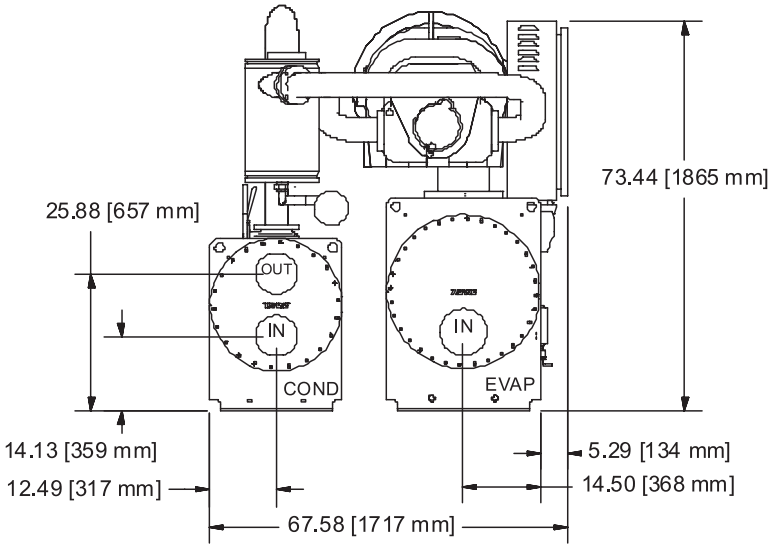
Note:

1. Dimensions are based on 3 Pass Evap / 2 Pass Cond and LH/LH water connections. Refer to submittals for exact configuration.
2. Refer to the Nominal Capacity Data table in the General Data section for capacity ranges of each compressor.





Dimensions and Weights



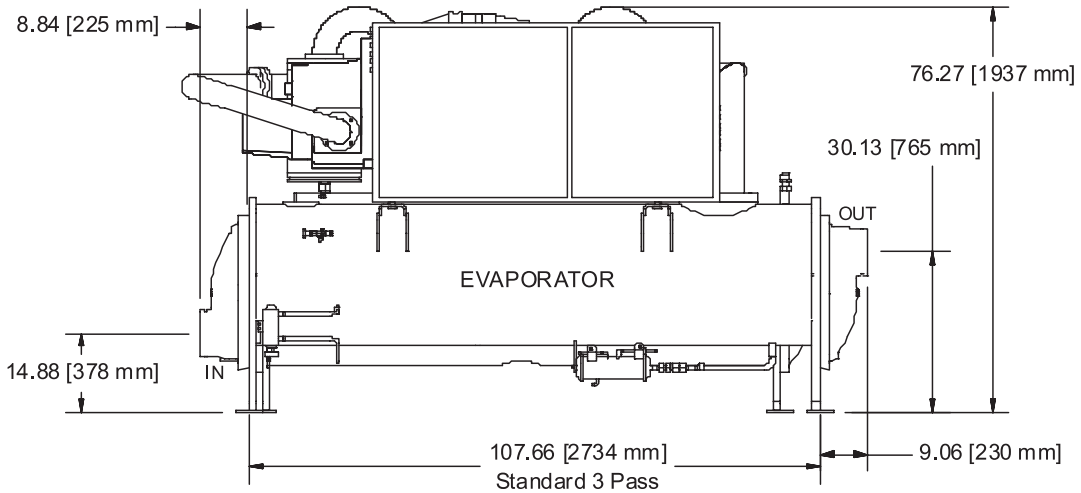
CDE, DDE, EDE Configuration

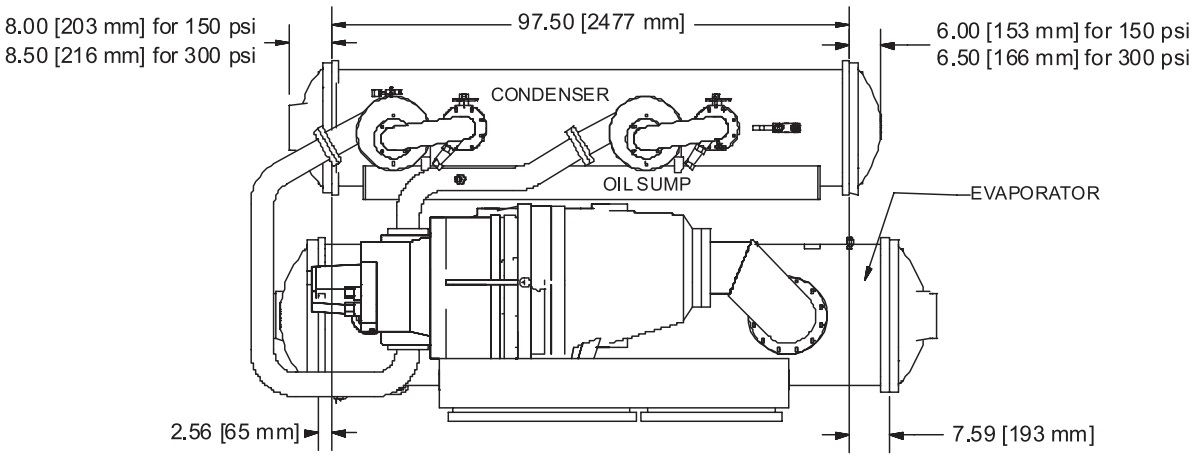
	Recommended Clearances
Front	36" (914 mm)
Back	36" (914 mm)
Either End	36" (914 mm)
Other End*	108" (2743 mm)
Top	36" (914 mm)

* Clearance for tube removal

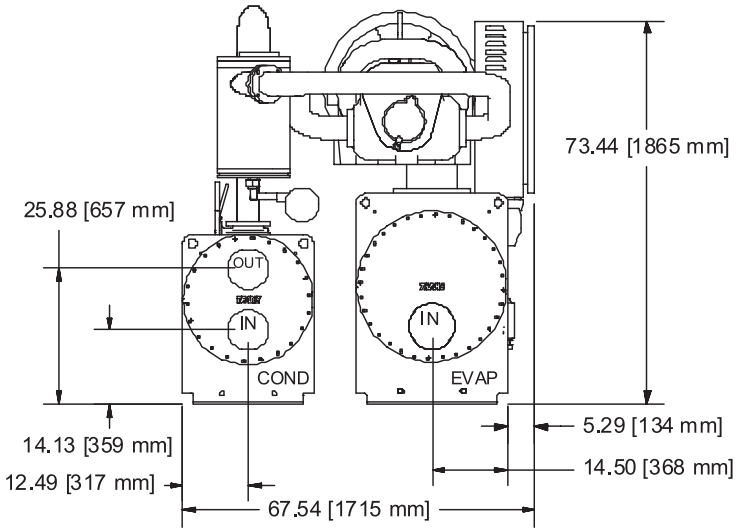
Note:

1. Dimensions are based on 3 Pass Evap / 2 Pass Cond and LH/LH water connections. Refer to submittals for exact configuration.
2. Refer to the Nominal Capacity Data table in the General Data section for capacity ranges of each compressor.





Dimensions and Weights



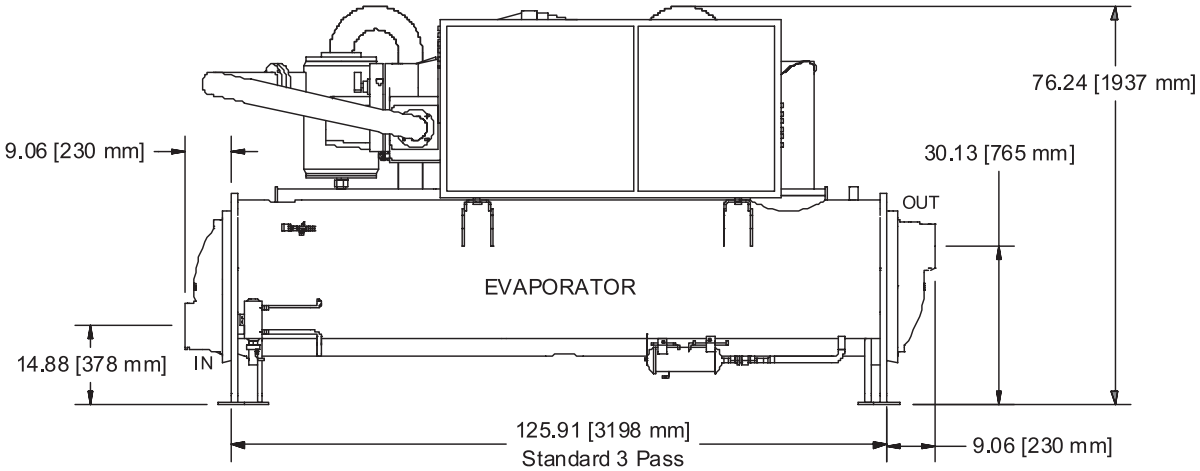
CEF Configuration

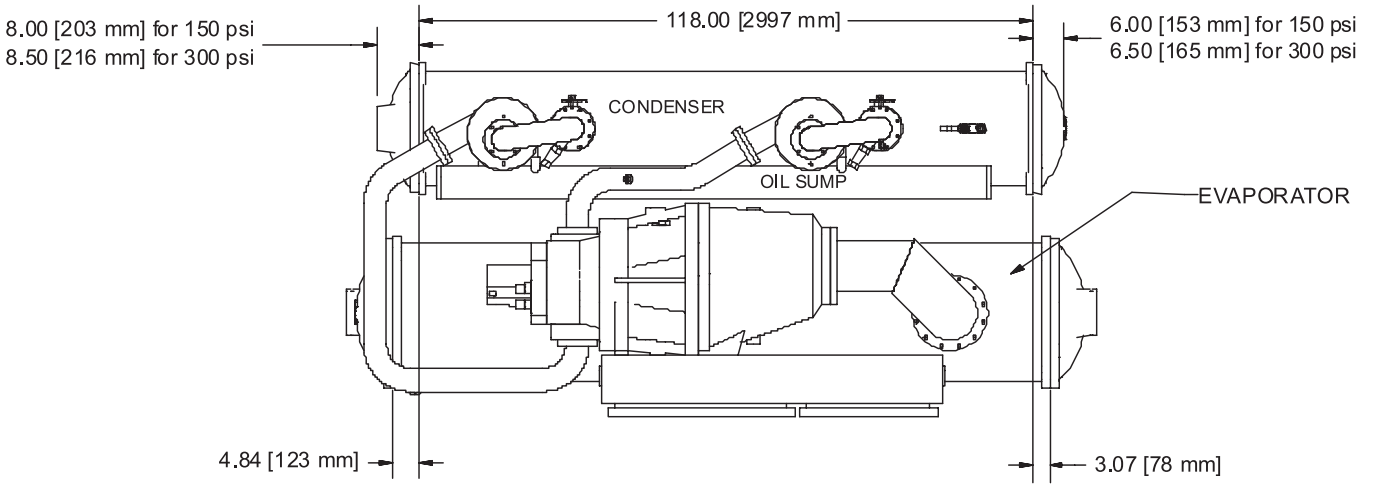
	Recommended Clearances
Front	36" (914 mm)
Back	36" (914 mm)
Either End	36" (914 mm)
Other End*	126" (3200 mm)
Top	36" (914 mm)

* Clearance for tube removal

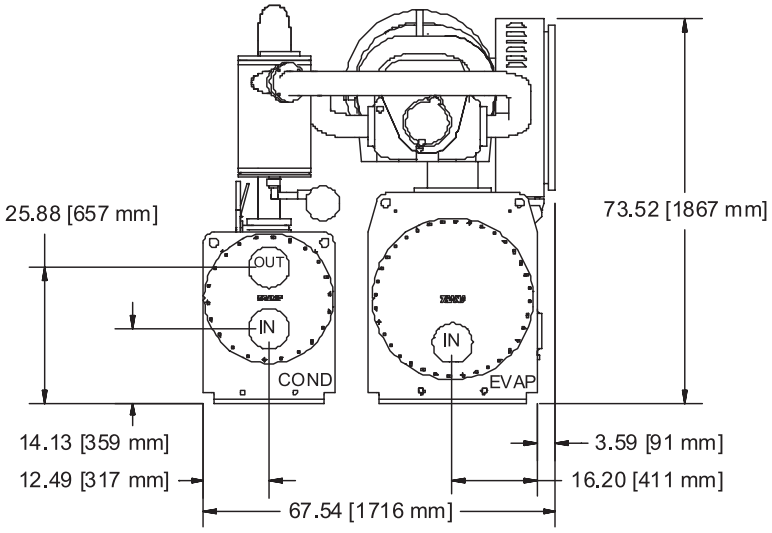
Note:

1. Dimensions are based on 3 Pass Evap / 2 Pass Cond and LH/LH water connections. Refer to submittals for exact configuration.
2. Refer to the Nominal Capacity Data table in the General Data section for capacity ranges of each compressor.





Dimensions and Weights



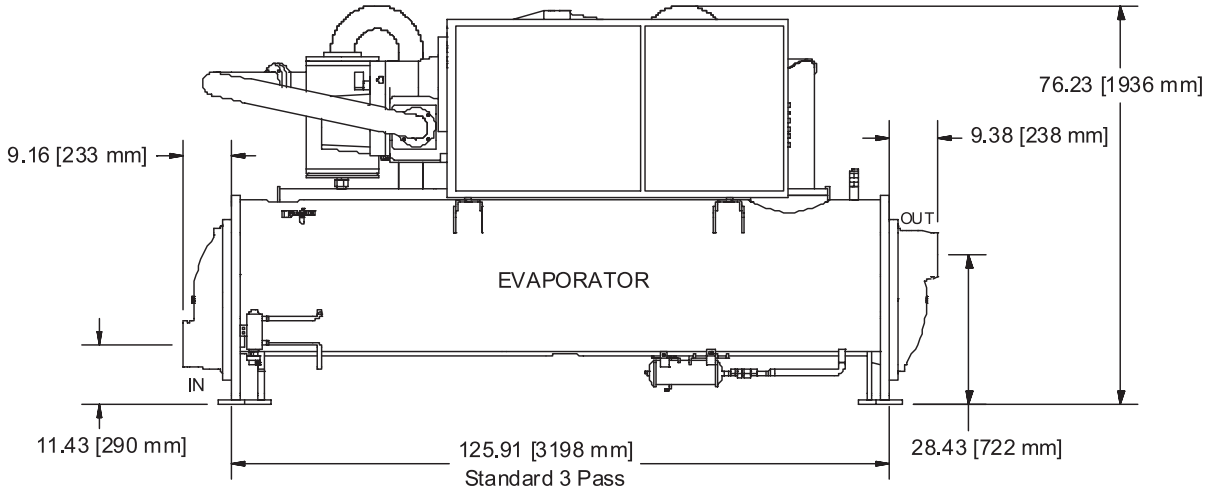
CFF, DFF, EFF Configuration

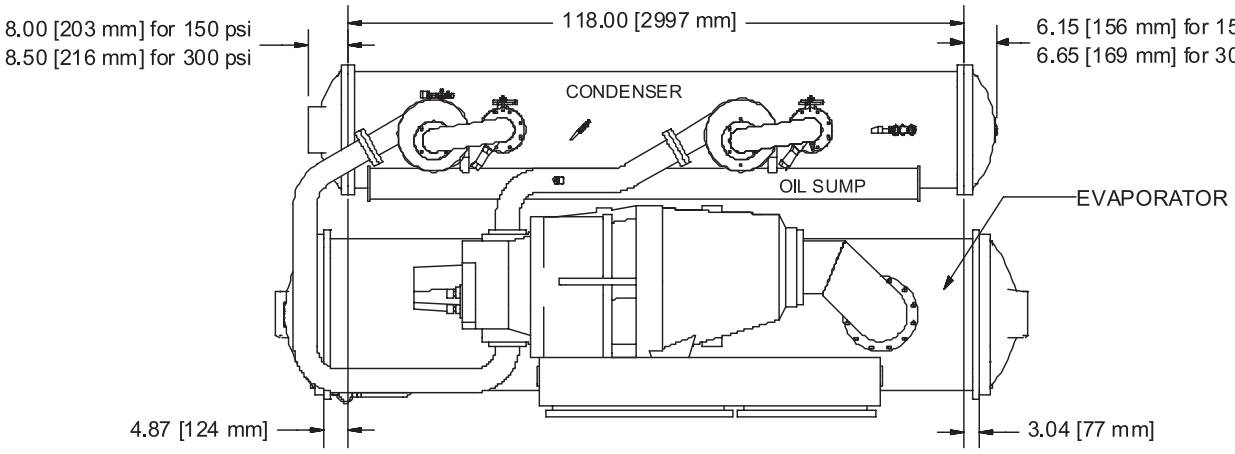
	Recommended Clearances
Front	36" (914 mm)
Back	36" (914 mm)
Either End	36" (914 mm)
Other End*	126" (3200 mm)
Top	36" (914 mm)

* Clearance for tube removal

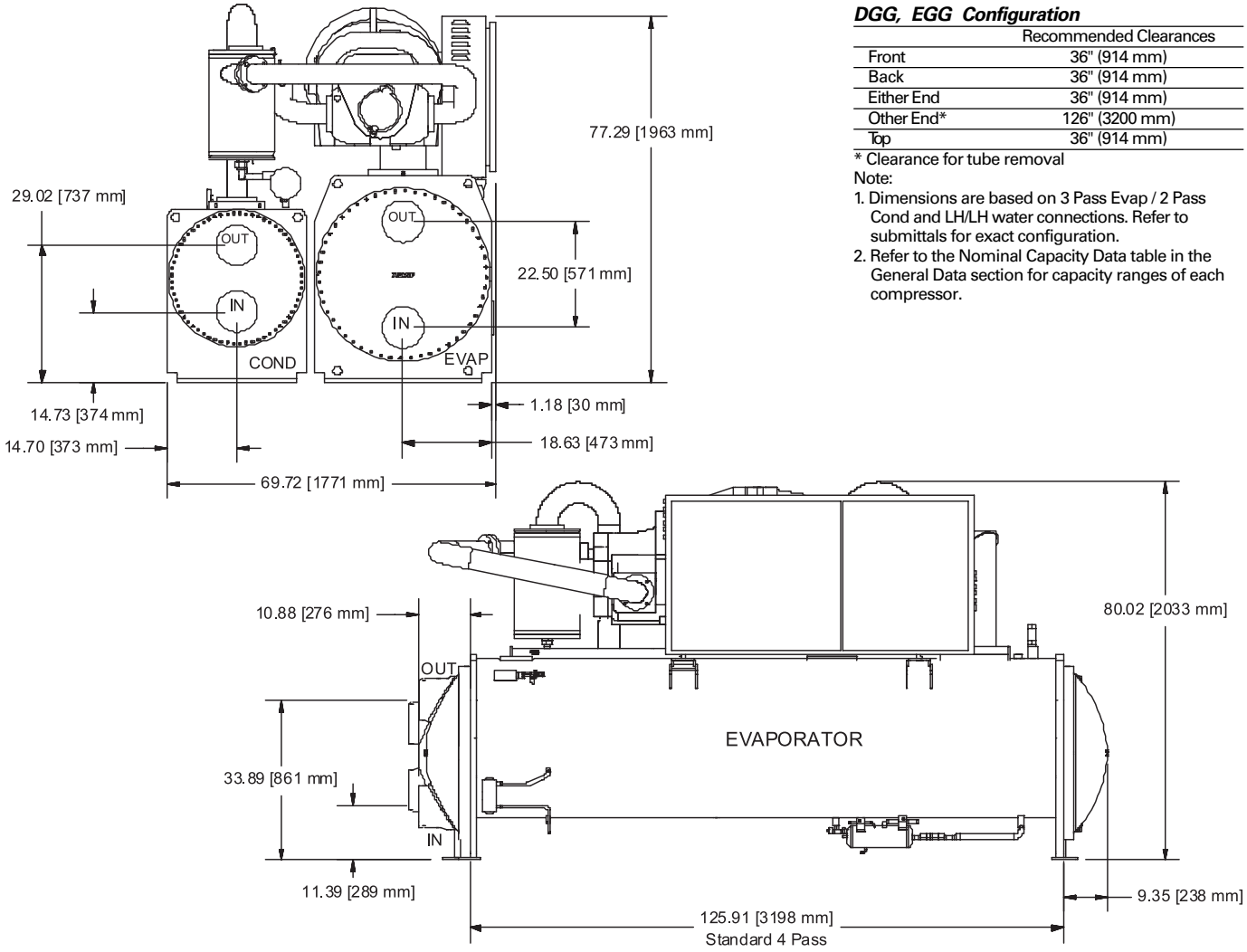
Note:

1. Dimensions are based on 3 Pass Evap / 2 Pass Cond and LH/LH water connections. Refer to submittals for exact configuration.
2. Refer to the Nominal Capacity Data table in the General Data section for capacity ranges of each compressor.





Dimensions and Weights



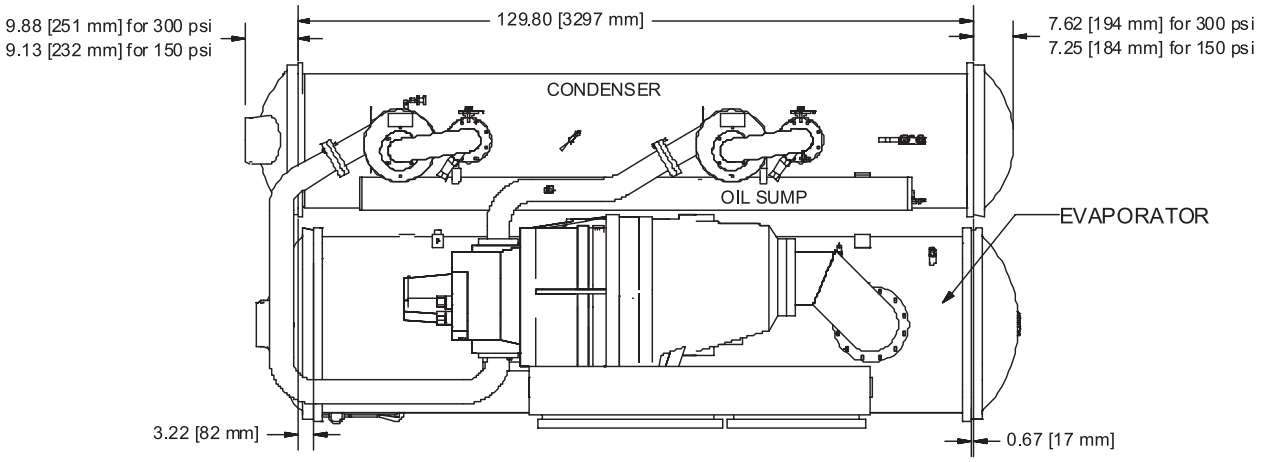
DGG, EGG Configuration

	Recommended Clearances
Front	36" (914 mm)
Back	36" (914 mm)
Either End	36" (914 mm)
Other End*	126" (3200 mm)
Top	36" (914 mm)

* Clearance for tube removal

Note:

1. Dimensions are based on 3 Pass Evap / 2 Pass Cond and LH/LH water connections. Refer to submittals for exact configuration.
2. Refer to the Nominal Capacity Data table in the General Data section for capacity ranges of each compressor.



Mechanical Specifications

General
Exposed metal surfaces are painted with air-dry beige, direct-to-metal, single-component paint. Each unit ships with full operating charges of refrigerant and oil. Molded neoprene isolation pads are supplied for placement under all support points. Startup and operator instruction by factory-trained service personnel are included.

Compressor and Motor
The unit is equipped with a semi-hermetic, direct-drive, 3600-rpm (3000 rpm @ 50 Hz) rotary compressor that includes a capacity control slide valve, oil sump heater, and differential pressure refrigerant oil flow system. Four pressure-lubricated, rolling-element bearing groups support the rotating assembly.

The motor is a suction gas-cooled, hermetically sealed, two-pole, squirrel cage induction-type.

Unit-Mounted Starter
The unit is supplied with a NEMA 1 type enclosure with top power-wiring access and three-phase, solid state overload protection. The starter is available in a Wye-Delta configuration, factory-mounted and fully pre-wired to the compressor motor and control panel. A factory-installed, factory-wired 600VA control power transformer provides all unit control power (120VAC secondary) and CH530 module power (24VAC secondary). Optional starter features include circuit breakers, ground fault circuit breakers, and mechanical, non-fused disconnects.

Evaporator and Condenser
Shells are carbon steel plate. The evaporator and condenser are designed, tested, and stamped in accordance with ASME Code for refrigerant-side/working-side pressure of 200 psig.

All tube sheets are made of carbon steel; tubes are mechanically expanded into tube sheets and mechanically fastened to tube supports. Evaporator tubes are 1.0-inch (25.4 mm) diameter and condenser tubes are 0.75-inch (19.05 mm) diameter. Both types can be individually replaced. Standard tubes are externally finned, internally enhanced seamless copper with lands at all tube sheets.

All water pass arrangements are available with grooved connections (150 or 300 psig waterside). All connections may be either right- or left-handed. Waterside shall be hydrostatically tested at 1.5X design working pressure.

Refrigerant Circuit
An electronically controlled expansion valve is provided to maintain proper refrigerant flow.

Unit Controls (CH530)
The microprocessor-based control panel is factory-installed and factory-tested. The control system is powered by a control power transformer, and will load and unload the chiller through adjustment of the compressor slide valve. Microprocessor-based chilled water reset based on return water is standard.

The CH530 microprocessor automatically acts to prevent unit shutdown due to abnormal operating conditions associated with low evaporator refrigerant temperature, high condensing temperature, and/or motor current overload. If an abnormal operating condition continues and the protective limit is reached, the machine should shut down.

The panel includes machine protection shutdown requiring *manual reset* for the following conditions:
- low evaporator refrigerant temperature and pressure
- high condenser refrigerant pressure
- low oil flow
- critical sensor or detection circuit faults
- motor current overload
- high compressor discharge temperature
- lost communication between modules
- electrical distribution faults: phase loss, phase imbalance, or phase reversal
- external and local emergency stop
- starter transition failure

The panel also includes machine protection shutdown with *automatic reset* for the following correctable conditions:
- momentary power loss
- under/over voltage
- loss of evaporator or condenser water flow

When a fault is detected, the control system conducts more than 100 diagnostic checks and displays results.

The display will identify the fault, indicate date, time, and operating mode at time of occurrence, and provide type of reset required and a help message. The diagnostic history will display the last ten diagnostics with their times and dates of occurrence.

Clear Language Display Panel
Factory-mounted to the control panel door, the operator interface has an LCD touch-screen display for operator input and information output. This interface provides access to the following information: evaporator report, condenser report, compressor report, ASHRAE Guideline 3 report, operator settings, service settings, service tests, and diagnostics. All diagnostics and messages are displayed in "clear language."

Data contained in available reports includes:
- Water and air temperatures
- Refrigerant levels and temperatures
- Oil pressure
- Flow switch status
- EXV position
- Head pressure control command
- Compressor starts and run-time
- Line phase percent RLA, amps, and volts

All necessary settings and setpoints are programmed into the microprocessor-based controller via the operator interface. The controller is capable of receiving signals contemporaneously from a variety of control sources, in any combination, and priority order of control sources can be programmed. The control source with priority determines active setpoints via the signal it sends to the control panel. Control sources may be:
- the local operator interface (standard)
- a hard-wired 4-20 mA or 2-10VDC signal from an external source (interface optional; control source not supplied)
- Generic BAS (optional points; control source not supplied)
- LonTalk LCI-C (interface optional; control source not supplied)
- Trane Tracer Summit™ system (interface optional)

Conversion Table

To Convert From:	To:	Multiply By:
Length		
Feet (ft)	meters (m)	0.30481
Inches (In)	millimeters (mm)	25.4
Area		
Square Feet (ft^2)	square meters (m^2)	0.093
Square Inches (In^2)	square millimeters (mm^2)	645.2
Volume		
Cubic Feet (ft^3)	Cubic meters (m^3)	0.0283
Cubic Inches (In^3)	Cubic mm (mm3)	16387
Gallons (gal)	litres (l)	3.785
Gallons (gal)	cubic meters (m^3)	0.003785
Flow		
Cubic feet/min (cfm)	cubic meters/second (m^3/s)	0.000472
Cubic Feet/min (cfm)	cubic meters/hr (m^3/hr)	1.69884
Gallons/minute (GPM)	cubic meters/hr (m^3/hr)	0.2271
Gallons/minute (GPM)	litres/second (l/s)	0.06308
Velocity		
Feet per minute (ft/m)	meters per second (m/s)	0.00508
Feet per second (ft/s)	meters per second (m/s)	0.3048

To Convert From:	To:	Multiply By:
Energy and Power and Capacity		
British Thermal Units (BTUH)	Kilowatt (kW)	0.000293
British Thermal Units (BTU)	KCalorie (Kcal)	0.252
Tons (refrig. effect)	Kilowatt (refrig. effect)	3.516
Tons (refrig. effect)	Kilocalories per hour (Kcal/hr)	3024
Horsepower	Kilowatt (kW)	0.7457
Pressure		
Feet of water (ftH_20)	Pascals (PA)	2990
Inches of water (inH_20)	Pascals (PA)	249
Pounds per square inch (PSI)	Pascals (PA)	6895
PSI	Bar or KG/CM^2	6.895×10^{-2}
Weight		
Ounches (oz)	Kilograms (kg)	0.02835
Pounds (lbs)	Kilograms (Kg)	0.4536
Fouling factors for heat exchangers		
0.00075 ft^2 ˚F hr/BTU	= 0.132 m^2 ˚ K/kW	
0.00025 ft^2 ˚F hr/BTU	= 0.044 m^2 ˚ K/kW	

Temperature – Centigrade (˚C) Versus Fahrenheit (˚F)

Note: The center columns of numbers, referred to as BASE TEMP., is the temperature in either degrees Fahrenheit (˚F) or Centigrade (˚C), whichever is desired to convert into the other. If degrees Centrigrade is given, read degrees Fahrenheit to the right. If degrees Fahrenheit is given, read degrees Centigrade to the left.

Temperature		
˚C	C or F	˚F
– 40.0	**– 40**	– 40.0
– 39.4	**– 39**	– 38.2
– 38.9	**– 38**	– 36.4
– 38.3	**– 37**	– 34.6
– 37.8	**– 36**	– 32.8
– 37.2	**– 35**	– 31.0
– 36.7	**– 34**	– 29.2
– 36.1	**– 33**	– 27.4
– 35.6	**– 32**	– 25.6
– 35.0	**– 31**	– 23.8
– 34.4	**– 30**	– 22.0
– 33.9	**– 29**	– 20.2
– 33.3	**– 28**	– 18.4
– 32.8	**– 27**	– 16.6
– 32.2	**– 26**	– 14.8
– 31.7	**– 25**	– 13.0
– 31.1	**– 24**	– 11.2
– 30.6	**– 23**	– 9.4
– 30.0	**– 22**	– 7.6
– 29.4	**– 21**	– 5.8
– 28.9	**– 20**	– 4.0
– 28.3	**– 19**	– 2.2
– 27.8	**– 18**	– 0.4
– 27.2	**– 17**	+ 1.4
– 26.7	**– 16**	+ 3.2
– 26.1	**– 15**	+ 5.0
– 25.6	**– 14**	+ 6.8
– 25.0	**– 13**	+ 8.6
– 24.4	**– 12**	+ 10.4
– 23.9	**– 11**	+ 12.2
– 23.3	**– 10**	+ 14.0
– 22.8	**– 9**	+ 15.8
– 22.2	**– 8**	+ 17.6
– 21.7	**– 7**	+ 19.4
– 21.1	**– 6**	+ 21.2
– 20.6	**– 5**	+ 23.0
– 20.0	**– 4**	+ 24.8
– 19.4	**– 3**	+ 26.6
– 18.9	**– 2**	+ 28.4
– 18.3	**– 1**	+ 30.2
– 17.8	**0**	+ 32.0
– 17.2	**+ 1**	+ 33.8
– 16.7	**+ 2**	+ 35.6
– 16.1	**+ 3**	+ 37.4
– 15.6	**+ 4**	+ 39.2

Temperature		
˚C	C or F	˚F
– 15.0	**+ 5**	+ 41.0
– 14.4	**+ 6**	+ 42.8
– 13.9	**+ 7**	+ 44.6
– 13.3	**+ 8**	+ 46.4
– 12.8	**+ 9**	+ 48.2
– 12.2	**+ 10**	+ 50.0
– 11.7	**+ 11**	+ 51.8
– 11.1	**+ 12**	+ 53.6
– 10.6	**+ 13**	+ 55.4
– 10.0	**+ 14**	+ 57.2
– 9.4	**+ 15**	+ 59.0
– 8.9	**+ 16**	+ 60.8
– 8.3	**+ 17**	+ 62.6
– 7.8	**+ 18**	+ 64.4
– 7.2	**+ 19**	+ 66.2
– 6.7	**+ 20**	+ 68.0
– 6.1	**+ 21**	+ 69.8
– 5.5	**+ 22**	+ 71.6
– 5.0	**+ 23**	+ 73.4
– 4.4	**+ 24**	+ 75.2
– 3.9	**+ 25**	+ 77.0
– 3.3	**+ 26**	+ 78.8
– 2.8	**+ 27**	+ 80.6
– 2.2	**+ 28**	+ 82.4
– 1.7	**+ 29**	+ 84.2
– 1.1	**+ 30**	+ 86.0
– 0.6	**+ 31**	+ 87.8
0.0	**+ 32**	+ 89.6
+ 0.6	**+ 33**	+ 91.4
+ 1.1	**+ 34**	+ 93.2
+ 1.7	**+ 35**	+ 95.0
+ 2.2	**+ 36**	+ 96.8
+ 2.8	**+ 37**	+ 98.6
+ 3.3	**+ 38**	+ 100.4
+ 3.9	**+ 39**	+ 102.2
+ 4.4	**+ 40**	+ 104.0
+ 5.0	**+ 41**	+ 105.8
+ 5.5	**+ 42**	+ 107.6
+ 6.1	**+ 43**	+ 109.4
+ 6.7	**+ 44**	+ 111.2
+ 7.2	**+ 45**	+ 113.0
+ 7.8	**+ 46**	+ 114.8
+ 8.3	**+ 47**	+ 116.6
+ 8.9	**+ 48**	+ 118.4
+ 9.4	**+ 49**	+ 120.2

Temperature		
˚C	C or F	˚F
+ 10.0	**+ 50**	+ 122.0
+ 10.6	**+ 51**	+ 123.8
+ 11.1	**+ 52**	+ 125.6
+ 11.7	**+ 53**	+ 127.4
+ 12.2	**+ 54**	+ 129.2
+ 12.8	**+ 55**	+ 131.0
+ 13.3	**+ 56**	+ 132.8
+ 13.9	**+ 57**	+ 134.6
+ 14.4	**+ 58**	+ 136.4
+ 15.0	**+ 59**	+ 138.2
+ 15.6	**+ 60**	+ 140.0
+ 16.1	**+ 61**	+ 141.8
+ 16.7	**+ 62**	+ 143.6
+ 17.2	**+ 63**	+ 145.4
+ 17.8	**+ 64**	+ 147.2
+ 18.3	**+ 65**	+ 149.0
+ 18.9	**+ 66**	+ 150.8
+ 19.4	**+ 67**	+ 152.6
+ 20.0	**+ 68**	+ 154.4
+ 20.6	**+ 69**	+ 156.2
+ 21.1	**+ 70**	+ 158.0
+ 21.7	**+ 71**	+ 159.8
+ 22.2	**+ 72**	+ 161.6
+ 22.8	**+ 73**	+ 163.4
+ 23.3	**+ 74**	+ 165.2
+ 23.9	**+ 75**	+ 167.0
+ 24.4	**+ 76**	+ 168.8
+ 25.0	**+ 77**	+ 170.6
+ 25.6	**+ 78**	+ 172.4
+ 26.1	**+ 79**	+ 174.2
+ 26.7	**+ 80**	+ 176.0
+ 27.2	**+ 81**	+ 177.8
+ 27.8	**+ 82**	+ 179.6
+ 28.3	**+ 83**	+ 181.4
+ 28.9	**+ 84**	+ 183.2
+ 29.4	**+ 85**	+ 185.0
+ 30.0	**+ 86**	+ 186.8
+ 30.6	**+ 87**	+ 188.6
+ 31.1	**+ 88**	+ 199.4
+ 31.7	**+ 89**	+ 192.2
+ 32.2	**+ 90**	+ 194.0
+ 32.8	**+ 91**	+ 195.8
+ 33.3	**+ 92**	+ 197.6
+ 33.9	**+ 93**	+ 199.4
+ 34.4	**+ 94**	+ 201.2

Temperature		
˚C	C or F	˚F
+ 35.0	**+ 95**	+ 203.0
+ 35.6	**+ 96**	+ 204.8
+ 36.1	**+ 97**	+ 206.6
+ 36.7	**+ 98**	+ 208.4
+ 37.2	**+ 99**	+ 210.2
+ 37.8	**+ 100**	+ 212.0
+ 38.3	**+ 101**	+ 213.8
+ 38.9	**+ 102**	+ 215.6
+ 39.4	**+ 103**	+ 217.4
+ 40.0	**+ 104**	+ 219.2
+ 40.6	**+ 105**	+ 221.0
+ 41.1	**+ 106**	+ 222.8
+ 41.7	**+ 107**	+ 224.6
+ 42.2	**+ 108**	+ 226.4
+ 42.8	**+ 109**	+ 228.2
+ 43.3	**+ 110**	+ 230.0
+ 43.9	**+ 111**	+ 231.8
+ 44.4	**+ 112**	+ 233.6
+ 45.0	**+ 113**	+ 235.4
+ 45.6	**+ 114**	+ 237.2
+ 46.1	**+ 115**	+ 239.0
+ 46.7	**+ 116**	+ 240.8
+ 47.2	**+ 117**	+ 242.6
+ 47.8	**+ 118**	+ 244.4
+ 48.3	**+ 119**	+ 246.2
+ 48.9	**+ 120**	+ 248.0
+ 49.4	**+ 121**	+ 249.8
+ 50.0	**+ 122**	+ 251.6
+ 50.6	**+ 123**	+ 253.4
+ 51.1	**+ 124**	+ 255.2
+ 51.7	**+ 125**	+ 257.0
+ 52.2	**+ 126**	+ 258.8
+ 52.8	**+ 127**	+ 260.6
+ 53.3	**+ 128**	+ 262.4
+ 53.9	**+ 129**	+ 264.2
+ 54.4	**+ 130**	+ 266.0
+ 55.0	**+ 131**	+ 267.8
+ 55.6	**+ 132**	+ 269.6
+ 56.1	**+ 133**	+ 271.4
+ 56.7	**+ 134**	+ 273.2
+ 57.2	**+ 135**	+ 275.0
+ 57.8	**+ 136**	+ 276.8
+ 58.3	**+ 137**	+ 278.6
+ 58.9	**+ 138**	+ 280.4
+ 59.4	**+ 139**	+ 282.2

Temperature		
˚C	C or F	˚F
+ 60.0	**+ 140**	+ 284.0
+ 60.6	**+ 141**	+ 285.8
+ 61.1	**+ 142**	+ 287.6
+ 61.7	**+ 143**	+ 289.4
+ 62.2	**+ 144**	+ 291.2
+ 62.8	**+ 145**	+ 293.0
+ 63.3	**+ 146**	+ 294.8
+ 63.9	**+ 147**	+ 296.6
+ 64.4	**+ 148**	+ 298.4
+ 65.0	**+ 149**	+ 300.2
+ 65.6	**+ 150**	+ 302.0
+ 66.1	**+ 151**	+ 303.8
+ 66.7	**+ 152**	+ 305.6
+ 67.2	**+ 153**	+ 307.4
+ 67.8	**+ 154**	+ 309.2
+ 68.3	**+ 155**	+ 311.0
+ 68.9	**+ 156**	+ 312.8
+ 69.4	**+ 157**	+ 314.6
+ 70.0	**+ 158**	+ 316.4
+ 70.6	**+ 159**	+ 318.2
+ 71.1	**+ 160**	+ 320.0
+ 71.7	**+ 161**	+ 321.8
+ 72.2	**+ 162**	+ 323.6
+ 72.8	**+ 163**	+ 325.4
+ 73.3	**+ 164**	+ 327.2
+ 73.9	**+ 165**	+ 329.0
+ 74.4	**+ 166**	+ 330.8
+ 75.0	**+ 167**	+ 332.6
+ 75.6	**+ 168**	+ 334.4
+ 76.1	**+ 169**	+ 336.2
+ 76.7	**+ 170**	+ 338.0
+ 77.2	**+ 171**	+ 339.8
+ 77.8	**+ 172**	+ 341.6
+ 78.3	**+ 173**	+ 343.4
+ 78.9	**+ 174**	+ 345.2
+ 79.4	**+ 175**	+ 347.0
+ 80.0	**+ 176**	+ 348.8
+ 80.6	**+ 177**	+ 350.6
+ 81.1	**+ 178**	+ 352.4
+ 81.7	**+ 179**	+ 354.2
+ 82.2	**+ 180**	+ 356.0
+ 82.8	**+ 181**	+ 357.8
+ 83.3	**+ 182**	+ 359.8
+ 83.9	**+ 183**	+ 361.4
+ 84.4	**+ 184**	+ 363.2

FOR INTERPOLATION IN THE ABOVE TABLE USE:

BASE TEMPERATURE (˚F or ˚C)	1	2	3	4	5	6	7	8	9	10
DEGREES CENTIGRADE:	0.56	1.11	1.67	2.22	2.78	3.33	3.89	4.44	5.00	5.56
DEGREES FAHRENHEIT:	1.8	3.6	5.4	7.2	9.0	10.8	12.6	14.4	16.2	18.0

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Stocking Location	Inland

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