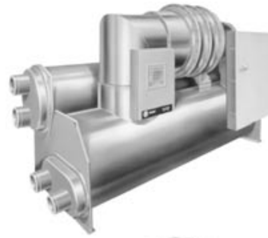
CenTraVac™ Liquid Chillers

Centrifugal Liquid Chillers/ Water-Cooled 170-3500 Tons 50 and 60 Hz

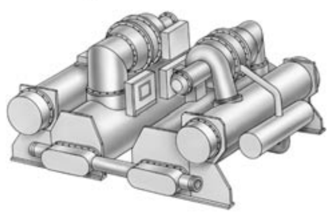
Built For the Industrial and Commercial Markets



CVHE — Three Stage: 170 – 500

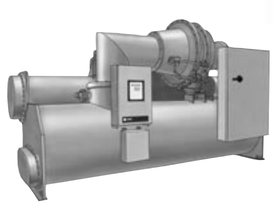
CVHG — Three Stage: 450 – 1300

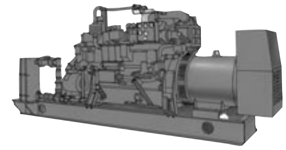
CVHF — Two-Stage CenTraVac: 325 – 1750



LHCV — Module CenTraVac: 1300 – 3500

GPC — Gas Powered CenTraVac Package: 170 – 3500





April 2001

CTV-PRC007-EN

Introduction

World's Most Efficient Lowest Emissions Chiller

What We Mean By Earth•Wise Breaking the .48 kW/Ton Efficiency Barrier

The Trane Earth•Wise CenTraVac has a proven track record as literally the world's most efficient, lowest emissions chiller. In fact, a portion of the product line is selectable at an unmatched efficiency level of .48 kW/ton, at standard ARI rated conditions. This is an efficiency level of 16 to 25 percent better than competitive chillers using other alternative refrigerants, which are typically in the .56 to .60 kW/ton range.

On a 1000-ton chiller, this efficiency difference can provide savings of over $24,000 per year or nearly three quarters of a million dollars over the life of the machine . . . typically more than twice the initial cost of the machine. And, at part-load conditions, the kW/ton ratings are even better; a fact that can be seen by comparing Trane's ARI certified applied part load values (NPLV's) to those of competitive units.

The development of the .48 kW/ton chiller also has a positive environmental impact. Consider this:
If every centrifugal chiller in the world were able to operate at .48 vs .56 kW/ton, utility generated greenhouse gas emissions could be reduced annually by nearly 17 billion pounds of CO_2 while SO_2 and NO_x could be reduced by over 64 and 27 billion grams, respectively. This reduction is equivalent to removing more than two million cars from the road or to planting nearly 500 million trees each year.

Lowest Total Refrigerant Emissions In The Industry

Furthermore, the Trane "near zero" emissions Earth•Wise chiller also has the lowest total refrigerant emissions in the industry. So low that it's essentially a closed system.

The key to the industry's highest energy efficiency and lowest leak rate is the use of a low pressure refrigerant DuPont calls SUVA-123; a refrigerant that has the lowest direct-effect global warming potential and the highest thermodynamic efficiency of all non-CFC refrigerants; a refrigerant in use in more new centrifugals today than all other alternatives combined.

Balancing Our Accountability for Ozone Depletion, Global Warming and Energy Efficiency

Reduced power plant emissions and the industry's lowest refrigerant emission rate put the Trane .48 kW/ton Earth•Wise centrifugal chiller in a class by itself, from both a business and an environmental standpoint. The future lies in the prudent balance that takes into account the importance of ozone depletion, global warming and energy efficiency. A balance that is right for both business and the environment.

Built For The Industrial Market

- Direct drive for reliability
- Multi-stage compressor for efficiency.
- "Near Zero" refrigerant emission design.
- Evaporator and condenser designed to maximize efficiency and reduce operating costs.
- Proven shell and tube design offering a variety of high performance heat transfer surfaces.
- Evaporator, condenser and compressor combinations allow selection of a chiller that best meets the system requirements.
- Options like heat recovery, free cooling, auxiliary condensers, ice storage and a unit-mounted starter for expanded capability and maximum efficiency.
- Complete factory assembly of the CenTraVac™ options for reduced jobsite assembly labor and expense.
- Machines designed for operating with environmentally acceptable HCFC-123.
- Trane patented fixed orifice system for ensuring proper refrigerant flow at all load conditions. This eliminates the need for other moving parts such as float valves, expansion valves.
- Low speed direct drive capability offers up to 5 percent more energy efficiency, at full load, than gear drive chillers. Also, low speed direct-drive operation improves reliability and maintenance costs are also lower.
- CenTraVac control panel
- Adaptive Control™
- Microprocessor based
- Complete operating status and diagnostics display.
- Interfaces with building management system.
- High efficiency Purifier™ Purge works as an early warning leak detector that also takes purge refrigerant emissions to an industry low.

Contents

Introduction

Trane Hermetic Centrifugal Water Chillers

A Tradition of Innovation

The first Trane centrifugal chiller, the Turbovac™ was introduced in 1938. The simple, direct drive, slow speed design of the Turbovac revolutionized the air conditioning industry. The chiller was attractive to customers because its hermetic design reduced frequent service requirements.

In 1951 the Trane CenTraVac™ centrifugal chiller was introduced. Its unique two stage compressor with multiple inlet guide vanes and patented economizer reduced energy consumption on typical applications to less than 0.8 kW/ton.

The model PCV CenTraVac chiller that was introduced in 1966, allowed quality air conditioning for applications as small as 120 tons.

In 1982 the CenTraVac chiller solidified its position as the industry leader by introducing a three-stage compressor and a two-stage economizer. As a result, this chiller was 5 to 20 percent more efficient than previous designs.

Today's CenTraVac chiller still relies on the dependability of the proven direct drive and exclusive slow speed operation. Low operating costs and high reliability continue to be the CenTraVac chiller hallmark.

When a source of energy other than electricity is required
The Trane CenTraVac has the standard option of being coupled to a Waukesha Enginator to quite simply convert natural gas to chilled water. With COPs in the range of 1.5 to 2.2 depending on options selected, makes this option a very simple and attractive alternative when an alternative fuel source is desired.

Trane GPC* Benefits

- Combines two industry-recognized and proven products, the Trane Earth•Wise CenTraVac and Waukesha Enginator
- Ability to do both base and peak shaving
- No on-site piping connections
  - Refrigerant leaks minimized
  - No need to remove refrigerant charge from chiller during downtime
  - Installations more flexible, simpler and cost effective
- Ability to place the engine generator set in a location remote of the chiller
  - Allows for efficient use of plant floor space
  - Provides flexibility in sound sensitive work areas

*Limited availability for International orders – Please contact International CenTraVac Marketing Group.

Unmatched Expertise
The performance and reliability of a CenTraVac™ chiller is backed by a team of experienced field sales engineers with support from headquarters experts. No other manufacturer can offer that degree of support to its customers.

In the design phase, application engineers can help answer your questions or solve your problems. During the selection phase, software engineers are available to help you evaluate equipment alternatives. At the installation stage, field start-up of the CenTraVac chiller is included in the purchase price. Trane offers this support and more when you need it.

Delivery And Design Flexibility
If delivery time is a priority, Trane can meet your needs with a variety of quick shipment choices. Most fast track building schedules can be met with one of these choices.

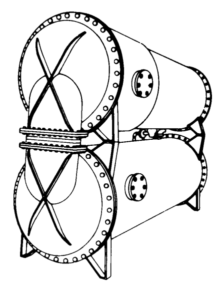
Design flexibility means Trane can custom build a unit to specific job requirements. Design parameters such as shell type, compressor, kW/ton, waterside pressure drop, as well as full and part load performance can be built to meet requirements.

ISO 9001 Certification
ISO 9001 Certification applies to the Trane La Crosse Business Unit. This process is based on the La Crosse Business Unit's ISO 9001 certified quality system. This system is documented in procedures which define how quality assurance activities are managed, performed, and continuously monitored. Included in the system are verification checkpoints from the time the order is entered until final shipment. In addition, product development for the marketplace is subjected to formal planning, review and validation. The system is designed to assure maximum consistency in meeting customer requirements.

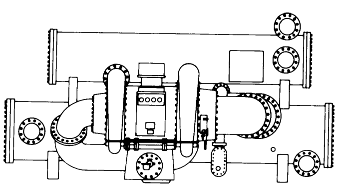
The Beauty of Simplicity
The reliability of a centrifugal chiller starts with its basic product design. At Trane we've found that the straightest path to reliability is simplicity. Years of research and field testing have honed the design of the CenTraVac chiller to a simple, precise solution to a complex engineering problem.

This simple design provides efficiency and reliability benefits. The Trane CenTraVac chiller has only one moving part — no gear boxes, couplings or extra shafts. The single rotating shaft is supported by two aircraft turbine grade/rated bearings. This direct drive concept minimizes the chance of failure for moving parts. It also reduces wear and drag on parts, resulting in more efficient operation.

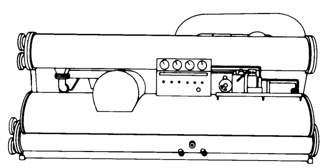
Introduction



1939 — The Trane Turbovac



1951 — The original Trane CenTraVac chiller



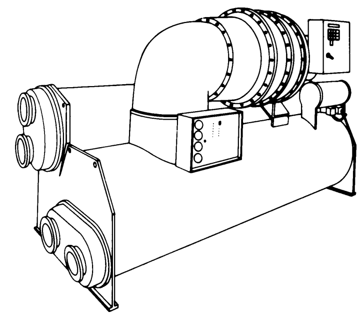
1965 — The Model PCV CenTraVac chiller

Specific Trane centrifugal chiller performance is certified by ARI Standard 550/590. Trane centrifugal chillers tested within the scope of the ARI program display the ARI symbol of compliance (shown on back cover) to certification sections of ARI Standard 550/590.

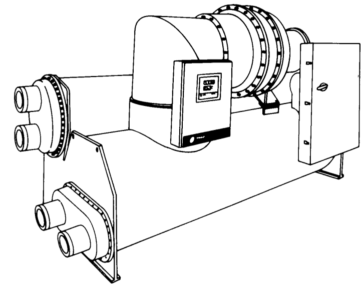
Purifier™ purge with Purifier Plus™ are rated in accordance with ARI Standard 580.

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

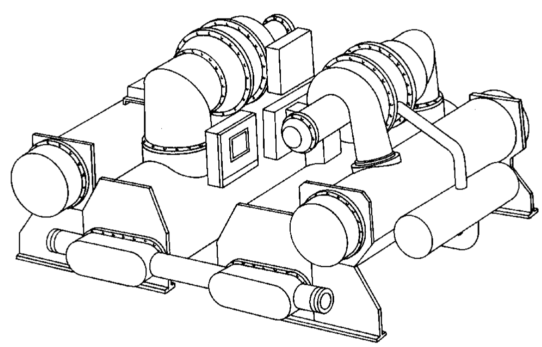
- Low temperature applications, including ice storage
- Glycol
- Chillers above 2000 tons
- Free cooling
- Heat recovery
- Auxiliary condenser
- Chillers that are 50 Hertz



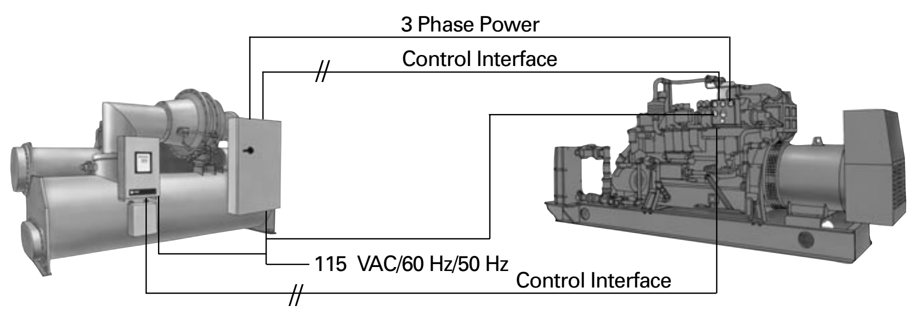
1982 — The three-stage CVHE CenTraVac Chiller



1992 — The two-stage CVHF CenTraVac Chiller



1992 — The LHCV CenTraVac Modular Chiller system



1997 — The Gas Powered CenTraVac (GPC) Chiller Package

Comparing the Attributes of Low Pressure Chiller Operation to High Pressure Chiller Operation.

Trane CenTraVac chillers continue to offer time tested and proven low pressure refrigerants including the alternative environment friendly HCFC- 123. Trane CenTraVac chillers provide the safety of low pressure with continued product improvement in leak proof design. Consider the following benefits of low pressure over high pressure chillers.

	Low Pressure	Medium/High Pressure
Evaporator	• Always at low negative pressure • Air leaks inward at low rate • Refrigerant lost: (# air leak in) x purge efficiency* • No refrigerant loss is into equipment room (vented to the outside via purge)	• Always at positive pressure • Refrigerant leaks outward at moderate rate • Refrigerant loss is into equipment room
Condenser	• At positive pressure during operation • Usually at negative pressure during inactivity (air leaks inward) • Refrigerant leaks outward at very low rate during operation	• Always at high positive pressure • Refrigerant leaks outward at very high rate
Monitoring of leak rate	• Trane Purifier Purge is able to continuously monitor in-leakage with a purge timer • Refrigerant monitor as required by ASHRAE • Purge timer can be connected to building automation system for notification of increased purge operation (in-leak). Similarly, the refrigerant monitor can be connected to the building automation system.	• Only ways to monitor leak rate on high pressure chiller are — periodic leak checks — purchase refrigerant monitor • Refrigerant monitor as required by ASHRAE • Normally the only time that a leak is detected on a high pressure chiller is during spring start-up. This means that a chiller which develops a leak in the summer, may leak continuously until the following spring.
	HCFC-123	**HFC-134a**
Typical Pressures (38°F evap.) (100°F cond.)	Evap: 18.7 inches of Mercury Cond: 6.1 psig	Evap: 33.1 psig Cond: 124.1 psig

*Trane Purifier Purge efficiency does not exceed 0.002 lbs./refrigerant/lbs.-air

TRANE

Features and Benefits

Control Panel

Operator Control Panel

Trane has multi-language support for all chillers controlled by the UCP2™ including but limited to: CVHE, CVHF, CVHG, GPC and LHCV alarm. The standard Clear Language Display (CLD) supports eight languages including English, French, German, Spanish, Katakana, Italian, Portuguese and Dutch. The Complex Character CLD was added to support languages such as Traditional and Simplified Chinese, Japanese, Thai and Korean.

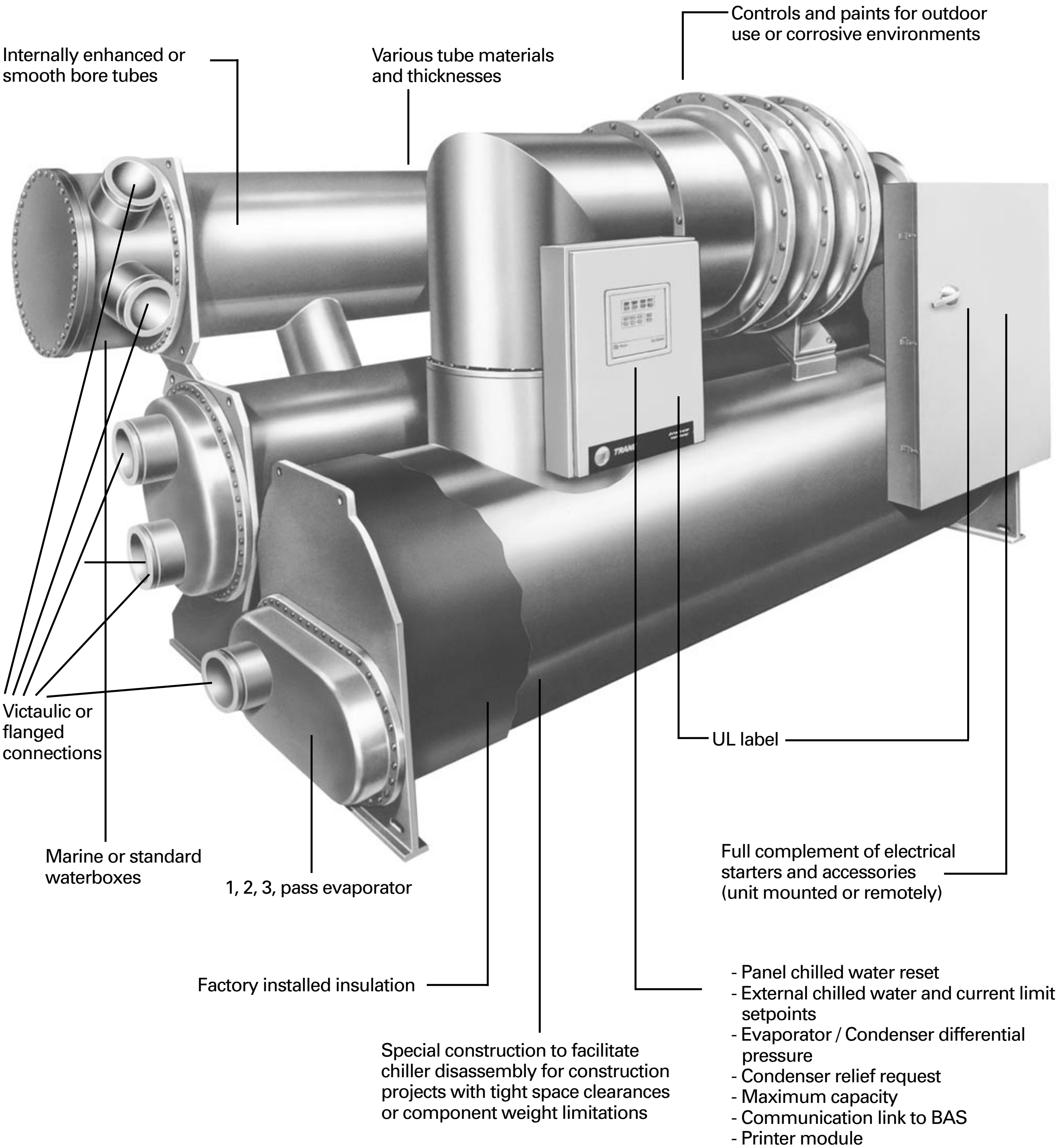
The Complex Character CLD is available as a retrofit kit for the standard CLD on the UCP2 panel. With the same wiring and mounting, it is as simple as disconnecting two wires, unbolting the existing CLD, bolting on the Complex Character CLD and reconnecting the two wires.

Capabilities include:

- Super-twist LCD display with backlighting for readability.
- Chiller data (more than 200 items) including:
  - Status
  - Setpoints
  - Field start-up items
  - Machine configuration items
  - Service test items
- Status reports:
  - Chiller Report
  - Refrigerant Report
  - Compressor Report
- Custom report capability.
- More than 100 diagnostic messages including a history log of the last 20 diagnostics
  - An alarm indicator
  - Expanded help messages
  - Operator security
  - Internationally recognized symbols

Features and Benefits

Components



Standard Features

The following features are provided as standard with all Trane CenTraVac™ chillers:

- Motor-compressor assembly with integral lubrication system.
- Evaporator condenser assembly.
- Two-stage economizer assembly on CVHE/CVHG style units (single-stage on CVHF style units).
- Prewired instrument and control panel.
- Oil and refrigerant charge.
- Oil heater.
- Isolation pads
- Wiring and conduit for purge and oil system interconnection to the main control panel.
- Installation, operation, and maintenance instructions.
- Start-up and operator instruction service.
- Advanced motor protection.

CenTraVac Motor
The motor provided in the Trane CenTraVac chiller is a specially designed squirrel cage, two pole induction motor suitable for 50 and 60 hertz, three-phase current.

Trane CenTraVac motors are cooled by liquid refrigerant surrounding the motor windings and rotor. Use of liquid refrigerant results in uniform low temperatures throughout the motor, thereby promoting long motor life.

Refrigerant/Oil Pump Motor
The oil pump motor is a 120 volt, 50/60 hertz, 3/4 hp, 1 phase motor with protective fusing and panel mounted contactor.

Purge
The purge unit motor is a 120 volt, 50/60 hertz, 3/4 hp, 1 phase motor with integral overload protection and panel mounted contactor.

The use of an air-cooled condensing unit obtains separation temperatures in the purge drum as low as 0°F. Normal operating efficiency does not exceed 0.002 lbs. of refrigerant lost per pound of dry air removed. The purge system can be operated at any time, independent of chiller operation.

Optional Features

Trane offers a selection of optional features to either complete the basic chiller installation or to allow modification for special purpose applications.

- Medium voltage (over 600 volts) hermetic compressor motor construction.
- Complete line of compressor motor starters.
- Unit mounted starter accessory on low voltage units up to an RLA of 1080 amps.
- Marine waterboxes for evaporators and condensers
- High pressure (300 psig working pressure) water side construction.
- Free cooling.
- Heat recovery or auxiliary condensers.
- Smooth bore tubing.
- Factory-applied thermal insulation
- One-inch deflection spring isolators for vibration-sensitive installations.
- Building automation systems (BAS) interface
- Variable speed drives
- Internally enhanced tubes
- Various tube wall thicknesses
- UL Label
- Three pass evaporator/one pass evaporator
- Special construction to facilitate chiller disassembly at the job
- CuNi Tubes
- Special paint and controls for outdoor use or corrosive environments
- Unit mounted refrigerator monitor

Factory Testing for Assured Performance

To prove that your chiller will perform as promised, Trane offers factory performance testing, which you can witness.

Trane provides laboratory-grade, calibrated performance testing on ARI approved test loops that proves the performance of the chiller tailored to your application. The test provides:

- Confirmed efficiency
- Confirmed capacity
- Smooth trouble-free start-up confirmed through factory testing and commissioning of both chiller and controls

Trane believes centrifugal chiller testing is so important that we invested over $2 million in CenTraVac testing facilities. Testing is in accordance with ARI Standard 550/590 and calibration of instrumentation meets or exceeds the National Institute of Standards Technology (NIST).

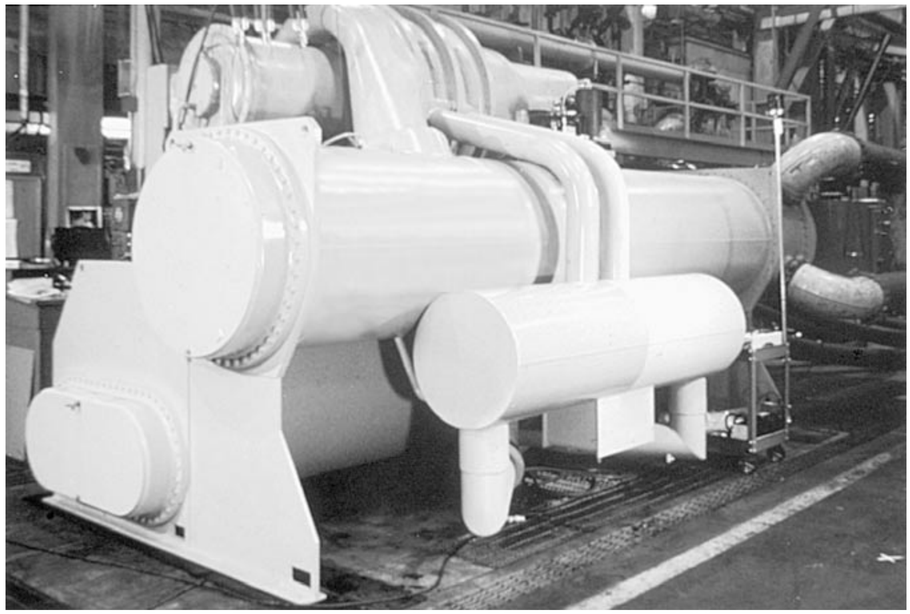
The industry has responded to the demand for more efficient chillers by developing machines with component mix-matching and many money saving options. It's possible that with the thousands of component combinations available, a specific chiller combination may be laboratory tested for the first time.

Trane offers two levels of CenTraVac performance testing:

- A performance test at design conditions plus a certified test report.
- A customer-witnessed performance test at design conditions plus a certified test report.

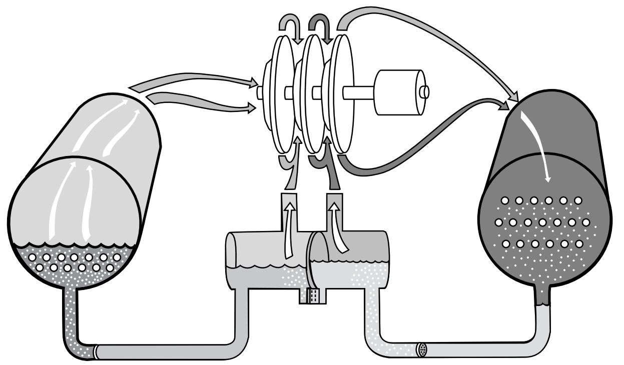
Trane is part of the ARI 550/590 certification program. The selection program and machines bear the ARI seal of approval. Performance testing is a key part of this program. While the certification program is technically sound, a factory run test, with your machine on the test stand, is still the best way to confirm machine performance and a trouble-free start-up.

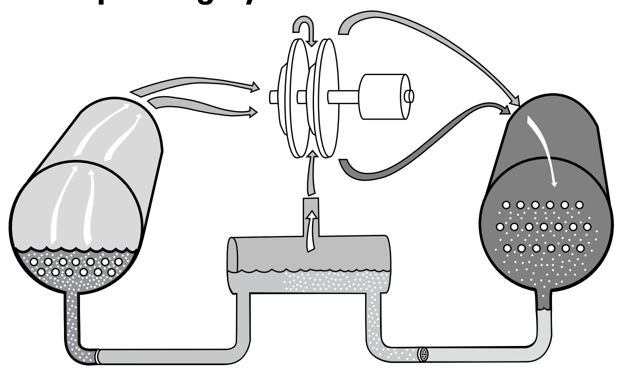
The single package design of the CenTraVac chiller allows testing of each assembled chiller at the factory. Actually all components including the evaporator, condenser, compressor and control panel are tested before final assembly. After assembly, performance testing of the chiller can confirm proper operation and virtually eliminate jobsite start-up problems.



During customer witnessed performance tests of Trane CenTraVac chillers, a nickel can be balanced on the edge of the compressor-motor assembly, demonstrating the extremely low vibrations generated by the unit while operating at full and part load conditions.

The CenTraVac™ Chiller Operating Cycle


Three Stage Refrigerant Flow


Two Stage Refrigerant Flow

Design Simplicity
Impellers are keyed directly to the motor shaft for high reliability and performance and low life-cycle costs.

Reliable Motor Cooling
The motor is engulfed in liquid refrigerant to provide efficient, complete cooling at all load conditions. This system is reliable and easy to maintain.

Fixed Orifice Flow Control
For proper refrigerant flow control at all load conditions, the CenTraVac design incorporates the Trane patented fixed orifice system. It eliminates float valves, thermal expansion valves and other moving parts. Since there are no moving parts, reliability is increased.

Quiet Operation
With only one moving component — the rotor and impeller assembly — the Trane low speed, direct drive design operates exceptionally quietly. The smoothly rotating CenTraVac compressor is inherently quieter than other compressor types. Typical CenTraVac chiller sound measurements are among the quietest in the industry. Trane can guarantee sound levels with factory testing and measurements in accordance with ARI standard 575.

The Reliability Standard
Just as a multi-stage turbine is more efficient than a single stage turbine, the CenTraVac multi-stage compressors are more efficient and reliable than single-stage designs.

Direct Drive Design — No Gear Losses
The direct drive compressor operates without speed increasing gears, thus eliminating gear energy losses. Compressors using gears suffer mesh losses and extra bearing losses in the range of three to five percent at full load. Since these losses are fairly constant over the load range, increasingly larger percentage losses result as load decreases.

Multiple Stages of Compression
The compressor operates more efficiently over a wide range of capacities, virtually eliminating the need for energy wasting hot gas bypass as typically found on single stage chillers.

The radial component of velocity determines the ability of the chiller to resist interruption of smooth refrigerant flow when operating at light loads and with high condensing temperatures. This interruption in flow and unstable operation, called “surge” is avoided with the two-stage design.

Inlet Guide Vanes
Part load performance is further improved through use of moveable designed variable inlet guide vanes. Inlet guide vanes improve performance by throttling refrigerant gas flow to exactly meet part load requirements and by prerotating refrigerant gas for optimum entry into the impeller. Prerotation of refrigerant gas minimizes turbulence and increases efficiency.

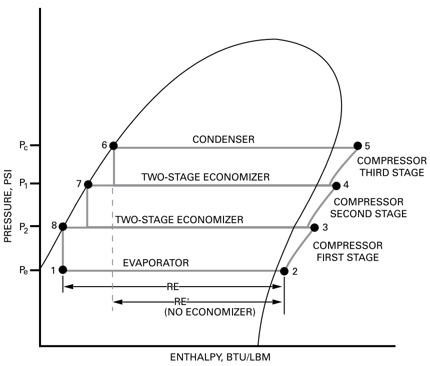
Two-Stage Economizer
The CVHE/CVHG CenTraVac chiller has a two-stage economizer — providing up to seven percent greater efficiency than designs with no economizer. Since the CVHE/CVHG uses three impellers, it is possible to flash refrigerant gas at two intermediate pressures between the evaporator and condenser pressures, significantly increasing chiller efficiency. This improvement in efficiency is not possible in single-stage chillers since all compression is done by one impeller.

Single Stage Economizer
The CVHF CenTraVac chiller has a single-stage economizer — providing up to 4½ percent greater efficiency than designs with no economizer.
Since the CVHF CenTraVac uses two impellers, it is possible to flash refrigerant gas at an intermediate pressure between the evaporator and condenser pressures, significantly increasing chiller efficiency. This improvement in efficiency is not possible in single-stage chillers since all compression is done by one impeller.

Features and Benefits

Refrigeration Cycle (Cont.)

Three-Stage CenTraVac P-H Diagram



CenTraVac™ Three-Stage P-H Diagram
The pressure-enthalphy (P-H) diagram describes refrigerant flow through the major CVHE/CVHG chiller components. This diagram confirms the superior operating cycle efficiency of the three-stage compressor and two-stage economizer.

Evaporator — A liquid-gas refrigerant mixture enters the evaporator at state point 1. Liquid refrigerant is vaporized to state point 2 as it absorbs heat from the system cooling load. The vaporized refrigerant then flows into the compressor first stage.

Compressor First Stage — Refrigerant gas is drawn from the evaporator into the first stage compressor. The first stage impeller accelerates the gas increasing its temperature and pressure to state point 3.

Compressor Second Stage — Refrigerant gas leaving the first stage compressor is mixed with cooler refrigerant gas from the low pressure side of the two-stage economizer. This mixing lowers the enthalpy of the mixture entering the second stage. The second stage impeller accelerates the gas, further increasing its temperature and pressure to state point 4.

Compressor Third Stage — Refrigerant gas leaving the compressor second stage is mixed with cooler refrigerant gas from the high pressure side of the two-stage economizer. This mixing lowers the enthalpy of the gas mixture entering the third stage compressor. The third stage impeller accelerates the gas, further increasing its temperature and pressure to state point 5, then discharges it to the condenser.

Condenser — Refrigerant gas enters the condenser where the system cooling load and heat of compression are rejected to the condenser water circuit. This heat rejection cools and condenses the refrigerant gas to a liquid at state point 6.

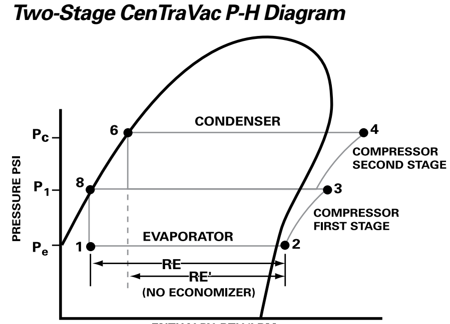
Patented Two-Stage Economizer and Refrigerant Orifice System-Liquid refrigerant leaving the condenser at state point 6 flows through the first orifice and enters the high pressure side of the economizer. The purpose of this orifice and economizer is to preflash a small amount of refrigerant at an intermediate pressure called P1. P1 is between the evaporator and condenser pressures. Preflashing some liquid refrigerant cools the remaining liquid to state point 7.

Refrigerant leaving the first stage economizer flows through the second orifice and enters the second stage economizer. Some refrigerant is preflashed at intermediate pressure P2. Preflashing the liquid refrigerant cools the remaining liquid to state point 8.

Another benefit of preflashing refrigerant is to increase the total evaporator refrigeration effect from RE' to RE. The two-stage economizer provides a seven percent energy savings compared to chillers with no economizer.

To complete the operating cycle, liquid refrigerant leaving the economizer at state point 8 flows through a third orifice system. Here, refrigerant pressure and temperature are reduced to evaporator conditions at state point 1.

Two-Stage CenTraVac P-H Diagram



CenTraVac Two-Stage P-H Diagram
The pressure-enthalphy (P-H) diagram describes refrigerant flow through the major CVHF chiller components. This diagram confirms the superior operating cycle efficiency of the two- stage compressor and economizer.

Evaporator — A liquid-gas refrigerant mixture enters the evaporator at state point 1. Liquid refrigerant is vaporized to state point 2 as it absorbs heat from the system cooling load. The vaporized refrigerant then flows into the compressor first stage.

Compressor First Stage — Refrigerant gas is drawn from the evaporator into the first stage compressor. The first stage impeller accelerates the gas increasing its temperature and pressure to state point 3.

Compressor Second Stage — Refrigerant gas leaving the first stage compressor is mixed with cooler refrigerant gas from the economizer. This mixing lowers the enthalpy of the mixture entering the second stage. The second stage impeller accelerates the gas, further increasing its temperature and pressure to state point 4.

Condenser — Refrigerant gas enters the condenser where the system cooling load and heat of compression are rejected to the condenser water circuit. This heat rejection cools and condenses the refrigerant gas to a liquid at state point 6.

Economizer and Refrigerant Orifice System-Liquid refrigerant leaving the condenser at state point 6 flows through the first orifice and enters the economizer. The purpose of this orifice and economizer is to preflash a small amount of refrigerant at an intermediate pressure called P1. P1 is between the evaporator and condenser pressures. Preflashing some liquid refrigerant cools the remaining liquid to state point 8.

Another benefit of flashing refrigerant is to increase the total evaporator refrigeration effect from RE' to RE. The economizer provides a 4½ percent energy savings compared to chillers with no economizer. To complete the operating cycle, liquid refrigerant leaving the economizer at state point 8 flows through a second orifice system. Here, refrigerant pressure and temperature are reduced to evaporator conditions at state point 1.

Unit Options

Unit Mounted Starter

Unit-Mounted Starters

Trane factory installed options make installation of a CenTraVac™ chiller easier, faster and less costly. Another example of the Trane packaged concept is the factory installed unit-mounted star delta starter available on CenTraVac chillers up to 1300 tons capacity or solid-state starters up to 1000 tons, depending on jobsite electrical requirements. It's a single chiller/starter package designed for years of reliable operation and low life-cycle costs.

Installation cost is reduced by eliminating chiller-to-starter, starter-to-disconnect and starter-to-control panel field wiring. All this wiring is completed and tested in the factory, ensuring electrical integrity. Since most wiring is factory completed, electrical system design time is reduced.

Starter components are pre-engineered and selected to provide a reliable, cost effective chiller/starter package. This single source responsibility for the CenTraVac chiller and unit-mounted starter package is a real advantage. Potential scheduling problems associated with separate starter and chiller installations are eliminated. When the CenTraVac chiller arrives at the jobsite with the unit-mounted starter, the only remaining wiring is the main power wiring to the disconnect switch, and a few simple electrical interlocks to the chilled water and condenser water flow sensing devices.

To ensure a trouble-free start-up on the electrical side, the unit-mounted starter is tested with the chiller as part of the factory performance testing program.

Our commitment to customer and equipment safety offers the Underwriters Laboratories Inc. (UL) mark of safety on both chiller and starter and available accessories.

Compressor Motor Starting Equipment Features

Trane can provide compressor motor starting equipment built to rigid Trane specifications. The types of starters available include:

Low Voltage (200 to 600 volts)
- Star (wye)-delta closed transition
- Full voltage
- Autotransformer, closed transition
- Solid-state starters

Medium Voltage (2300 to 6000 Volts)
- Full voltage
- Primary reactor, closed transition
- Autotransformer, closed transition

Medium voltage starters are provided as standard with a non-load break isolation switch and current limiting fuses.

All starters provided by Trane include the following standard features for safe, efficient application and ease of installation:
- NEMA 1 starter enclosure.
- 120 volt, 60 hertz, 1 phase fused pilot and safety circuits.
- Control power transformer (4.0 KVA) with 120 volt, 50 or 60 hertz, single-phase.
- One pilot relay to initiate start sequence from CenTraVac control circuit signal.
- Starter enclosures capable of being padlocked.
- Automatic transfer from wye to delta on any two-step starter.

In addition, Trane offers a wide selection of optional starter features.
- Starters with standard or high interrupting capacity circuit breakers, to provide disconnect means and short circuit protection (low voltage only).
- Ammeters and voltmeters.
- Special function pilot lights.
- Special NEMA enclosures.
- Ground fault protection.
- Power factor correction capacitors.
- I.Q. Data Plus monitor device.

If the CenTraVac compressor starting equipment is provided by others, the starter must be designed in accordance with the current Trane standard engineering specification "Water-Cooled CenTraVac™ Starter Specification." It is also recommended that two copies of the interconnecting and control circuit wiring diagrams be forwarded to The Trane Company for review. This service is provided at no charge, and is intended to help minimize the possibility that Trane CenTraVac chillers will be applied in improper starting and control systems. However, the responsibility for providing proper starting and control systems must remain with the system designer and the installer.

Contact your local Trane sales office for further information.

The typical equipment room layout for a Trane CenTraVac™ unit or remote mounted starter are shown in Figures O-1 and O-2. A NEMA 1, star-delta (wye-delta) type closed transition reduced voltage motor starter is mounted, as an optional accessory, on Trane CenTraVac chillers rated up to and including 1080 RLA on low voltage (600 volts and below) systems. All power and control wiring between the starter and the chiller are factory assembled. Factory assembly enhances total system reliability and integrity. Total installed chiller/starter costs are significantly reduced by the unit mounted starter option rather than a conventional remote mounted starter.

Benefits
- **Reduces starter installation costs 20 to 35 percent:**
- By eliminating chiller-to-starter field wiring
- By eliminating starter-to-disconnect switch field wiring (when optional circuit breaker is used)
- By eliminating field installed disconnect switch (when optional circuit breaker is used)
- By eliminating starter mounting pad and required equipment room floor space
- By eliminating control wiring from starter to control panel
- **Electrical system reliability is enhanced:**
- By reducing the number of field electrical connections
- By making starter-to-chiller electrical connections under factory-controlled conditions
- By testing the entire chiller/starter combination, in the factory
- By providing control components designed to operate with the unique CenTraVac motor/compressor start and protection subsystem
- **Single Source Responsibility**
  Trane retains complete responsibility for the starter and associated chiller/starter interconnecting wiring.

Unit Options

Unit Mounted Starter (Cont.)

- **System Design Time Cost Savings**
  System design time is reduced, since all starter components and interconnecting wiring are pre-engineered and selected.
- **Complete package available with Agency Approval**
- **Application**
  The Trane unit mounted starter can be applied on low voltage (600 volts) and below applications up to approximately 1300 tons capacity. To determine the unit mounted starter to be used with a particular selection, it is necessary to know the current draw of the compressor motor. The starter current draw must be greater than, or equal to, the compressor motor current draw.
- **Reliability**
  The unit mounted starter is a star-delta closed transition electromechanical starter. Motor starters of this configuration have proven reliability in thousands of centrifugal chiller applications around the world. The proven electromechanical concept plus the use of industrial quality components makes the CenTraVac unit mounted starter dependable in all kinds of service applications.

Operation

The unit mounted starter is a star (wye) delta, closed transition, reduced voltage starter. When starting and during acceleration, the motor is connected in its wye configuration. Because of this arrangement the voltage applied to the motor windings is reduced to one divided by the square root of three or 0.58 times line voltage. This reduction in winding voltage results in a reduction in inrush current. The inrush current is 0.33 times the full voltage locked rotor current rating of the motor. The accelerating torque of the motor is also reduced to 0.33 times the full voltage torque rating. This is sufficient to fully accelerate the compressor motor. The unit control panel monitors motor current during operation via current transformers located in the starter enclosure. When during acceleration the line current drops to approximately 0.85 times rated load current, transition is initiated. The closed transition feature provides for a continuous motor current flow during transition by placing resistors in the circuit momentarily. This prevents buildup of damaging torques to the system during this period. With the completion of transition, the motor windings are connected in the delta configuration with full line voltage.

Three precision current transformers monitor phase current. Contactor position and various voltage signals provide extensive interlocking between the starter and the microcomputer in the CenTraVac™ control panel. All logic and subsequent instruction originate in the unit control panel. Protection against the following starter defects is provided:
- High motor current (starting and running)
- Improper starter circuitry
- Excessive accelerating time
- Incomplete starting sequence
- Loss of phase
- Phase amperage unbalance
- Phase reversal
- Distribution fault

Features

The Trane CenTraVac Unit Mounted Starter includes the following standard features:
- NEMA 1 enclosure, designed to accommodate padlock
- 3 KVA control power transformer with 120V secondary
- Fused 120V control circuit
- 3-phase incoming line terminals
- 6 output load terminals factory-connected to the motor

Figure O-1 – Typical Equipment Room Layout – Conventional Remote Star-Delta Starter

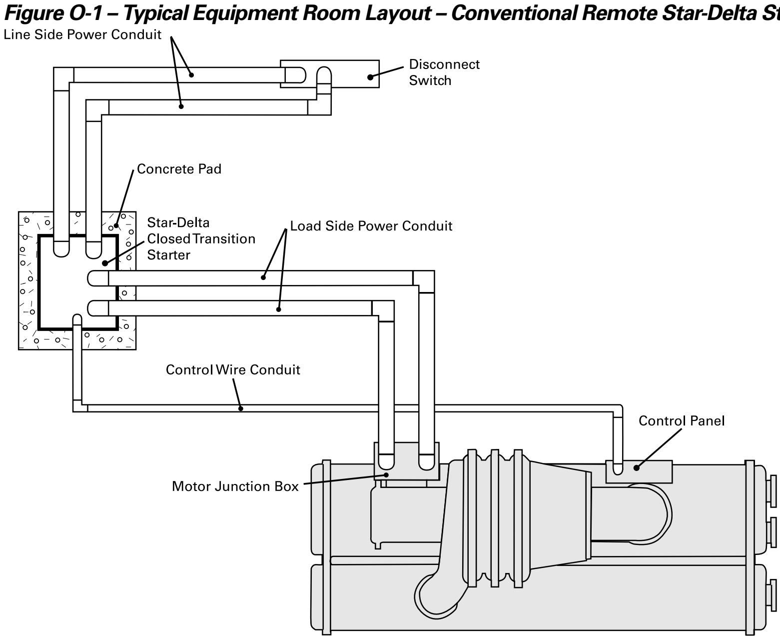
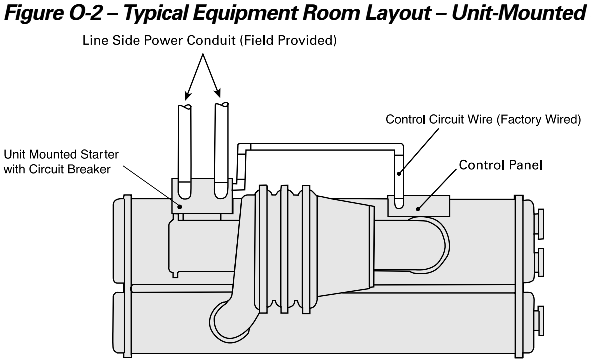


Figure O-2 – Typical Equipment Room Layout – Unit-Mounted Star-Delta Starter



Available options include:

- Circuit Breaker — A standard interrupting capacity circuit breaker is available. The circuit breaker is mechanically interlocked to disconnect line power from the starter when the starter door is open.
- High Interrupting Capacity Circuit Breaker — A high interrupting capacity circuit breaker is available. This breaker is also interlocked to disconnect line power from the starter when the starter door is open.
- Circuit Breaker with Ground Fault — Ground Fault protection is available with either standard or high interrupting capacity circuit breakers. An indicating light is provided to indicate if a ground fault has occurred.
- Current Limiting Circuit Breaker — A standard circuit breaker incorporating the current limiters with fuse links is available. A fault current in excess of the circuit breaker capacity will blow the fuse links and interrupt the fault current. The circuit breaker cannot be reset until the blown current limiters are replaced.
- Ground fault detection and protection (available only with circuit breaker options)

The solid-state starter controls the starting characteristics of a motor by controlling the current that flow to the motor. It does so through the use of SCRs (Silicon Controlled Rectifiers), which are solid-state switching devices, and an integral bypass contactor for power control.

SCR's
An SCR will conduct current in one direction only when a control signal (gate signal) is applied. Because the solid-state starter is for use on AC (alternating current), two SCR's per phase are connected in parallel, opposing each other so that current may flow in both directions. For three- phase loads, a full six-SCR configuration is used. The connection is shown in Figure O-3.

During starting, control of current or acceleration time is achieved by gating the SCR on at different times within the half-cycle. The gate pulses are originally applied late in the half-cycle and then gradually applied sooner in the half-cycle. If the gate pulse is applied **late in the cycle,** only a **small increment of the wave form** is passed through, and the **output is low.**

If the gate pulse is applied **sooner in the cycle,** a greater increment of the wave form is passed through, and **the output is increased.** So, by controlling the SCR's output voltage, the motor's acceleration characteristic and current inrush can be controlled. These forms are shown in Figure O-4.

Integral Bypass Contactors
When the SCR's are fully "phased on," the integral bypass contactors are energized. The current flow is transferred from the power pole to the contactors. This reduces the energy loss associated with the power pole, which is otherwise about one watt per amp per phase.

When the starter is given the stop command, the bypass contactors are de-energized, which transfers the current flow from the contactors back to the power poles. Two-hundred fifty milliseconds later, the SCR's are turned off, and the current flow is stopped.

Figure O-3 — Six-SCR Configuration

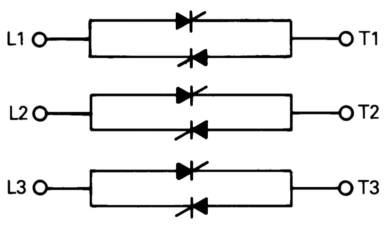
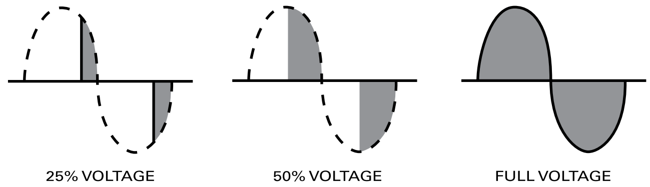


Figure O-4 — Wave Forms



Unit Options

Adaptive Frequency Drives

Benefits
Trane Adaptive Frequency drives* provide motor control, but they are much more than just starters. They also control the operating speed of the chiller compressor motor by regulating output voltage in proportion to output frequency. Varying the speed of the compressor motor can translate into significant energy cost savings.

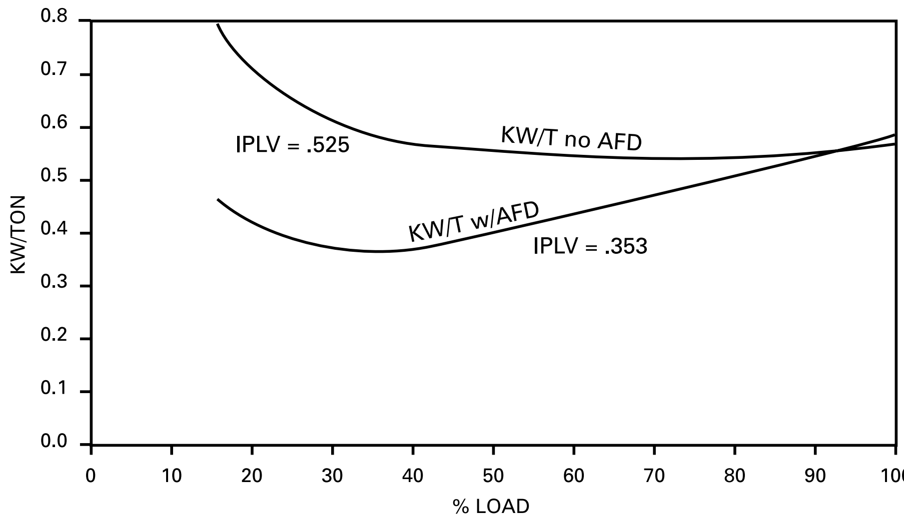
Reliable, Optimized Compressor Efficiency for Energy Savings
Conventional chillers use inlet vanes to provide stable operation at part-load conditions. Capacity is reduced by closing the vanes while maintaining a constant motor speed. The drive can be used to significantly reduce power consumption by reducing motor speed at low load conditions. Trane patented AFD Adaptive Control™ logic safely allows inlet guide vane and speed control combinations that optimize part-load performance.

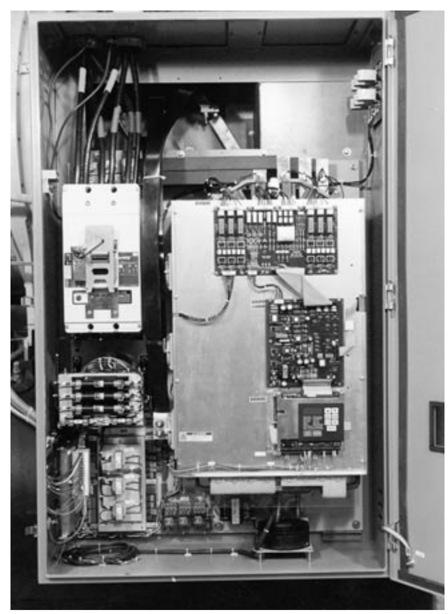
To Avoid Mechanical Stress
Controlled "soft" start with linear acceleration results in limited starting current to eliminate motor stress, reduce power line disturbance and provide a lower power demand on start. Reduced motor speed as a result of reduced chiller load means less current drawn, less heat generated, increased motor winding life. This translates into longer time between compressor maintenance and less downtime throughout the life of the machine.

Application
Certain system characteristics favor installation of an AFD because of energy cost savings and shorter payback. Among them are:

A large number of part-load operating hours annually
Figure O-4, based on a CVHE500, 500-ton load at standard ARI conditions, shows that major kW savings occur at part-load conditions, typically below 90 percent load.

Figure O-4 — CVHE500 Part Load Efficiencies with/without AFD





Unit Options — Adaptive Frequency Drives

Condenser water temperature relief of chilled water reset
Compressor lift reduction is required for a chiller application, both to provide stable chiller operation at part-loads and to achieve greater energy savings. Intelligent control to reduce condenser water temperature, or chiller water reset strategies are key to AFD savings in chiller applications.

High kW Charges
Electric utility bills normally include both demand and energy components. The demand or kW portion is established by usage during utility peak hours, by individual peak usage or a combination. This portion may or may not be influenced by installation of an AFD. But the energy or kWh portion will almost certainly be reduced because of the improved efficiency of the chiller plant during part-load conditions throughout the year. The greater the kWh charge, the shorter the payback.

Operation
The Trane AFD controls the speed of the chiller compressor by regulating the output voltage in proportion to the output frequency to provide a nominally constant rate of voltage to frequency as required by the characteristics of the compressor motor. Motor speed is proportional to this applied frequency.

The Trane AFD is a voltage source, pulse-width modulated (PWM) design. It consists of three basic power sections:

- Converter — Semi-conductor bridge rectifier takes incoming AC power and converts it to a fixed voltage DC bus.
- DC bus filter — The converted DC bus voltage contains a significant amount of ripple. The DC bus filter smooths the voltage ripple from the converter with capacitors and a DC link reactor to supply a fixed constant voltage to the inverter section. It also minimizes the electrical harmonics generated by the drive back to the distribution system.
- Inverter — Converts the DC voltage into a sinusoidal synthesized output AC voltage. This synthesized output controls both the voltage and frequency which is applied to the motor.

A fourth element of AFD design is the microprocessor control logic which is the intelligence for the power section. It also includes all feedback sensors required for stability in the system and any required shutdown due to a fault.

Soft Start: Inrush Current and Torque
Trane AFD's are programmed to start the compressor motor from low frequency and low voltage. The motor is brought up to speed by increasing both frequency and voltage at the same ratio. Thus current and torque are much lower during start-up and acceleration than the high current, high torque associated with across-the-line or even reduced voltage starters.

Note that the actual torque developed by the AFD is the total of the torque required by the load and the accelerating torque. The AFD is rated by output current and is limited to a maximum of 100 percent continuous RLA through the chiller control (UCP2). A 100 percent output current capability results in 100 percent torque generated by the motor. In other words, the drive regulates output voltage in proportion to output frequency to maintain ideal motor flux and constant torque producing capability.

Free Cooling Allows Reduced Operating Costs

Consider a CenTraVac™ chiller option that can provide up to 45 percent of the nominal chiller capacity — without operating the compressor. Think of the significant energy and cost savings possible in many applications. This option is available on all Trane chillers, factory installed.

Free cooling operation is based on the principle that refrigerant migrates to the area of lowest temperature. When condenser water is available at temperatures lower than the required leaving chilled water temperature (typically 50 to 55°F), the unit control panel starts the free cooling cycle automatically.

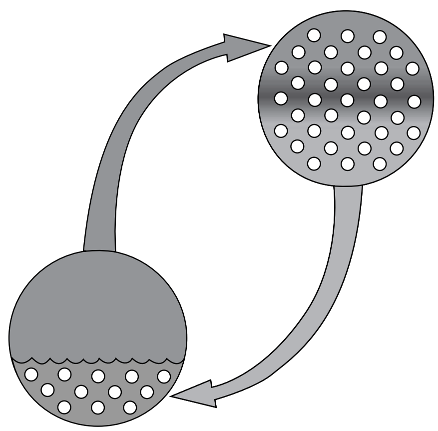
When the free cooling cycle can no longer provide sufficient capacity to meet cooling requirements, mechanical cooling is restarted automatically by the unit control panel.

For example, a building with a high internal cooling load is located in a climate with cold winters. It is possible to cool the building exclusively with free cooling three to six months of the year! Free cooling payback can easily be less than a year.

Free cooling is completely factory installed and requires no more floor space or piping than the standard CenTraVac chiller (unlike plate frame heat exchangers).

Benefits
The Trane patented free cooling accessory for Trane CenTraVac™ chillers adapts the basic chiller so it may function as a simple heat exchanger using refrigerant as the working fluid. When condenser water is available at temperatures lower than the desired chilled liquid temperature, free cooling can provide up to 45 percent of nominal chiller capacity without operation of the compressor. This feature may result in substantial energy cost savings on many installations.

Free Cooling Operation Schematic



Reliability
Two simple valves are the only moving parts.

Single-Source Responsibility
Free cooling is Trane engineered, manufactured and installed.

Ease of Operation
Changeover on free cooling by single switch control.

Ease of Installation
Completely factory-installed and leak-tested components. All valve operators and controls are factory wired.

Application
Modern buildings often require some form of year-round cooling to handle interior zones, solar loads, or computer loads. As the outside air temperature decreases below the inside air design temperature, it is often possible to use an outside air economizer to satisfy the cooling requirements. There are a number of instances, however, where CenTraVac free cooling offers a number of advantages over the use of an outside air economizer. It is possible for the free cooling chiller to satisfy the cooling load for many hours, days, or months during the fall, winter, or spring seasons without operation of the compressor motor. This method of satisfying the cooling requirement can result in significant total energy savings over other types of systems. The savings available are most easily determined through the use of a computer energy analysis and economic program, such as TRACE™ (Trane Air Conditioning and Economics).

The suitability of free cooling for any particular installation depends upon a number of factors. The availability of low temperature condensing water, the quality of the outside air, the type of airside system, the temperature and humidity control requirements, and the cost of electricity all have a direct impact on the decision to use a free cooling chiller.

The use of CenTraVac free cooling depends on the availability of cold condenser water from a cooling tower, river, lake, or pond. As a general rule of thumb, locations which have a substantial number of days with ambient temperatures below 45°F wet bulb or more than 4000 degree-days per year are well suited to free cooling operation. A cooling tower usually must be winterized for off-season operation and the minimum sump temperature is limited by some cooling tower manufacturers. Cooling tower manufacturers should be consulted for recommendations on low temperature operation. With river, lake or pond supply, condenser water temperatures down to freezing levels are possible. Areas which have badly fouled air may be more conducive to free cooling operation than the use of an outside air economizer.

Airside systems which both heat and cool the air can often effectively use a free cooling chiller. Dual-duct, multizone, and reheat systems fall into this general category. As the outside temperature begins to fall, the cool outside air satisfies the cooling requirements (through an outside air economizer). As the outdoor air temperature becomes very low, the outdoor air may need to be heated in order to maintain the design supply air temperature when it is mixed with return air. This “heating penalty” can be eliminated by using CenTraVac free cooling. Warm chilled water temperatures provided by the free cooling chiller would allow a warmer air temperature off the chilled water coils, eliminating the heating energy required by using only an outside air economizer. With today’s high cost electricity in most areas of the country, this heating penalty can be very significant.

Temperature and humidity control requirements are important considerations when evaluating the use of CenTraVac free cooling. Low temperature outside air (from the outside air economizer) often requires a large amount of energy for humidification purposes. Free cooling operation helps to reduce these humidification costs on many applications.

It is important to note that those applications which require extremely precise humidity control typically cannot tolerate warmer than design chilled water temperatures. Therefore, since free cooling chillers normally deliver warmer than design chilled water temperatures, free cooling operation is usually not applicable with systems which require precise humidity control.

Also, free cooling is generally not used in conjunction with heat recovery systems, since mechanical cooling must be used to recover heat that will be used elsewhere in the building for simultaneous heating.

Operation
Free cooling operates on the principle that refrigerant flows to the area of lowest temperature in the system. The Tracer™ system/Chiller Plant Manager (CPM) can be used for automatic free cooling control. When condenser water is available at a temperature lower than the required leaving chilled water temperature, the CPM starts the free cooling cycle. If the load cannot be satisfied with free cooling, the CPM or a customer supplied system can automatically switch to the powered cooling mode. If desired, the chiller can be manually switched to the free cooling mode at the unit control panel. Upon changeover to free cooling, the shutoff valves in the liquid and gas lines are opened and a lockout circuit prevents compressor energization. Liquid refrigerant drains by gravity from the storage tank into the evaporator, flooding the tube bundle. Since the refrigerant temperature and pressure will be higher in the evaporator than in the condenser, due to the water temperature difference, the refrigerant gas boiled off in the evaporator will flow to the condenser. The gas then condenses and flows by gravity back to the evaporator. This automatic refrigeration cycle is sustained as long as a temperature difference exists between the condenser water and evaporator water.

The difference in temperature between the condenser and evaporator determines the rate of refrigerant flow between the two shells and hence the free cooling capacity.

If the system load becomes greater than the free cooling capacity either the operator manually stops free cooling, a binary input from a customer-supplied system disables free cooling or the CPM can automatically perform this function. The gas and liquid valves close and the compressor starts. Refrigerant gas is drawn out of the evaporator by the compressor, compressed and introduced into the condenser. Most of the condensed liquid first takes the path of least resistance by flowing into the storage tank which is vented to the high pressure economizer sump by a small bleed line. When the storage tank is filled, liquid refrigerant must flow through the bleed line restriction. The pressure drop through the bleed line is greater than that associated with the orifice flow control device, hence liquid refrigerant flows normally from the condenser through the orifice system and into the economizer.

The free cooling accessory consists of the following factory-installed or supplied components:

- A refrigerant gas line, including an electrically actuated shutoff valve, installed between the evaporator and condenser.
- A valved liquid return line including an electrically activated shutoff valve, between the condenser sump and evaporator.
- A liquid refrigerant storage vessel.
- Added refrigerant charge.
- Manual free cooling controls on the unit control panel.

For specific information on free cooling applications, contact the local Trane sales office.

Figure O-5 — Compressor Operation Schematic

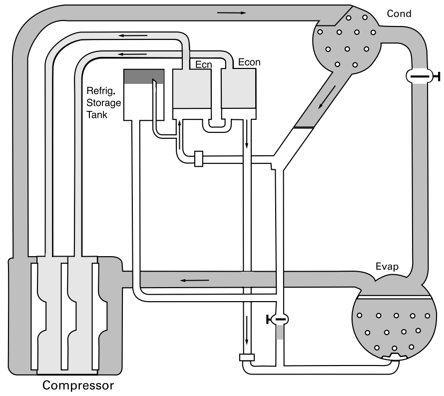
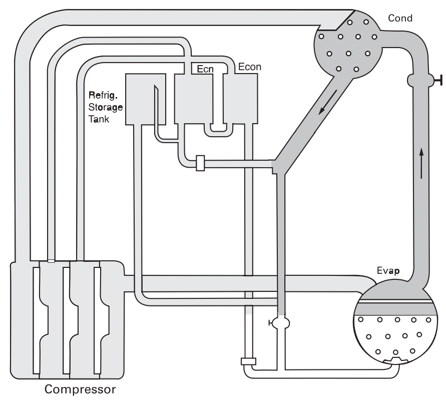


Figure O-6 — Free Cooling Operation Schematic



System Options

Auxiliary Condenser

Auxiliary Condenser

The Trane auxiliary condenser provides economical heat recovery for applications with small heating demand. It's well-suited to preheat applications including domestic hot water, boiler makeup water and swimming pools.

The Trane auxiliary condenser option consists of a separate condenser connected in parallel with the standard condenser to provide simple heat recovery capability for applications where full heat recovery or high heating water temperatures are not required. Heat which normally would be rejected to the regular condenser water is picked up in the auxiliary condenser before the water enters the hot water heating system. Typical uses for this water include domestic water preheat, boiler makeup water preheat, and reheat air conditioning systems, as opposed to traditional heat recovery applications where higher temperature water is used to satisfy a building heating load, provide full heat input for domestic hot water, or provide the typically larger flow rates of hot water for process applications.

The auxiliary condenser not only captures energy otherwise lost, it also increases chiller efficiency.

Auxiliary condensers are available in two sizes: standard and large. Because the auxiliary condenser is a separate condenser, there is no cross contamination between the cooling tower water and the heat recovery water circuits.

No temperature controls are required. Auxiliary condensers are factory mounted and tested.

Benefits

Simplicity
No temperature controls are required. Auxiliary condensers are factory-mounted and tested.

Flexibility
Two auxiliary condenser sizes are available — standard and large. Either auxiliary condenser can be applied to any size CenTraVac™.

Safe
Because the auxiliary condenser is a separate condenser, there is no possibility of cross contamination between the cooling tower water and the auxiliary condenser water circuits.

Efficient
Use of the auxiliary condenser option actually increases the chiller's efficiency by increasing condenser heat transfer surface area and lowering the pressure differential the compressor must generate.

Decreased life cycle operating costs result through use of the auxiliary condenser option because heat, which normally would be rejected by the cooling tower circuit, is now used for building heating requirements.

Application
A simultaneous demand for heating and cooling is necessary to apply any heat recovery system. Common uses for heated water from an auxiliary condenser include domestic water preheat, reheat air conditioning systems, and boiler makeup water. Building use is not limited to the traditional heat recovery candidates. Schools, hospitals, office buildings, and hotels have all proved to be excellent applications for the auxiliary condenser option.

System Options

Auxiliary Condenser (Cont.)

Controls
The auxiliary condenser was designed for simplicity of operation. Machine load, water flow rate, and temperature determine the amount of heat recovered. There are no controls needed for heating water temperature because no attempt is made to maintain a specific hot water temperature in or out of the auxiliary condenser.

Operation
The auxiliary condenser is a factory-mounted, separate, shell and tube heat exchanger available on water-cooled CenTraVac chillers.

Because hot refrigerant gas always migrates to the area of lowest temperature, auxiliary condenser operation is simple. As hot gas leaves the compressor, it is free to flow to the auxiliary condenser or the standard condenser. Since water entering the auxiliary condenser is normally colder than that entering the standard condenser, the auxiliary condenser will have a lower bundle temperature and will attract the refrigerant gas. The auxiliary condenser will recover as much heat as the machine cooling load, heating water temperature, and flow rate will allow. All remaining heat will automatically be rejected through the standard condenser to the atmosphere through the cooling tower. No controls are needed to balance heat rejection in the two condensers.

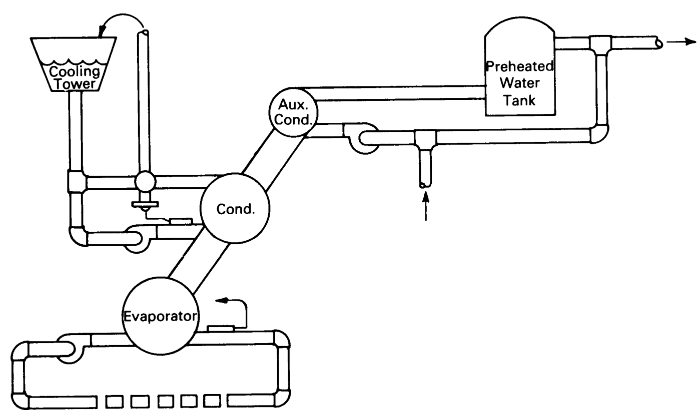
Good system design will include a heated water bypass to ensure that water does not circulate through the auxiliary condenser when the chiller is de-energized. There are several ways to bypass the auxiliary condenser. When the hot water system is installed as shown in the figure below, the bypass is automatic if the heating water pump is interlocked with the chiller compressor motor.

Another bypass arrangement is to install a diverting valve. When interlocked with the compressor motor, this valve diverts the heating water flow to the conventional heating system whenever the chiller is not operating. These are only examples of the many ways of accomplishing a bypass.

Contact your local Trane sales office for further specific information.

Table O-1 — Auxiliary Condenser Flow Limits and Connection Sizes

Auxiliary Condenser Bundle Size	Two Pass				
	Inter Enhanced		Smooth Bore		Connection Size (In)
	Minimum Gpm	Maximum Gpm	Minimum Gpm	Maximum Gpm	
Standard	74	276	70	258	5
Large	121	453	115	423	5



System Options

Ice Storage

Ice Storage Provides Reduced Electrical Demand

Ice storage is the hottest thing in cooling today. It has been accepted by building owners and tenants who are concerned about utility costs.

An ice storage system uses a standard chiller to make ice at night when utilities charge less for electricity. The ice supplements or even replaces mechanical cooling during the day when utility rates are at their highest. This reduced need for cooling results in big utility cost savings.

Another advantage of ice storage is standby cooling capacity. If the chiller is unable to operate, one or two days of ice may still be available to provide cooling. In that time the chiller can be repaired before building occupants feel any loss of comfort.

The Trane CenTraVac chiller is uniquely suited to low temperature applications like ice storage because it provides multiple stages of compression. Competitive chillers provide only one stage. This allows the CenTraVac chiller to produce ice efficiently, with less stress on the machine.

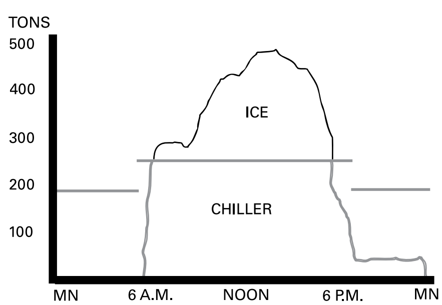
Simple and smart control strategies are another advantage the CenTraVac chiller has for ice storage applications. Trane Tracer™ building management systems can actually anticipate how much ice needs to be made at night and operate the system accordingly. The controls are integrated right into the chiller. Two wires and preprogrammed software dramatically reduce field installation cost and complex programming.

Trane centrifugal chillers are well suited for ice production. The unique multi-stage compressor design allows the lower suction temperatures required to produce ice and the higher chiller efficiencies attributed to centrifugal chillers. Trane three stage and two stage centrifugal chillers produce ice by supplying ice storage vessels with a constant supply of 22 to 24°F glycol. Centrifugal chillers selected for these lower leaving fluid temperatures are also selected for efficient production of chilled fluid at nominal comfort cooling conditions. The ability of Trane chillers to serve "double duty" in ice production and comfort cooling greatly reduces the capital cost of ice storage systems.

A glycol solution is used to transfer heat from the ice storage tanks to the centrifugal chiller and from the cooling coils to either the chiller or ice storage tanks. The use of a freeze protected solution eliminates the design time, field construction cost, large refrigerant charges, and leaks associated with ice plants. Ice is produced by circulating 22-24°F glycol through modular insulated ice storage tanks. Each tank contains a heat exchanger constructed of polyethylene tubing. Water in each tank is completely frozen with no need for agitation. The problems of ice bridging and air pumps are eliminated.

When cooling is required, ice chilled glycol is pumped from the ice storage tanks directly to the cooling coils. No expensive heat exchanger is required. The glycol loop is a sealed system, eliminating expensive annual chemical treatment costs. The centrifugal chiller is also available for comfort cooling duty at nominal cooling conditions and efficiencies. The modular concept of glycol ice storage systems and the proven simplicity of Trane Tracer™ controls allow the successful blend of reliability and energy saving performance in any ice storage application.

Ice Storage Demand Cost Savings



The ice storage system is operated in six different modes: each optimized for the utility cost of the hour.

1 Provide comfort cooling with chiller

2 Provide comfort cooling with ice

3 Provide comfort cooling with ice and chiller

4 Freeze ice storage

5 Freeze ice storage when comfort cooling is required

6 Off

Tracer optimization software controls operation of the required equipment and accessories to easily transition from one mode of operation to another. For example:

Even with ice storage systems there are numerous hours when ice is neither produced or consumed, but saved. In this mode the chiller is the sole source of cooling. For example, to cool the building after all ice is produced but before high electrical demand charges take effect, Tracer sets the centrifugal chiller leaving fluid setpoint to its most efficient setting and starts the chiller, chiller pump, and load pump.

When electrical demand is high, the ice pump is started and the chiller is either demand limited or shut down completely. Tracer controls have the intelligence to optimally balance the contribution of ice and chiller in meeting the cooling load.

The capacity of the chiller plant is extended by operating the chiller and ice in tandem. Tracer rations the ice, augmenting chiller capacity while reducing cooling costs.

When ice is produced, Tracer will lower the centrifugal chiller leaving fluid setpoint and start the chiller, chiller and ice pumps, and other accessories. Any incidental loads that persists while producing ice can be addressed by starting the load pump and drawing spent cooling fluid from the ice storage tanks.

For specific information on ice storage applications, contact your local Trane sales office.

System Options

Heat Recovery

Heat Recovery

Use of the Heat Recovery CenTraVac™ can significantly reduce the energy operating costs of many buildings by using heat which normally would be rejected to the atmosphere. Typical uses for this heat are perimeter zone heating, reheat air conditioning systems and any hot water requirements. Any building with a simultaneous heating and cooling load is a potential candidate.

Most heating applications require water temperatures higher than the 85°F to 95°F typically sent to the cooling tower. Therefore, most heat recovery chillers are required to produce higher leaving condenser water temperatures, and thus will not duplicate the energy efficiencies of cooling-only machines. Figure O-7 illustrates the typical operating cycles of a cooling-only machine and a heat recovery machine. The most noticeable differences are:

1. The pressure differential provided by the compressor is much greater for the heat recovery cycle.
2. The amount of heat rejected from the heat recovery condenser is greater than that which would be rejected in cooling-only operation.
3. There is a decrease in the refrigeration effect. (RE) Higher condensing pressures increase the intermediate pressure in the economizer. Therefore, the liquid in the economizer has a higher enthalpy during the heat recovery mode than during standard chiller operation and the refrigeration effect is slightly decreased. Because of this decreased refrigeration effect, the compressor must pump more gas per ton of refrigeration.

The effect of this increased pressure differential and decreased refrigeration effect is a heat recovery machine which has a higher kW/ton energy consumption during heat recovery operation.

Typical catalog kW/ton for heat recovery machines operating in the heat recovery mode range from .64 to .84 kW/ton compared to a range of .61 to .79 for a cooling-only machine. Not only can there be an energy consumption penalty paid due to the inherent differences in operating cycles for heat recovery machines, but traditional machine design can add to that energy handicap. In the past, a heat recovery machine's operating efficiency was normally penalized year- round by having the capability to produce high heating water temperatures. Impellers are selected to produce the maximum required refrigerant pressure difference between the evaporator and condenser, Figure O-8. Usually, that meant the impeller diameters were determined by the heat recovery operating conditions.

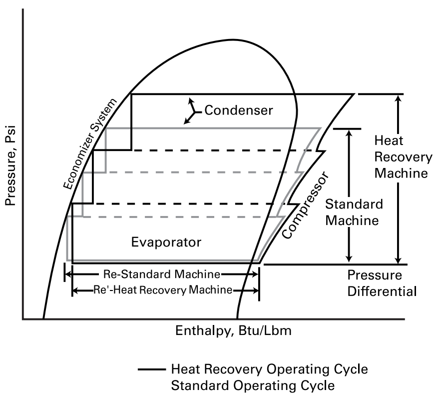
During cooling-only operation, the condensing pressures and temperatures are normally lower than during the heat recovery operation. So, in essence, the impeller diameters were oversized. This would result in a compressor efficiency during cooling- only season which was lower than if the impellers had been selected for a cooling-only application.

The multi-stage compressor and advanced impeller design on the CenTraVac™ chiller reduce this costly energy penalty. Neither the capacity nor the power consumption changes substantially as the heat recovery operating conditions divert from the cooling-only condition. The multi-stage compressor allows a closer match of impeller size to the operating condition. In addition, the computer designed impellers and crossover are designed to reduce losses as the kinetic energy of the refrigerant gas is converted to static pressure.

These advances make the Trane Heat Recovery CenTraVac™ chillers even more attractive now than in the past.

- The CenTraVac heat recovery chiller was designed for efficient operation with kW/ton efficiencies among the best in the industry for heat recovery chillers.
- The energy penalty paid in the past to operate a heat recovery machine in the cooling-only mode is essentially eliminated.

Figure O-7 — Typical Operating Cycles



Simultaneous Heating and Cooling
The Trane Heat Recovery CenTraVac™ chiller is an excellent choice for applications requiring simultaneous heating and cooling. CenTraVac models save energy by recovering heat normally rejected to the atmosphere and putting that energy to use providing space heating, building hot water or process hot water. This heat is provided at a fraction of conventional heating systems cost. A heat recovery CenTraVac can provide 95 to 120°F hot water.

An advanced computer selection program chooses a heat recovery condenser to match your needs. Two separate condenser shells are used with the Heat Recovery CenTraVac chiller. The heating circuit and cooling tower circuit are separate, preventing cross contamination. Refrigerant gas from the compressor flows into both condenser shells allowing heat rejection to one or both condenser water circuits.

The reliability of the Heat Recovery CenTraVac chiller has been proven in installations around the world. This option is completely factory packaged.

To further reduce the system energy requirements, the following design considerations should be incorporated into any heat recovery system.

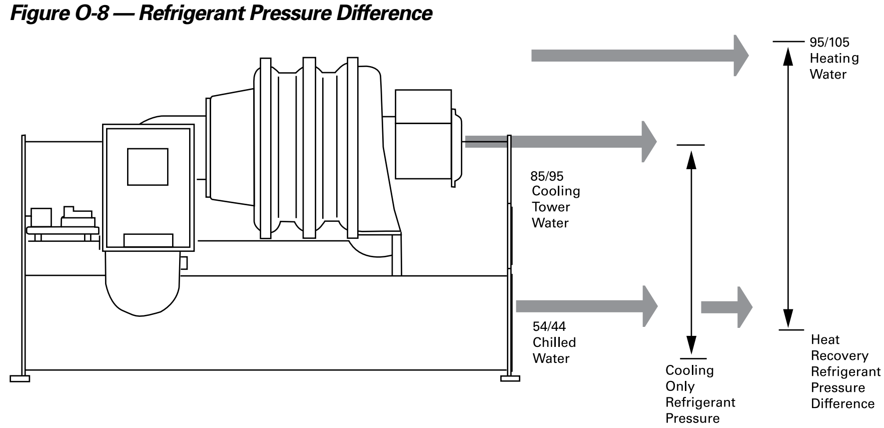
System Design Considerations

Heating Water Temperatures and Control — It is always desirable to use as low a heating water temperature as the application allows. Experience has shown that a design heating water temperature of 105 to 110°F can satisfy most heating requirements. Lower heating water temperatures increase the chiller operating efficiency both in the heating mode and in the cooling mode. In general, the heat recovery power consumption will increase 7 to 14 percent for every 10°F increase in the design heating water temperature. A consideration which is just as important as the design heating water temperature is how that temperature is controlled. In most cases, the heating water temperature control should be designed to maintain the return heating water temperature. By allowing the supply water temperature to float, the mean water temperature in the system drops as the chiller load decreases and less heat is rejected to the condenser. As the mean heating water temperature drops, so does the refrigerant condensing temperature and pressure difference which the compressor is required to produce at part load. This increases the unloading range of the compressor.

When the supply heating water temperature to the building system is maintained and the return heating water temperature to the condenser is allowed to float, the mean heating water temperature actually rises as the chiller load decreases and less heat is rejected to the condenser. As Figure O-8 illustrates, when the compressor unloads, the pressure difference that it must oppose to prevent surging remains essentially the same, while the compressor's capability to handle the pressure difference decreases. Therefore, the unit's capability to unload without the use of hot gas bypass is reduced.

Hot gas bypass artificially increases the load on the compressor (cfm of refrigerant gas) by diverting refrigerant gas from the condenser back to the compressor. Although hot gas bypass increases the unit's power consumption by forcing the compressor to pump more refrigerant gas, it will increase the heat available to recover for those applications where significant heating loads remain as the cooling load decreases.

Figure O-8 — Refrigerant Pressure Difference



System Options

Chilled Water Reset

Chilled Water Reset — Chilled water reset is often a practical means of reducing energy consumption during periods of the year when heating loads are high but cooling loads are reduced. Resetting the chilled water temperature increases the evaporator refrigerant pressure. This increased evaporator pressure reduces the pressure differential the compressor must generate while in the heat recovery mode. A secondary benefit of chilled water reset is that it enables the chiller to produce higher heating water temperature than would normally be possible.

Figure O-9 — Heating Water Control

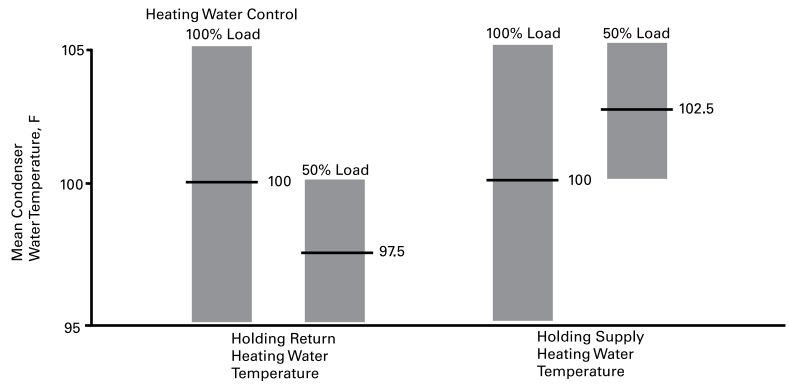
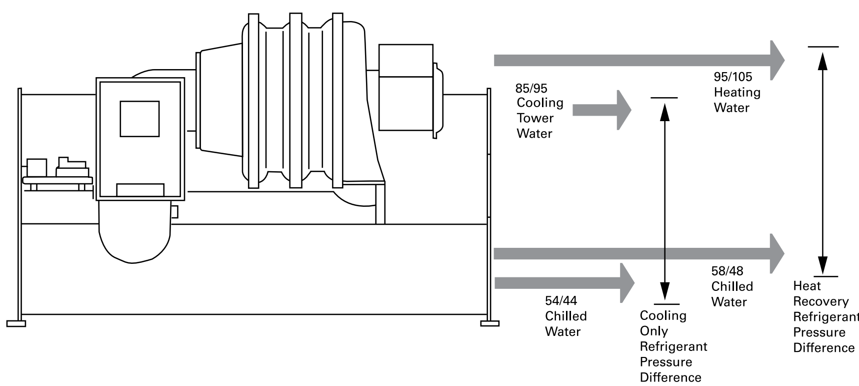


Figure O-10 — Chilled Water Reset



Application Considerations

CVHE, CVHG, CVHF

For Applications Requiring CVHE 170-500 Tons (60 Hz) CVHG 450-1300 Tons (50 Hz)

The Trane multi-stage CenTraVac chiller is built with a commitment to quality which has made it the world's premier centrifugal chiller.

- A multi-stage compressor for superior efficiency compared to single stage designs. Multi-stages also provide stable, surge-resistant operation.
- Exceptionally quiet operation — lowest sound levels in the industry.
- Patented two-stage economizer provides up to seven percent efficiency increase and similar energy cost decrease.

CVHF 325 To 1750 Tons (60 Hz)

The two-stage CenTraVac chiller, built with the same tradition and commitment to quality.

- Two-stage compressor for continued superior efficiency over single stage designs.
- Exceptionally quiet operation — lowest sound level in the industry.
- Patented single-stage economizer provides up to five percent efficiency increase and similar energy cost decrease.

For Applications Requiring 1300-3500 Tons (60 Hz), Choose LHCV

- The LHCV chiller system is the modern solution for large central plant applications. It offers significant first cost and operating cost advantages compared to field-assembled very large chillers.
- The Trane Integrated Comfort™ system (ICS) is the key to high performance for the LHCV system. Applications software takes advantage of Trane chiller and chiller plant expertise delivering sophisticated chiller plant sequencing capabilities in an easy to use prepackaged system.
- The LHCV extends the CenTraVac™ chiller line from 1300 to 3000 tons. The hermetic, direct drive design delivers the quality and reliability you need and have come to expect from large chillers. The dependability is especially critical for the large central plants that the LHCV is ideally suited for.
- The modular design concept of the LHCV chiller system paired with the chiller plant optimization capability of Trane Integrated Comfort systems (ICS) provides the flexibility you need to optimize your central chiller water plant design. This system configuration is ideally suited to deliver the highest performance for free cooling, heat recovery and combined energy source systems.

Application Considerations

Condenser Water Limitations

Trane CenTraVac™ chillers start and operate over a range of load conditions with controlled water temperatures. Reducing the condenser water temperature is an effective method of lowering the chiller power input. However, the effect of lowering the condenser water temperature may cause an increase in system power consumption.

In many applications Trane CenTraVac chillers can start and operate without control of the condenser water temperature. However, for optimum system power consumption, and for any applications with multiple chillers, control of the condenser water circuit is recommended. Integrated control of the chillers, pumps and towers is easily accomplished with Trane's UCP2 and/or Tracer system.

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

Water Pumps
Avoid specifying or using 3600 rpm condenser and chilled water pumps. Such pumps may operate with objectionable noises and vibrations. In addition, a low frequency beat may occur due to the slight difference in operating rpm between water pumps and CenTraVac motors. Where noise and vibration-free operation are important, The Trane Company encourages the use of 1750 rpm pumps.

Chillers are designed to ARI conditions of 85°F, but Trane CenTraVac chillers can operate to a 3 psig pressure differential between the condenser and evaporator at any steady state load without oil loss, oil return, motor cooling, refrigerant hang-up or purge problems. And this differential can equate to safe minimum entering condenser water temperatures at or below 55°F, dependent on a variety of factors such as load, leaving evaporator temperature and component combinations. Start-up below this differential is possible as well, especially with UCP2 soft start features

Water Flow
Today's technology challenges ARI's traditional design of three gpm per ton through the condenser. Reduced condenser flows are a simple and effective way to reduce both first and operating costs for the entire chiller plant. This design strategy will require more effort from the chiller. But pump and tower savings will typically offset any penalty. This is especially true when the plant is partially loaded or condenser relief is available.

In new systems, the benefits can include dramatic savings with:
- Size and cost for condenser lines and valves
- Size and cost of the cooling tower.
- Size and cost of the water pumps.
- Pump energy (30 to 35% reduction).
- Tower fan energy (30 to 35% reduction).

Replacement chiller plants can reap even greater benefits from low flow condensers. Because the water lines and tower are already in place, reduced flows would offer a tremendous energy advantage. Theoretically, a 2 GPM/ton design applied to a system that originally used 3 GPM/ton would offer a 70% reduction in pump energy. At the same time, the original tower would require a nozzle change but would then be able to produce about two degrees colder condenser water than before. These two benefits would again typically offset any extra effort required by the chiller.

Contact your local Trane Sales Office for information regarding optimum condenser water temperatures and flow rates for a specific application.

Electrical Information

Minimum Circuit Ampacity
To properly size field electrical wiring, the electrical engineer or contractor on a project needs to know the minimum circuit ampacity of the CenTraVac™ machine. The National Electrical Code (NEC), in Article 440-33, defines the method of calculating the minimum circuit ampacity. The minimum circuit ampacity is defined as the sum of two amperages: 125 percent of the compressor motor Rated Load Amps (RLA), plus the Full Load Amps (FLA) of all remaining loads on the same circuit. For starter to motor wiring, there are no other remaining loads. For main power supply to the starter, there is a remaining load consisting of the 4 KVA control power transformer which supplies power to the controls, the oil pump motor, oil sump heater and the purge unit motor. Therefore, the remaining load FLA equals 4000 divided by the unit design voltage.

As an example, calculate the minimum circuit ampacity of a machine which has a design RLA of 350 amps and is to be operated on a 460 volt power supply:

Minimum Circuit Ampacity =

$$(125\% \times 350 \text{ Amps}) + \frac{4000 \text{ VA}}{460 \text{ V}}$$

= 437.5 Amps + 8.7 Amps

= 446.2 Amps

After the minimum circuit ampacity has been determined, the electrical engineer or contractor will refer to the appropriate conductor sizing table in the NEC to determine the exact conductors required. A typical table for 75°F conductors is included in the Trane submittal. The selection of conductors is based on a number of jobsite conditions (i.e. type of conductor, number of conductors, length of conductors, ambient temperature rating of conductors).

Branch-Circuit Short-Circuit and Ground Fault Protection
Circuit breakers and fused disconnects should be sized by the electrical engineer or contractor in strict accordance with NEC Article 440-21 and in accordance with all local codes. This protection should be for motor type loads and should not be less than 150 percent of the compressor motor rated load amps (RLA).

Selection Procedure

Selection
The CenTraVac™ centrifugal chiller product line provides more than 200,000 individual unit selections over a capacity range of 170 through 3500 tons. Chiller selections and performance data can be obtained through the use of the CenTraVac chiller selection program available in local Trane sales offices. This program can provide a list of chiller selections optimized to closely match specific project requirements. Nominal data and physical data for typical compressor-evaporator- condenser combinations are given by product family.

Trane Model Number
The Trane model number defines a Trane CenTraVac with its particular component combination. These components along with the project design conditions are required to determine chiller performance from the CenTraVac computer selection program:

- Compressor size and voltage
- Evaporator bundle size, bundle length, and number of water passes
- Condenser bundle size, bundle length, and number of water passes
- Leaving chilled water temperature, evaporator water flow rate, temperature drop through the chiller
- Entering condenser water temperature, condenser water flow rate, and temperature rise through the condenser
- Water side fouling factors for the evaporator and condenser
- Refrigerant type for operating on HCFC-123.

Performance
The CenTraVac computer selection program provides performance data for each chiller selection at the full load design point and part load operating points as required.

The Trane computer selection program is certified by ARI in accordance with ARI Standard 550/590. To assure that the specific chiller built for your project will meet the required performance, and to ensure a more troublefree start-up, it is recommended that the chiller be performance tested.

The CenTraVac computer selection program has the flexibility to select chillers for excessive field fouling allowances.

Fouling Factors
ARI Standard 550/590 includes a definition of clean tube fouling. Recommended field fouling allowances have not changed on a relative basis; the standard fouling adjustment is a 0.0001 increment from 0.0000 "clean" on the evaporator and 0.00025 increment from 0.0000 "clean" on the condenser.

Chiller specifications should be developed using the most current standard fouling factors.

It should be noted that changing the number of water passes or water flow rates may significantly alter the performance of a particular chiller.
To obtain the maximum benefit from the wide range of selections available, designers are encouraged to develop performance specifications and use the computer selection program to optimize their selections. This will allow the selection of the particular compressor-evaporator-condenser combination which most closely meets the job requirements. All selections should be made by using the computer selection program.

Unit Performance With Fluid Media Other Than Water
CenTraVac chillers can be selected with a wide variety of media other than water. Typically used media include ethylene glycol or propylene glycol either in the evaporator, condenser or both. Chillers using media other than water are excluded from the ARI 550/590 Certification Program, but are rated in accordance with ARI 550/590. Trane factory performance tests are only performed with water as the cooling and heat rejection media. For media other than water, contact the local Trane sales office for chiller selections and information regarding factory performance testing.

Flow Rate Limits
Flow rate limits for all pass combinations for evaporators and condensers are tabulated in the data section for the appropriate chiller family. For applications outside of these limits, contact your local Trane office.

Selection Procedure

Roughing-in Dimensions
The dimensional drawings illustrate overall measurements of the chiller. The recommended space envelope indicates clearances required to easily service the CenTraVac chiller. A view of the unit is superimposed on this drawing with unit support feet shown.

All catalog dimensional drawings are subject to change. Current submittal drawings should be referred to for detailed dimensional information. Contact the local Trane sales office for submittal and template information.

Evaporator and Condenser Data Tables
Evaporator and condenser data is shown in the Performance Data section. Data includes minimum and maximum water flow limits and water connection sizes for all standard pass configurations and tube type. Pressure drops are calculated by the CenTraVac computer selection program.

Part Load Performance

The CenTraVac chiller possesses excellent performance characteristics over its full range of operation. The multi-stage direct drive compressor enables stable and efficient operation over a wide range of capacities, virtually eliminating the need for energy wasting hot gas bypass typically found on single stage chillers.

An in-depth examination of project-specific conditions and energy rate structures should be performed to appropriately evaluate total energy costs over a period of time. TRACE™, Trane's unique energy analysis program, is particularly well suited for this type of analysis, as well as for economic evaluation of equipment and system alternatives.

Local utilities may offer substantial monetary rebates for centrifugal chillers with specific operating kW ratings. Contact your local utility representative or Trane sales office for further information.

The electrical rate structure is a key component of an economic evaluation. Most power bills are now constituted of 1/3 demand charge and 2/3 usage charge. The full load power consumption of the chiller plant is likely to set the kW peak and demand charge for the billing period. This places an increased emphasis on the need to keep the full load consumption of the chiller plant low.

There are a number of variables that should be considered in developing an accurate chiller load profile to use for measuring how one machine compares with another machine at part load. The use of outdoor air economizers, variations in chiller sequencing and chiller plant load optimization strategies should be considered. The use of a decoupled or primary/secondary water loop is generally acknowledged as the simplest, most efficient way to control multiple chiller water plants. This control strategy results in one chiller operating at a more fully loaded condition rather than multiple chillers operating at part load, which would require more pumping energy.

ARI Standard 550/590 provides chiller performance certification for the full load condition and the "NPLV" (non-standard part load value). The NPLV uses a generic weighted chiller load profile to simplify certification of part load performance data. Although these values are not necessarily a precise indicator of actual energy use, they do provide a valuable basis for comparison.

Performance Data

Evaporator Flow Rates (English & SI Units)

Minimum/Maximum Evaporator Flow Rates (GPM)

Shell	Bundle	One Pass			Two Pass			Three Pass		
Size	Size	SBCU	TECU	IECU	SBCU	TECU	IECU	SBCU	TECU	IECU
EVSZ	EVBS	Min / Max	Min / Max	Min / Max	Min / Max	Min / Max	Min / Max	Min / Max	Min / Max	Min / Max
032S	200	216 / 1187	230 / 1237	143 / 1050	108 / 593	115 / 618	72 / 525	72 / 396	77 / 412	48 / 350
032S	230	242 / 1331	258 / 1388	165 / 1212	121 / 666	129 / 694	83 / 606	81 / 444	86 / 463	55 / 404
032S	250	267 / 1465	284 / 1527	177 / 1293	134 / 733	142 / 764	88 / 646	89 / 488	95 / 509	59 / 431
032S/L	280	304 / 1672	324 / 1743	201 / 1474	152 / 836	162 / 871	101 / 737	102 / 557	108 / 581	67 / 491
032S/L	320	340 / 1868	362 / 1947	229 / 1676	170 / 934	181 / 973	115 / 838	114 / 623	121 / 649	76 / 559
032S/L	350	— / —	— / —	251 / 1838	— / —	— / —	126 / 919	— / —	— / —	84 / 613
050S	320	340 / 1868	362 / 1947	232 / 1696	170 / 934	181 / 973	116 / 848	114 / 623	121 / 649	77 / 565
050S	360	383 / 2105	399 / 2194	254 / 1858	192 / 1052	200 / 1097	127 / 929	128 / 702	133 / 731	85 / 619
050S	400	424 / 2332	442 / 2431	284 / 2080	212 / 1166	221 / 1215	142 / 1040	142 / 777	148 / 810	95 / 693
050S/L	450	482 / 2652	503 / 2764	322 / 2363	241 / 1326	252 / 1382	161 / 1181	161 / 884	108 / 921	108 / 788
050S/L	500	535 / 2941	558 / 3066	361 / 2646	268 / 1470	279 / 1533	181 / 1323	178 / 980	186 / 1022	121 / 882
050S/L	550	— / —	— / —	397 / 2908	— / —	— / —	198 / 1454	— / —	— / —	132 / 969
080S	500	535 / 2941	558 / 3066	361 / 2646	268 / 1470	279 / 1533	181 / 1323	178 / 980	186 / 1022	121 / 882
080S	560	602 / 3312	628 / 3453	400 / 2928	301 / 1656	314 / 1726	200 / 1464	201 / 1104	210 / 1151	133 / 976
080S	630	676 / 3715	704 / 3872	452 / 3312	338 / 1857	352 / 1936	226 / 1656	226 / 1238	235 / 1291	151 / 1104
080S/L	710	758 / 4169	790 / 4346	517 / 3756	379 / 2084	395 / 2173	259 / 1878	253 / 1390	264 / 1449	171 / 1252
080S/L	800	861 / 4736	898 / 4937	576 / 4221	431 / 2368	449 / 2469	288 / 2110	288 / 1579	300 / 1646	192 / 1407
080S/L	890	— / —	— / —	642 / 4706	— / —	— / —	321 / 2353	— / —	— / —	214 / 1569
142M/L	890	863 / 4746	900 / 4948	645 / 4726	432 / 2373	450 / 2474	323 / 2363	288 / 1582	300 / 1649	215 / 1575
142M/L	980	966 / 5314	1008 / 5540	716 / 5251	483 / 2657	504 / 2770	358 / 2625	322 / 1771	336 / 1847	239 / 1750
142M/L	1080	1075 / 5912	1121 / 6163	807 / 5917	538 / 2956	561 / 3082	404 / 2959	358 / 1971	374 / 2054	269 / 1972
142M/L/E	1220	1208 / 6645	1260 / 6927	895 / 6564	604 / 3323	630 / 3464	448 / 3282	403 / 2215	420 / 2309	299 / 2188
142M/L/E	1420	1345 / 7398	1402 / 7712	1041 / 7634	673 / 3699	701 / 3856	521 / 3817	449 / 2466	468 / 2571	347 / 2545
210L	1610	1318 / 7244	1373 / 7551	1146 / 8402	659 / 3622	687 / 3775	573 / 4201	440 / 2415	458 / 2517	382 / 2801
210L	1760	1471 / 8090	1534 / 8433	1286 / 9432	736 / 4045	767 / 4216	643 / 4716	490 / 2697	512 / 2811	429 / 3144
210L	1900	1634 / 8987	1704 / 9369	1421 / 10421	817 / 4494	852 / 4684	711 / 5211	545 / 2996	568 / 3123	474 / 3474
210L	2100	1802 / 9906	1878 / 10326	1509 / 11067	901 / 4953	939 / 5163	755 / 5534	601 / 3302	626 / 3442	503 / 3689
250E	2300	1948 / 10710	2030 / 11165	N/A	974 / 5355	1015 / 5583	N/A	650 / 3570	677 / 3722	N/A
250E	2500	2145 / 11794	2236 / 12295	N/A	1073 / 5897	1118 / 6147	N/A	715 / 3931	746 / 4098	N/A

Note: The minimum evaporator water velocity is 1.5 ft/sec for IECU tubes and 2.0 ft/sec for all other tubes. For a variable evaporator water flow system, the minimum GPME is generally not applicable at full load.

Minimum/Maximum Evaporator Flow Rates (Liters/Second)

Shell	Bundle	One Pass			Two Pass			Three Pass		
Size	Size	SBCU	TECU	IECU	SBCU	TECU	IECU	SBCU	TECU	IECU
EVSZ	EVBS	Min / Max	Min / Max	Min / Max	Min / Max	Min / Max	Min / Max	Min / Max	Min / Max	Min / Max
032S	200	14 / 75	14 / 78	9 / 66	7 / 37	8 / 39	5 / 33	5 / 25	5 / 26	3 / 22
032S	230	16 / 84	16 / 88	11 / 76	8 / 42	8 / 44	5 / 38	6 / 28	6 / 29	4 / 25
032S	250	17 / 92	18 / 96	11 / 82	9 / 46	9 / 48	6 / 41	6 / 31	6 / 32	4 / 27
032S/L	280	20 / 105	20 / 110	13 / 93	10 / 53	10 / 55	7 / 47	7 / 35	7 / 37	4 / 31
032S/L	320	22 / 118	22 / 123	15 / 106	11 / 59	12 / 61	7 / 53	8 / 39	8 / 41	5 / 35
032S/L	350	— / —	— / —	16 / 116	— / —	— / —	8 / 58	— / —	— / —	6 / 39
050S	320	22 / 118	22 / 123	15 / 107	11 / 59	12 / 61	8 / 54	8 / 39	8 / 41	5 / 36
050S	360	24 / 133	26 / 138	16 / 117	12 / 66	13 / 69	8 / 59	8 / 44	9 / 46	6 / 39
050S	400	27 / 147	28 / 153	18 / 131	14 / 74	14 / 77	9 / 66	9 / 49	10 / 51	6 / 44
050S/L	450	31 / 167	32 / 174	22 / 149	16 / 84	16 / 87	10 / 75	10 / 56	11 / 58	7 / 50
050S/L	500	34 / 186	36 / 193	23 / 167	17 / 93	18 / 97	12 / 83	12 / 62	12 / 64	8 / 56
050S/L	550	— / —	— / —	25 / 183	— / —	— / —	13 / 92	— / —	— / —	9 / 61
080S	500	34 / 186	36 / 193	23 / 167	17 / 93	18 / 97	12 / 83	12 / 62	12 / 64	8 / 56
080S	560	38 / 209	40 / 218	25 / 185	19 / 104	20 / 109	13 / 92	13 / 70	14 / 73	9 / 62
080S	630	43 / 234	45 / 244	29 / 209	22 / 117	22 / 122	14 / 104	14 / 78	15 / 81	10 / 70
080S/L	710	48 / 263	50 / 274	33 / 237	24 / 131	25 / 137	16 / 118	16 / 88	17 / 91	11 / 79
080S/L	800	54 / 299	57 / 311	37 / 266	28 / 149	28 / 156	18 / 133	18 / 100	19 / 104	12 / 89
080S/L	890	— / —	— / —	41 / 297	— / —	— / —	20 / 148	— / —	— / —	14 / 99
142M/L	890	55 / 299	57 / 312	41 / 298	28 / 150	29 / 156	21 / 149	18 / 100	19 / 104	14 / 99
142M/L	980	61 / 335	63 / 349	45 / 331	31 / 168	32 / 175	23 / 166	20 / 112	22 / 116	15 / 110
142M/L	1080	68 / 373	71 / 389	51 / 373	34 / 186	36 / 194	26 / 187	23 / 124	24 / 130	17 / 124
142M/L/E	1220	76 / 419	80 / 437	57 / 414	38 / 210	40 / 218	28 / 207	26 / 140	27 / 146	19 / 138
142M/L/E	1420	85 / 467	89 / 487	66 / 482	43 / 233	44 / 243	33 / 241	28 / 156	30 / 162	22 / 161
210L	1610	84 / 457	87 / 476	73 / 530	42 / 228	44 / 238	36 / 265	28 / 152	29 / 159	24 / 177
210L	1760	86 / 510	97 / 532	81 / 595	47 / 255	49 / 266	41 / 297	31 / 170	32 / 177	27 / 198
210L	1900	104 / 567	108 / 591	90 / 657	52 / 283	54 / 296	45 / 329	35 / 189	36 / 197	30 / 219
210L	2100	114 / 625	119 / 651	95 / 698	57 / 312	60 / 326	48 / 349	38 / 208	40 / 217	32 / 233
250E	2300	123 / 676	128 / 704	N/A	62 / 338	64 / 352	N/A	41 / 235	43 / 235	N/A
250E	2500	136 / 744	142 / 776	N/A	68 / 372	71 / 388	N/A	46 / 248	48 / 259	N/A

Condenser Flow Rates (English & SI Units)

Minimum/Maximum Condenser Flow Rates (GPM)

Shell Size CDSZ	Bundle Size CDBS	Two Pass SBCU Min / Max	Two Pass TECU Min / Max	Two Pass IECU Min / Max
032S	230	214 / 784	209 / 767	218 / 798
032S/L	250	239 / 877	234 / 857	245 / 899
032S/L	280	267 / 980	261 / 958	273 / 1000
032S/L	320	295 / 1083	289 / 1059	306 / 1121
050S	360	336 / 1233	329 / 1205	347 / 1272
050S/L	400	378 / 1388	370 / 1357	391 / 1434
050S/L	450	426 / 1563	417 / 1528	441 / 1616
050S/L	500	473 / 1733	462 / 1695	490 / 1797
080S	500	473 / 1733	462 / 1695	490 / 1797
080S	560	529 / 1940	517 / 1896	548 / 2010
080S/L	630	595 / 2182	582 / 2133	614 / 2252
080S/L	710	673 / 2466	657 / 2411	689 / 2525
080S/L	800	756 / 2770	739 / 2708	774 / 2838
142L	890	853 / 3126	833 / 3056	876 / 3211
142L	980	948 / 3477	927 / 3399	975 / 3575
142L	1080	1060 / 3885	1036 / 3798	1091 / 3999
142L	1220	1185 / 4344	1158 / 4246	1217 / 4463
142L	1420	1335 / 4896	1305 / 4786	1407 / 5160
210L	1610	1331 / 4881	1301 / 4771	1495 / 5483
210L	1760	1473 / 5402	1440 / 5280	1655 / 6069
210L	1900	1615 / 5923	1579 / 5790	1812 / 6645
210L	2100	1760 / 6454	1721 / 6309	1964 / 7200
250L	2100	1760 / 6454	1721 / 6309	N/A
250L	2300	1935 / 7094	1891 / 6934	N/A
250L	2500	2113 / 7749	2066 / 7575	N/A

Note: The minimum/maximum condenser water velocity is 3 / 11 ft/sec.

Minimum/Maximum Condenser Flow Rates (Liters/Second)

Shell Size CDSZ	Bundle Size CDBS	Two Pass SBCU Min / Max	Two Pass TECU Min / Max	Two Pass IECU Min / Max
032S	230	13 / 49	13 / 48	14 / 50
032S/L	250	15 / 55	15 / 54	15 / 57
032S/L	280	17 / 62	16 / 60	17 / 63
032S/L	320	19 / 68	18 / 67	19 / 71
050S	360	21 / 78	21 / 76	22 / 80
050S/L	400	24 / 88	23 / 86	25 / 90
050S/L	450	27 / 99	26 / 96	28 / 102
050S/L	500	30 / 109	29 / 107	31 / 113
080S	500	30 / 109	29 / 107	31 / 113
080S	560	33 / 122	33 / 120	35 / 127
080S/L	630	38 / 138	37 / 135	39 / 142
080S/L	710	42 / 156	41 / 152	43 / 159
080S/L	800	48 / 175	47 / 171	49 / 179
142L	890	54 / 197	53 / 193	55 / 203
142L	980	60 / 219	58 / 214	62 / 226
142L	1080	67 / 245	65 / 240	69 / 252
142L	1220	75 / 274	73 / 268	77 / 282
142L	1420	84 / 309	82 / 302	89 / 326
210L	1610	84 / 308	82 / 301	94 / 346
210L	1760	93 / 341	91 / 333	104 / 383
210L	1900	102 / 374	100 / 365	114 / 419
210L	2100	111 / 407	109 / 398	124 / 454
250L	2100	111 / 407	109 / 398	N/A
250L	2300	122 / 447	119 / 437	N/A
250L	2500	133 / 489	130 / 478	N/A

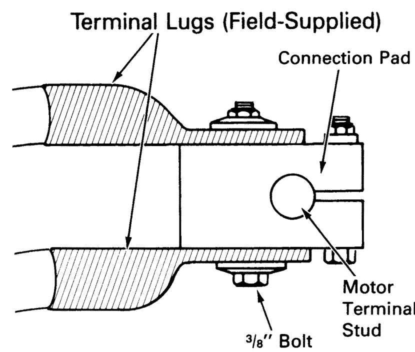
Jobsite Connections

Supply and Motor Lead Wiring and Connections

Copper conductors only should be connected to the compressor motor due to the possibility of galvanic corrosion as a result of moisture if aluminum conductors are used. Copper conductors are recommended for supply leads in the starter panel.

Suggested starter panel line and load side lug sizes (when lugs are provided) are noted in the starter submittals. These submitted lug sizes should be carefully reviewed for compatibility with conductor sizes specified by the electrical engineer or contractor. If they are not compatible, the electrical engineer or contractor should specify the required lug sizes for the particular application. Ground lugs are provided in the motor terminal box and starter panel. The motor terminals are supplied with connection pads which will accommodate bus bars or standard terminal lugs (crimp type recommended). **Terminal lugs are field-supplied.** These connection pads provide additional surface area to minimize improper electrical connections. Also, a 3/8-inch bolt is provided on all connection pads for mounting the lugs. Figure J-1 illustrates the connection between the motor connection pads and the terminal lugs.

Figure J-1 — Electric Connections



Shipment and Assembly

All style hermetic CenTraVac™ units ship as a factory assembled, factory tested package, ready to rig into place on factory supplied isolation pads.

Controls

Advanced Controls

Trane set the standard for unit microprocessor controls in 1985 with the first generation Unit control panel. Associated with this standard have been:

- Proportional Integral Derivative (PID) control strategies which provide stable operation and higher accuracy for better performance;
- Adaptive Control™ to keep the chiller on line during adverse operating conditions and at the same time keep the chiller from a major failure;
- Software based safeties that do not depend on electromechanical hardware — hardware that means questionable reliability and added cost;
- Operator interface that accesses chiller information and control adjustments at the front of the panel.

Flexibility

UCP2 adds more flexibility, more reliability and better system performance than even our most demanding customers expect.

- The modular structure of UCP2 makes it possible for the designer to select the system controls and associated interfaces to Tracer™ (or other building automation systems) that are required for the chiller plant design. With this modular concept, capability can be added or upgraded at any time — with only temporary interruption of chilled water production.
- The operator can quickly program his Custom Report — so that only what is considered to be the most frequently accessed/important reports are available —at any time, right at the front of the panel.
- With easy front panel programmability of Daily, Service Start-up and Machine Configuration settings and setpoints, the operator, serviceman, and system designer can customize the use of the micro controller to the unique conditions of the chiller plant — whether the purpose of chilled water is for comfort cooling or for process cooling.
- All data that is necessary for the safe operation and easy serviceability of the chiller is provided as standard on all CenTraVac™ chillers. Options are available that provide additional controls/data that are required for: an industrial/process system design, applications outside of the typical chilled water system design, the need for redundant machine protection, or the desire for more system information.
- Equipment room refrigerant ppm monitoring can be integrated into the control panel by employing a chiller mounted monitor or a wall mounted monitor.

UCP2 is modular in design which offers the ability to adapt to changes easily and effectively without adding prohibitive cost. To provide flexibility, the controller responds to a wide variety of needs for:

System Designs including equipment, operating conditions, and controls variations that are either existing or being considered for new installations.

Key to designing non-traditional systems is the ability to evaluate the cost and reliability issues of these systems in comparison to the more traditional systems. Trane recommends the use of C.D.S. Network Equipment Economics, the Trane Applications Manuals, and consultation with a Trane sales engineer for help in this analysis.

System Upgrades including the ability to accommodate changes in the chilled water system design or equipment room requirements or to accommodate new technologies that become available.

Reliability

To most people, reliability means "dependable — giving the same result on successive trials." However, to our customers it has come to mean "keep chilled water flowing." In other words, "when I turn the switch on —cold water comes out." In order to do this, the micro controller must be aware of what is happening in the system. But, more importantly, it must be able to make decisions and adjustments to keep the chiller running as long as possible even when non-standard conditions exist. Conditions such as bad power or bad water (flow, temperature, fouling) or system component failure.

- With Enhanced Adaptive Control™ the controller does everything it can to avoid taking the chiller off line:
  - — senses potential overload, freeze and condenser overpressure conditions
  - — displays a warning message about the potential condition/safety trip
  - — takes the following corrective action sequentially as the condition worsens:
    - limits loading
    - prevents further loading
    - unloads until condition improves
    - takes chiller off line
- With the ability to detect surge, UCP2 can call for corrective action to be taken to prevent a surge failure. If the system can respond within 15 minutes, the chiller will continue to operate until further corrective action can be taken.
- With the ability to function across a broader operating map, UCP2, in conjunction with the multiple-stage compressor, can provide safe operation when undesirable inputs to the chiller are encountered. This capability includes:
  - — cold condenser start
  - — running with hot condenser water
  - — low condenser water flow
  - — hot evaporator start
  - — varying water/fluid loop flow operation
  - — return from momentary power losses in less than one minute
  - — smart restart inhibit designed to get the chiller back on line fast
- With more diagnostics and diagnostic history that are time/date stamped and with help messages, the operator or serviceman can take faster and more effective corrective action.
- With the new stepper motor/inlet guide vane actuator, the same technology used in the machine tool industry offers highly reliable and precise inlet vane control.

Systems Performance

"Chilled Water System" encompasses many levels of control: Stand-alone Chiller, Chiller Plant, Applied System, Central Building Automation System.

Building Automation and Chiller Plant Control
For building automation and control of chilled water plants, Trane has developed the Tracer Summit™. It can control the operation of the complete installation: chillers, pumps, cooling towers, isolating valves, air handlers and terminal units. It is a pre-programmable, but, flexible control system module, configured according to the requirements of the end user. Trane can undertake full responsibility for an optimized automation and energy management for the entire chiller plant.

The main functions are:
- **Chiller sequencing:** equalizes the number of running hours of the chillers. Different control strategies are available depending on the configuration of the installation.
- **Control of the auxiliaries:** includes input/output modules to control the operation of the various auxiliary equipments (water pumps, valves, cooling towers, etc.)
- **Time of day scheduling**: allows the end user to define the occupancy period, i.e. time of the day, holiday periods and exception schedules.
- **Optimization of the start/stop time of the installation:** based on the programmed schedule of occupancy and on the historical record of the behavior of the temperatures, calculates the optimal time of start and stop of the installation to get the best compromise between energy savings and comfort of the occupants.
- **Soft loading:** the soft loading function minimizes the number of chillers that are operated to satisfy the building morning pull down, thus preventing an overshoot of the actual capacity required. Unnecessary starts are avoided and the peak current demand is lowered.
- **Communication capabilities**: several communication levels are provided:
  — local, through a PC workstation keyboard. Summit can be programmed to send messages to local or remote workstations and or a pager in the following cases:
  — Analog parameter exceeding a programmed value.
  — Maintenance warning.
  — Component failure alarm.
  — Critical alarm messages. In this latter case, the message is displayed until the operator acknowledges the receipt of the information. From the remote station it is also possible to access and modify the chiller plant's control parameters.
- Remote communication through a modem: As an option, a modem can be connected to communicate the plant operation parameters through voice grade phone lines.

The remote terminal is a PC workstation equipped with a modem and software to display the remote plant parameters.

Controls

Functions/ Protections

Optimal Performance
Regardless of the system level being designed, the unit controls become critical not just in making every level operate reliably but in facilitating optimal performance. UCP2 provides more capability and more intelligence to make this operation/ optimization possible:

Chiller Level
- Factory mounted water temperature sensors
- Variable speed drive for those installations in which the chiller is operating at part load conditions a significant percentage of the time and where cold condenser water is available.
- Hot gas bypass for those process installations where the chiller will need to respond quickly to sudden load increases.
- ASHRAE Guideline 3 Report incorporated into the Chiller Report and Printer Report. Guideline 3 aids operators in managing refrigerant assets.

Chiller Plant Level
- Heat recovery — to take advantage of waste heat from the chiller for heating applications.
- Heat pump — for those applications in which heating is the primary mission of the chiller and cooling is a waste product (requiring an endless source of heat such as a well or lake water).
- Free-cooling — for use in those parts of the country where cold condenser water is available to eliminate the need to operate the compressor.
- Variable flow — for applications where either the condenser water or the system water flows must vary.
- Ice-making — for demand charge avoidance or for additional capacity needs and where no cooling requirements exist for considerable periods of time.
- Low condenser gpm for chiller plant optimization.
- Cooling tower reset based on head pressure for tower optimization.
- Low evaporator fluid temperature for process applications.
- kW demand limiting for those installations where avoidance of demand charges is more critical than maintaining capacity.
- Chilled water reset (based on return water temperatures or ambient temperature or based on a 4-20 mA signal) for those installations where energy savings is more critical than maintaining design leaving chilled water temperature at part loads.

Applied Systems
- Low evaporator fluid temperature for cold air/humidity control applications.
- Variable fluid flow where evaporator flow is modulated by a device outside the control of the chiller or the chiller plant.

Control Functions

Constant Evaporator Leaving Fluid Temperature

Current Limit/Demand Limit

Condenser Limit

Softloading

Hot Gas Bypass (optional)

Leaving Condenser Water Temperature (programmable setting) heat pump only (optional)

Ability to Control with Varying Water Loop Flow

Heat Recovery Temperatures (optional)

Constant Entering Fluid Temperature (programmable setting)

Variable Speed Drive (optional drive with adaptive tuning for safe operation and maximum efficiency)

Loss of Load for Sudden Load Loss (nuisance trip prevention)

Note: capacity control can be accomplished in several ways: entering or leaving evaporator fluid temperature, leaving condenser water temperature.

Machine Protections

Starter
Compressor Contactor Failure Detection

Solid-state starter heat sink (included with SSS)

Compressor
Smart Shutdown Sequence

High Compressor Discharge Temperature (optional)

Surge Detection

Extended Surge Protection

Oil Temperature

Bearing Temperatures (optional)

Condenser
Loss of flow

High condenser pressure limit

High pressure cutout

Evaporator
Loss of flow

Low refrigerant temperature limit

Low evaporator leaving fluid cutout

Motor
Current limit

Current overload

High motor winding temperatures

High vacuum operation lockout

Momentary power loss, phase unbalance, phase loss, reverse rotation. Over/under voltage is optional

Smart short cycling protection

Purge
Tank full protection

Low current detection

Continuous or excessive pumpout detection

Excessive air leakage detection

Monitored Points
Chiller information is available at the operator interface that can access a variety of reports: Custom, Chiller Refrigerant and Compressor.

Custom Report: User Defined Custom Report (operator may choose up to 20 points — from a list of over 100 choices).

Chiller Report
Status, Fluid Temperatures and Setpoints
- ASHRAE Guideline 3 Report
- Operating mode (i.e. run status)
- Setpoint source or reset source

- Evaporator leaving fluid temperature setpoint
- Evaporator entering and leaving fluid temperatures
- Condenser water entering and leaving water temperature
- Current limit setpoint
- Evaporator flow and condenser flow (optional)
- Outdoor temperature (optional)
- Fluid or water pressure drops (optional) evaporator and condenser
- Active ice-making setpoint (if applicable)
- Active hot water setpoint (if applicable)
- Auxiliary heat recovery temperature (if applicable)

Refrigerant Report
Refrigerant Temperatures and Pressures
- ppm of refrigerant from multiple points outside of machine
- Saturated condenser temperature
- Condenser pressure
- Saturated evaporator temperature
- Evaporator pressure
- Compressor discharge temperature (optional)
- Purge suction temperature
- Purge elapsed time
- Pumpout activity

Compressor Report
- Starts and hours counters
- Phase currents
- Phase voltages (optional)
- Oil temperature and flow
- Motor winding temperature
- Bearing temperatures (optional)
- Kilowatts/power factor (optional)

Diagnostics

Water and refrigerant temperatures out of range

Loss of flows

Sensor and switch faults

Overload trips

Over/under voltage (if applicable)

Surge/extended surge

Compressor acceleration failure

Transition failure

Other drives faults

Distribution faults

Oil pressures and temperatures out of range

High condenser pressure cutout

Low and high differential pressure

Emergency stop

Loss of communications to other sources

Microprocessor memory errors

High motor winding temperature

Excessive purge activity

Operator Interface
The Trane CenTraVac chiller control panel, UCP2 is easy to use, understand, to access information, to read, to change setpoints, to diagnose problems, to maintain, and to reset after shutdown.

Convenience
- Enunciation of all information is at the front panel display (including power, voltage, amps, purge, pressures, refrigerant monitoring, and number of starts data)
- Messages displayed using clear language

Readability
- LCD multi-language display that is easy to read from a distance anywhere within a 60 degree angle.
- LCD backlight so that the display can be read in a variety of equipment room lighting.

"Customizable" reports with understandable messages.

Maintainability and Serviceability
- Keypad programmability — no setpoint potentiometers
- No batteries — configuration stored in nonvolatile memory
- Logically arranged report groups with report header and setpoint groups
- Selectable security
- Variable points updated every two seconds
- Messages that direct user to problem source via a menu item

Application Flexibility
- Eight languages available
- Metric (SI) units or English
- Remote display interface (optional)

For more information on the Trane centrifugal chiller unit control panel, please contact your local Trane sales engineer.

Modules
Conventional “relay logic” circuits have, been replaced by software and hardware imbedded in the CenTraVac™ microprocessor controller. The functions of the microprocessor are divided into six standard modules. Optional modules are available for those applications that require additional control capability. Optional communication interface modules are available for alternative control sources. All modules communicate with each other on the interprocessor communication bus (IPC).

All information is available and all setpoint/setup adjustments can be accomplished at the operator interface. An optional remote display permits the operator to monitor and operate the chiller from a remote location.

The six standard modules consist of a chiller module, a circuit module, a starter module, a stepper module, a purge module and local display module.

The **chiller module** is the master of the chiller. It communicates commands to other modules and collects data/status/ diagnostic information from other modules over the IPC. The chiller module performs the leaving evaporator fluid temperature and limit control algorithms arbitrating capacity against any operating limit the chiller may find itself working against.

The **circuit module** is assigned inputs and outputs associated with the refrigerant and lubrication circuits.

The **starter module** provides control of the starter when starting, running and stopping the motor. It provides interface to and control of wye-delta, across the line, primary reactor, auto transformer, solid-state starters and Trane Adaptive Frequency™ drive. The starter module also provides protection to both the motor and the compressor in the form of running overload, phase reversal, phase loss, phase unbalance, momentary power loss and compressor surge. All diagnostics are communicated across the IPC to the human interface.

The **stepper module** is designed to drive the stepper motor inlet guide vane actuator and other flow control devices within a system. This module receives from the chiller module the direction and distance to drive the inlet guide vanes and then generates the appropriate signals to operate the stepper motor.

The **purge module** provides control of the purge including all the inputs and outputs to control the purge, to optimize both purge and chiller efficiency, and to communicate purge diagnostics to the human interface.

Before anything can begin, 115 volt (50 or 60 Hz) power is applied to the control panel. In that several control source devices may coexist, the operator determines which device has priority via the operator interface. All control settings at that control source are then in effect (i.e. active setpoints). A control source is the device that determines setpoints and whether the chiller is auto/off (such as local control panel, remote control display, 4-20 mA external device, Tracer™, generic BAS).

Sequence of Operation
For this sequence of operation it will be assumed that the control source has signaled the chiller to be in Automatic (i.e. when there is a load present, the chiller will turn on and when the load disappears, the chiller will turn off). It is also assumed that no diagnostic has occurred either prior to start-up or during run time and that no “special” applications exist.

Power Off	
Power On	
Auto	“Automatically Ready to Start
Evaporator Pump On	Waiting for Need to Cool”
In Parallel: Restart Inhibit	“Restart Temporarily Prevented -
Prelubrication	Time Remaining [:]”
Condenser Flow Established	“Establishing Condenser Flow
Start	and Oil Pressure”
Run: Normal	“Starting Compressor”
	“Running Normal” or
Softloading	“Softloading” or
Evaporator Limit	“Running - Capacity Limited by
Condenser Limit	Low Evaporator Temperature” or
Current/Demand Limit	“Running - Capacity Limited by
Unload	High Condenser Pressure”
	“Machine is Preparing to Shutdown”
Stop	“Operator Initiated Stop -
In Parallel: Close Inlet Guide Vanes	Press Auto to Restart”
Run Compressor	“Post Lubricating -
Post Lube	Time Remaining [:]
Auto	“Automatically Read to Start -
	Waiting for Need to Cool”

Controls

A demand for chilled water is determined by a temperature differential between the evaporator fluid setpoint and the supply fluid temperature.

Start is inhibited and the condition enunciated if high condenser pressure or low oil temperature or high motor winding temperature is detected. Restart (defined as successive, unsuccessful attempts to start — also called short-cycling) Inhibit and the time remaining before restart can be attempted will be enunciated if this condition exists.

The next step issues a command to start the condenser water pump, to confirm that the guide vanes are closed and to start the oil pump motor. When flow is proven, after confirmation that the guide vanes are closed, and after establishing oil pressure, a 15 second start signal is sent to the motor starter. A successful start and acceleration of the motor is followed by the "UNIT IS RUNNING" message.

Any failure to complete a successful start causes the sequence to abort and the CenTraVac™ to coast to a stop. A diagnostic describing the reason for failure, time and date of failure, a help message and reset action required will tell the operator that the micro- controller has detected a problem during the attempted start. As soon as the fail condition is corrected and reset (either manual or automatic) is accomplished, the chiller can go through the start-up sequence again.

Normal operation messages will include information about limit modes when the micro-controller identifies potential fail conditions. This allows the CenTraVac to continue safe operation even though some other part of the system is not operating properly.

"UNIT IS RUNNING CAPACITY LIMITED BY HIGH CURRENT;"

This condition means that a motor current limitation prevents further opening of the compressor inlet guide vanes in response to the temperature controller.

"UNIT IS RUNNING CAPACITY LIMITED BY HIGH COND PRES;"

The condenser high pressure limit has been approached that further loading of the compressor may result in a trip out. (optional)

"UNIT IS RUNNING CAPACITY LIMITED BY LOW EVAP TEMP;"

The evaporator low temperature limit has been approached that further loading of the compressor may result in a trip out.

This Adaptive Control™ prevents a nuisance trip, alerts the operator to the condition, and takes the following corrective action:

1
the control will limit the rate of inlet vane opening. If the condition worsens, then…

2
the control will hold the inlet vane position. If the condition worsens, then…

3
the control will close the inlet vanes at a controlled rate until the condition stabilizes. If, however, the condition worsens, the final step will be to close the vanes even further.

Therefore, even though operating in a controlled limit mode, the chiller may be opening or closing the guide vanes to keep the chiller on line as long as possible.

When UCP2 detects that the chiller is entering surge the message "UNIT IS RUNNING SURGE DETECTED" is enunciated. (Optional surge protection energizes the head relief request relay. If corrective action is not taken and surge continues for 15 minutes, a latching shutdown will occur with a diagnostic message.)

Under normal conditions and when the control source maintains an Auto signal, a stop signal originates from the chiller module which senses no further cooling demand. At this time a "UNIT IS PREPARING TO SHUT DOWN" message appears as the guide vanes close. Then the compressor motor starter and condenser pump starter are de-energized while the oil pump continues to run for approximately two minutes. The CenTraVac can be manually stopped at any time by pushing the Stop key once for a "friendly" stop (coastdown) and twice within five seconds for an emergency stop.

Weights

60 Hz Compressors (English & SI Units)

TYPE	NTON	CPKW	EVSZ	CDSZ	Operating Weight** (lbs)	Operating Weight** (kg)	Shipping Weight** (lbs)	Shipping Weight** (kg)
CVHE	230-320	287	032S	032S	14909	6763	13721	6224
CVHE	230-320	287	032S	032L	15548	7053	14265	6471
CVHE	230-320	287	032L	032L	16422	7449	14911	6764
CVHE	230-320	287	050S	050S	18530	8405	16579	7520
CVHE	230-320	287	050S	050L	19498	8844	17394	7890
CVHE	230-320	287	050L	050L	20789	9430	18326	8313
CVHE	360-500	453	050S	050S	19180	8700	17229	7815
CVHE	360-500	453	050S	050L	20148	9139	18044	8185
CVHE	360-500	453	050L	050L	21439	9725	18976	8608
CVHE	360-500	453	080S	080S	26327	11942	23212	10529
CVHE	360-500	453	080S	080L	27914	12662	24555	11138
CVHE	360-500	453	080L	080L	30027	13620	26135	11855
CVHF	350-485	453	050S	050S	18175	8244	16224	7359
CVHF	350-485	453	050S	050L	19143	8683	17039	7729
CVHF	350-485	453	050L	050L	20434	9269	17971	8152
CVHF	350-485	453	080S	080S	25297	11475	22182	10062
CVHF	350-485	453	080S	080L	26884	12195	23525	10671
CVHF	350-485	453	080L	080L	28997	13153	25105	11388
CVHF	555-640	588	050S	050S	19800	8981	17849	8096
CVHF	555-640	588	050S	050L	20768	9420	18664	8466
CVHF	555-640	588	050L	050L	22059	10006	19596	8889
CVHF	555-640	588	080S	080S	26947	12223	23832	10810
CVHF	555-640	588	080S	080L	28534	12943	25175	11419
CVHF	555-640	588	080L	080L	30647	13901	26755	12136
CVHF	650-910	745	080S	080S	28117	12754	25002	11341
CVHF	650-910	745	080S	080L	29704	13474	26345	11950
CVHF	650-910	745	080L	080L	31817	14432	27925	12667
CVHF	650-910	745	142M	142L	41646	18891	36068	16360
CVHF	650-910	745	142L	142L	42816	19421	36882	16730
CVHF	650-910	745	142E	142L	44762	20304	38299	17372
CVHF	1060-1280	1062	142M	142L	42246	19163	36668	16633
CVHF	1060-1280	1062	142L	142L	43416	19693	37482	17002
CVHF	1060-1280	1062	142E	142L	45362	20576	38899	17645
CVHF	1060-1280	1062	210L	210L	53043	24060	45196	20501
CVHF	1060-1280	1062	250E	250L	66146	30003	55176	25027
CVHF	1470	1340	210L	210L	57820	26227	49980	22671
CVHF	1470	1340	250E	250L	70930	32173	59960	27197

** Note: Values represent maximum unit weights including unit mounted starters, shells with TECU .028” tubes, max bundles, and 150 psig non-marine waterboxes, and compressors with the largest, low voltage motors for each family.

High voltage motors (to include the 1228 cpkw high voltage motor for the CVHF 1060-1280) weigh less than the low voltage motors shown in the table.

Weights

50 Hz Compressors (English & SI Units)

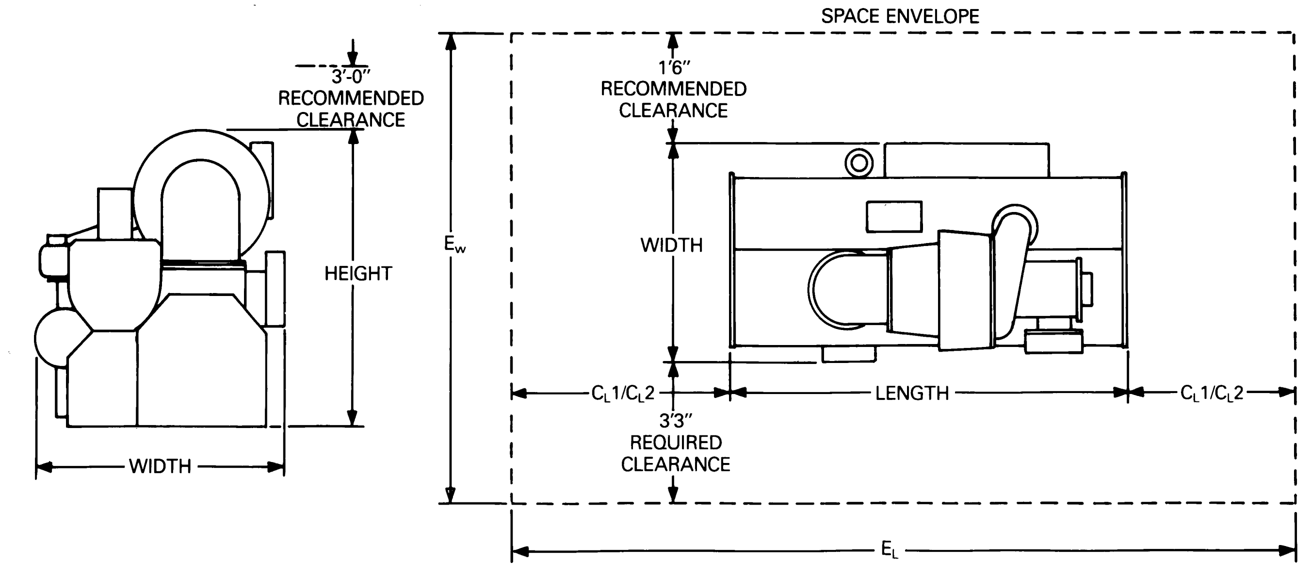
TYPE	NTON	CPKW	EVSZ	CDSZ	Operating Weight** (lbs)	Operating Weight** (kg)	Shipping Weight** (lbs)	Shipping Weight** (kg)
CVHE	190-270	242	032S	032S	14259	6468	13071	5929
CVHE	190-270	242	032S	032L	14898	6758	13615	6176
CVHE	190-270	242	032L	032L	15772	7154	14261	6469
CVHE	190-270	242	050S	050S	17880	8110	15929	7225
CVHE	190-270	242	050S	050L	18848	8549	16744	7595
CVHE	190-270	242	050L	050L	21039	9135	17676	8018
CVHE	300-420	379	050S	050S	19180	8700	17229	7815
CVHE	300-420	379	050S	050L	20148	9139	18044	8185
CVHE	300-420	379	050L	050L	21439	9725	18976	8607
CVHE	300-420	379	080S	080S	26327	11942	23212	10529
CVHE	300-420	379	080S	080L	27914	12662	24555	11138
CVHE	300-420	379	080L	080L	30027	13620	26135	11855
CVHG	480-565	548	050S	050S	20930	9494	18979	8609
CVHG	480-565	548	050S	050L	21898	9933	19794	8978
CVHG	480-565	548	050L	050L	23189	10518	20726	9401
CVHG	480-565	548	080S	080S	28077	12736	24962	11323
CVHG	480-565	548	080S	080L	29664	13455	26305	11932
CVHG	480-565	548	080L	080L	31777	14414	27885	12648
CVHG	670-780	716	080S	080S	28677	13008	25562	11595
CVHG	670-780	716	080S	080L	30264	13728	26905	12204
CVHG	670-780	716	080L	080L	32377	14686	28485	12921
CVHG	670-780	716	142M	142L	42735	19384	37157	16854
CVHG	670-780	716	142L	142L	43905	19915	37971	17223
CVHG	920-1067	892	142M	142L	44135	20019	38557	17489
CVHG	920-1067	892	142L	142L	45305	20550	39371	17858
CVHG	920-1067	892	210L	210L	54932	24917	47085	21357

**Note: Values represent maximum unit weights including unit mounted starters, shells with TECU .028" tubes, max bundles, and 150 psig non-marine waterboxes, and compressors with the largest, low voltage motors for each family.

High voltage motors weigh less than the low voltage motors shown in the table.

Physical Dimensions

50 Hz Compressors (English Units)



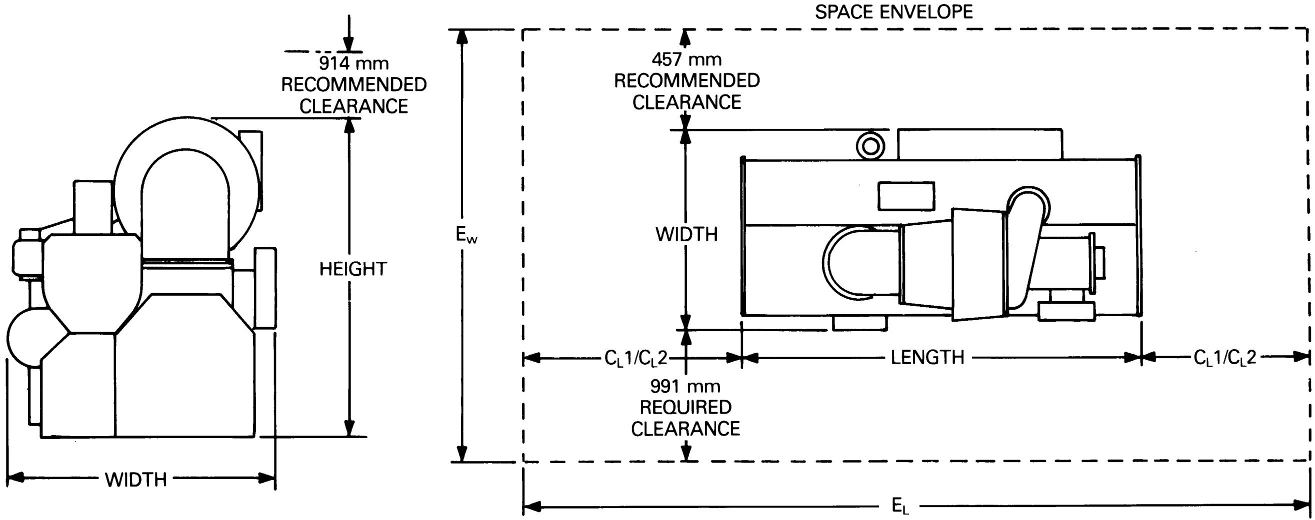
				ENGLISH UNITS								
				Envelope		Clearance		Unit Dimensions				
				W/O Unit Mounted Starters	With Unit Mounted Starters	Tube Pull				W/O Unit Mounted Starters	With Unit Mounted Starters
	COMP	Shell Size	Shell Arrange-ment	EL	EW	EW	CL1	CL2	Length	Height	Width	Width
	190-270	320	SS	26' 5″	10' 6 1/4″	11' 4 1/2″	11' 9″	3' 5″	11' 3″	7' 9 3/4″	5' 9 1/4″	6' 7 1/2″
	190-270	320	SL & LL	33' 11 1/4″	10' 6 1/4″	11' 4 1/2″	15' 6″	3' 5″	15' 0 1/4″	7' 9 3/4″	5″ 9 1/4″	6' 7 1/2″
	190-270	500	SS	26' 6 3/8″	11' 4 5/8″	12' 6 7/8″	11' 9″	3' 6 3/8″	11' 3″	8' 2 1/4″	6' 7 5/8″	7' 9 7/8″
C	190-270	500	SL & LL	34' 0 5/8″	11' 4 5/8″	12' 6 7/8″	15' 6″	3' 6 3/8″	15' 0 1/4″	8' 2 1/4″	6' 7 5/8″	7' 9 7/8″
V	300-420	500	SS	26' 6 3/8″	11' 4 5/8″	12' 5 1/2″	11' 9″	3' 6 3/8″	11' 3″	8' 2 1/2″	6' 7 5/8″	7' 8 1/2″
H	300-420	500	SL & LL	34' 0 5/8″	11' 4 5/8″	12' 5 1/2″	15' 6″	3' 6 3/8″	15' 0 1/4″	8' 2 1/2″	6' 7 5/8″	7' 8 1/2″
E	300-420	800	SS	27' 4 1/4″	12' 5 1/4″	13' 4 5/8″	11' 9″	4' 4 1/4″	11' 3″	9' 6 3/8″	7' 11 1/4″	8' 7 5/8″
	300-420	800	SL & LL	34' 10 1/2″	12' 5 1/4″	13' 4 5/8″	15' 6″	4' 4 1/4″	15' 0 1/4″	9' 6 3/8″	7' 11 1/4″	8' 7 5/8″
	480-565	500	SS	26' 6 3/8″	11' 4 5/8″	12' 5 3/4″	11' 9″	3' 6 3/8″	11' 3″	8' 7 1/4″	6' 7 5/8″	7' 8 3/4″
	480-565	500	SL & LL	34' 0 5/8″	11' 4 5/8″	12' 5 3/4″	15' 6″	3' 6 3/8″	15' 0 1/4″	8' 7 1/4″	6' 7 5/8″	7' 8 3/4″
	480-565	800	SS	27' 4 1/4″	12' 5 1/4″	13' 4 5/8″	11' 9″	4' 4 1/4″	11' 3″	9' 8″	7' 11 1/4″	8' 7 5/8″
C	480-565	800	SL & LL	34' 10 1/2″	12' 5 1/4″	13' 4 5/8″	15' 6″	4 4 1/4″	15' 0 1/4″	9' 8″	7' 11 1/4″	8' 7 5/8″
V	670-780	800	SS	27' 4 1/4″	12' 10″	13' 10 3/4″	11' 9″	4' 4 1/4″	11' 3″	9' 6 3/4″	8' 4″	9' 1 3/4″
H	670-780	800	SL & LL	34' 10 1/2″	12' 10″	13' 10 3/4″	15' 6″	4' 4 1/4″	15' 0 1/4″	9' 6 3/4″	8' 4″	9' 1 3/4″
G	670-780	1420	ML & LL	35' 5 1/4″	14' 5 3/4″	15' 0 7/8″	15' 6″	4' 11″	15' 0 1/4″	10' 1 1/8″	9' 11 3/4″	10' 3 7/8″
	920-1067	1420	ML & LL	35' 5 1/4″	14' 5 3/4″	15' 0 7/8″	15' 6″	4' 11″	15' 0 1/4″	10' 1 1/8″	9' 11 3/4″	10' 3 7/8″
	920-1067	2100	LL	35' 5 1/4″	15 3 3/4″	15' 7″	15' 6″	4' 11″	15' 0 1/4″	11' 0 7/8″	10' 9 3/4″	10' 10″

CL1 CAN BE AT EITHER END OF MACHINE AND IS REQUIRED FOR TUBE PULL CLEARANCE.
CL2 IS ALWAYS AT THE OPPOSITE END OF MACHINE FROM CL1 AND IS REQUIRED FOR SERVICE CLEARANCE.

CENTRAVAC WATER CONNECTION PIPE SIZE					
Water	Shell Size				
Passes	032	050	080	142	210
EVAPORATOR	Nominal Pipe Size (Inches)				
1 PASS	8	10	12	16	16
2 PASS	6	8	10	12	14
3 PASS	5	6	8	10	12
CONDENSER 2 PASS	6	8	10	12	14

Physical Dimensions

50 Hz Compressors (SI Units)



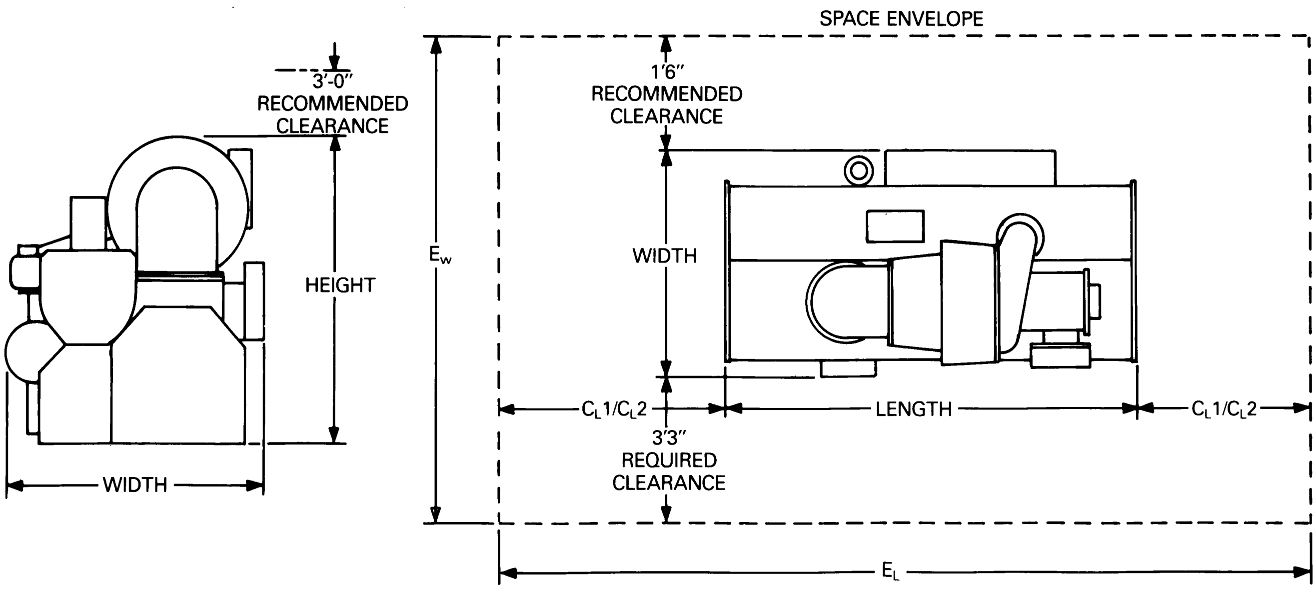
				METRIC UNITS								
				Envelope		Clearance		Unit Dimensions				
				W/O Unit Mounted Starters	With Unit Mounted Starters	Tube Pull				W/O Unit Mounted Starters	With Unit Mounted Starters
	COMP	Shell Size	Shell Arrange-ment	EL	EW	EW	CL1	CL2	Length	Height	Width	Width
	190-270	320	SS	8052	3207	3467	3581	1041	3429	2380	1759	2019
	190-270	320	SL & LL	10344	3207	3467	4724	1041	4578	2380	1759	2019
	190-270	500	SS	8087	3470	3832	3581	1076	3429	2494	2022	2384
C	190-270	500	SL & LL	10379	3470	3832	4724	1076	4578	2494	2022	2384
V	300-420	500	SS	8087	3470	3797	3581	1076	3429	2502	2022	2350
H	300-420	500	SL & LL	10379	3470	3797	4724	1076	4578	2502	2022	2350
E	300-420	800	SS	8338	3867	4080	3581	1327	3429	2905	2419	2632
	300-420	800	SL & LL	10630	3867	4080	4724	1327	4578	2905	2419	2632
	480-565	500	SS	8087	3470	3804	3581	1076	3429	2624	2022	2356
	480-565	500	SL & LL	10379	3470	3804	3581	1076	4578	2624	2022	2356
	480-565	800	SS	8338	3867	4080	4724	1327	3429	2946	2419	2632
C	480-565	800	SL & LL	10630	3867	4080	4724	1327	4578	2946	2419	2632
V	670-780	800	SS	8338	3912	4235	3581	1327	3429	2915	2540	2788
H	670-780	800	SL & LL	10630	3912	4235	4724	1327	4578	2915	2540	2788
G	670-780	1420	ML & LL	10754	4413	4594	4724	1499	4578	3077	3042	3146
	920-1067	1420	ML & LL	10754	4413	4594	4724	1499	4578	3077	3042	3146
	920-1067	2100	LL	10801	4667	4750	4724	1499	4578	3375	3296	3302

CL1 CAN BE AT EITHER END OF MACHINE AND IS REQUIRED FOR TUBE PULL CLEARANCE.
CL2 IS ALWAYS AT THE OPPOSITE END OF MACHINE FROM CL1 AND IS REQUIRED FOR SERVICE CLEARANCE.

CENTRAVAC WATER CONNECTION PIPE SIZE					
Water	Shell Size				
Passes	032	050	080	142	210
EVAPORATOR	Metric Pipe Size (Millimeters)				
1 PASS	DN200	DN250	DN300	DN400	DN400
2 PASS	DN150	DN200	DN250	DN300	DN350
3 PASS	DN125	DN150	DN200	DN250	DN300
CONDENSER 2 PASS	DN150	DN200	DN250	DN300	DN350

Physical Dimensions

60 Hz Compressors (English Units)



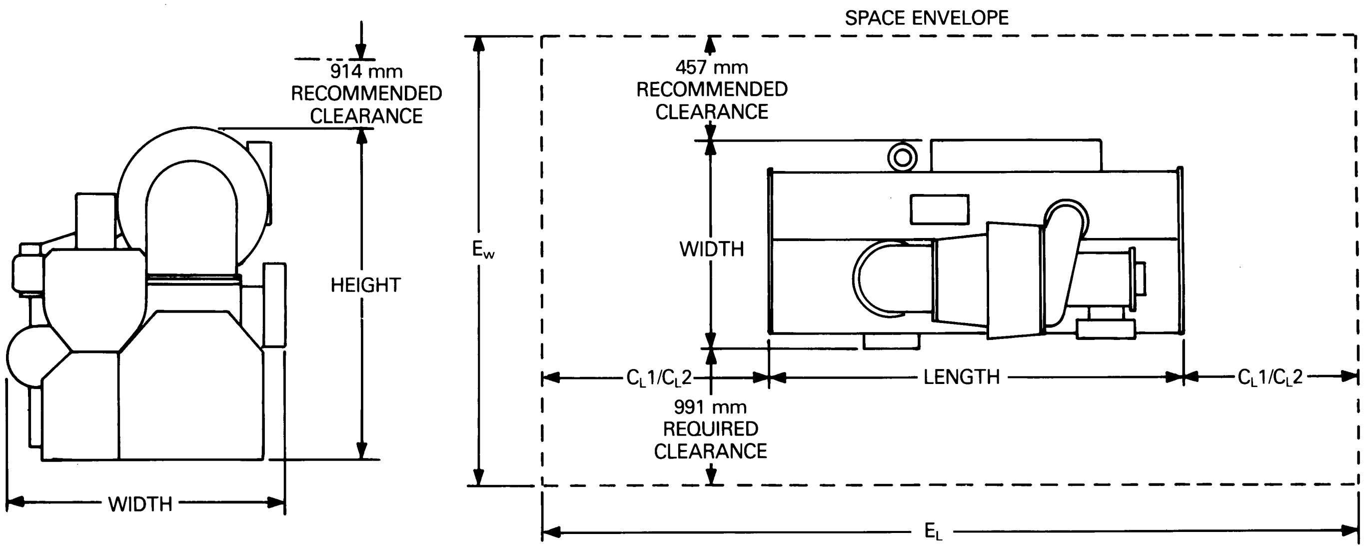
				ENGLISH UNITS								
					Envelope		Clearance		Unit Dimensions			
	COMP	Shell Size	Shell Arrange-ment	EL	W/O Unit Mounted Starters EW	With Unit Mounted Starters EW	Tube Pull CL1	CL2	Length	Height	W/O Unit Mounted Starters Width	With Unit Mounted Starters Width
	230-320	320	SS	26' 5″	10' 6 1/4″	11' 4 1/2″	11' 9″	3' 5″	11' 3″	7' 9 3/4″	5' 9 1/4″	6' 7 1/2″
	230-320	320	SL & LL	33' 11 1/4″	10' 6 1/4″	11' 4 1/2″	15' 6″	3' 5″	15' 0 1/4″	7' 9 3/4″	5″ 9 1/4″	6' 7 1/2″
	230-320	500	SS	26' 6 3/8″	11' 4 5/8″	12' 6 7/8″	11' 9″	3' 6 3/8″	11' 3″	8' 2 1/4″	6' 7 5/8″	7' 9 7/8″
C	230-320	500	SL & LL	34' 0 5/8″	11' 4 5/8″	12' 6 7/8″	15' 6″	3' 6 3/8″	15' 0 1/4″	8' 2 1/4″	6' 7 5/8″	7' 9 7/8″
V	360-500	500	SS	26' 6 3/8″	11' 4 5/8″	12' 5 1/2″	11' 9″	3' 6 3/8″	11' 3″	8' 2 1/2″	6' 7 5/8″	7' 8 1/2″
H	360-500	500	SL & LL	34' 0 5/8″	11' 4 5/8″	12' 5 1/2″	15' 6″	3' 6 3/8″	15' 0 1/4″	8' 2 1/2″	6' 7 5/8″	7' 8 1/2″
E	360-500	800	SS	27' 4 1/4″	12' 5 1/4″	13' 4 5/8″	11' 9″	4' 4 1/4″	11' 3″	9' 6 3/8″	7' 11 1/4″	8' 7 5/8″
	360-500	800	SL & LL	34' 10 1/2″	12' 5 1/4″	13' 4 5/8″	15' 6″	4' 4 1/4″	15' 0 1/4″	9' 6 3/8″	7' 11 1/4″	8' 7 5/8″
	350-485	500	SS	26' 6 3/8″	11' 4 5/8″	12' 5 1/2″	11' 9″	3' 6 3/8″	11' 3″	8' 4″	6' 7 5/8″	7' 8 1/2″
	350-485	500	SL & LL	34' 0 5/8″	11' 4 5/8″	12' 5 1/2″	15' 6″	3' 6 3/8″	15' 0 1/4″	8' 4″	6' 7 5/8″	7' 8 3/4″
	350-485	800	SS	27' 4 1/4″	12' 5 1/4″	13' 4 5/8″	11' 9″	4' 4 1/4″	11' 3″	9' 6 1/2″	7' 11 1/4″	8' 7 5/8″
	350-485	800	SL & LL	34' 10 1/2″	12' 5 1/4″	13' 4 5/8″	15' 6″	4' 4 1/4″	15' 0 1/4″	9' 6 1/2″	7' 11 1/4″	8' 7 5/8″
	555 & 640	500	SS	26' 6 3/8″	11' 4 5/8″	12' 5 3/4″	11' 9″	3' 6 3/8″	11' 3″	8' 7 1/4″	6' 7 5/8″	7' 8 3/4″
C	555 & 640	500	SL & LL	34' 0 5/8″	11' 4 5/8″	12' 5 3/4″	15' 6″	3' 6 3/8″	15' 0 1/4″	8' 7 1/4″	6' 7 5/8″	7' 8 3/4″
V	555 & 640	800	SS	27' 4 1/4″	12' 5 1/4″	13' 4 5/8″	11' 9″	4' 4 1/4″	11' 3″	9' 8″	7' 11 1/4″	8' 7 5/8″
H	555 & 640	800	SL & LL	34' 10 1/2″	12' 5 1/4″	13' 4 5/8″	15' 6″	4' 4 1/4″	15' 0 1/4″	9' 8″	7' 11 1/4″	8' 7 5/8″
F	650-910	800	SS	27' 4 1/4″	12' 10″	13' 10 3/4″	11' 9″	4' 4 1/4″	11' 3″	9' 6 3/4″	8' 4″	9' 1 3/4″
	650-910	800	SL & LL	34' 10 1/2″	12' 10″	13' 10 3/4″	15' 6″	4' 4 1/4″	15' 0 1/4″	9' 6 3/4″	8' 4″	9' 1 3/4″
	650-910	1420	ML & LL	35' 5 1/4″	14' 5 3/4″	15' 0 7/8″	15' 6″	4' 11″	15' 0 1/4″	10' 1 1/8″	9' 11 3/4″	10' 3 7/8″
	1060-1280	1420	ML &LL	35' 5 1/4″	14' 5 3/4″	15' 0 7/8″	15' 6″	4' 11″	15' 0 1/4″	10' 1 1/8″	9' 11 3/4″	10' 3 7/8″
	1060-1280	1420	EL	39' 2 7/8″	14' 5 3/4″	15' 0 7/8″	17' 5″	4' 11″	16' 10 3/4″	10' 1 1/8″	9' 11 3/4″	10' 3 7/8″
	1060-1280	2100	LL	35' 5 1/4″	15' 3 3/4″	15' 7″	15' 6″	4' 11″	15' 0 1/4″	11' 0 7/8″	10' 9 3/4″	10' 10″
	1060-1280	2500	EL	39' 5 7/8″	16' 7″	16' 7″	17' 5″	5' 2 1/8″	16' 10 3/4″	11' 4 7/8″	11' 11 1/2″	11' 11 1/2″
	1470	2100	LL	35' 5 1/4″	15' 3 3/4″	15' 7″	15' 6″	4' 11″	15' 0 1/4″	11' 5″	10' 9 3/4″	10' 10″
	1470	2500	EL	39' 5 7/8″	16' 7″	16' 7″	17' 5″	5' 2 1/8″	16' 10 3/4″	11' 4 7/8″	11' 11 1/2″	11' 11 1/2″

CL1 CAN BE AT EITHER END OF MACHINE AND IS REQUIRED FOR TUBE PULL CLEARANCE.
CL2 IS ALWAYS AT THE OPPOSITE END OF MACHINE FROM CL1 AND IS REQUIRED FOR SERVICE CLEARANCE.

CENTRAVAC WATER CONNECTION PIPE SIZE						
Water	Shell Size					
Passes	032	050	080	142	210	250
EVAPORATOR	Nominal Pipe Size (Inches)					
1 PASS	8	10	12	16	16	16
2 PASS	6	8	10	12	14	14
3 PASS	5	6	8	10	12	12
CONDENSER 2 PASS	6	8	10	12	14	14

Physical Dimensions

60 Hz Compressors (SI Units)



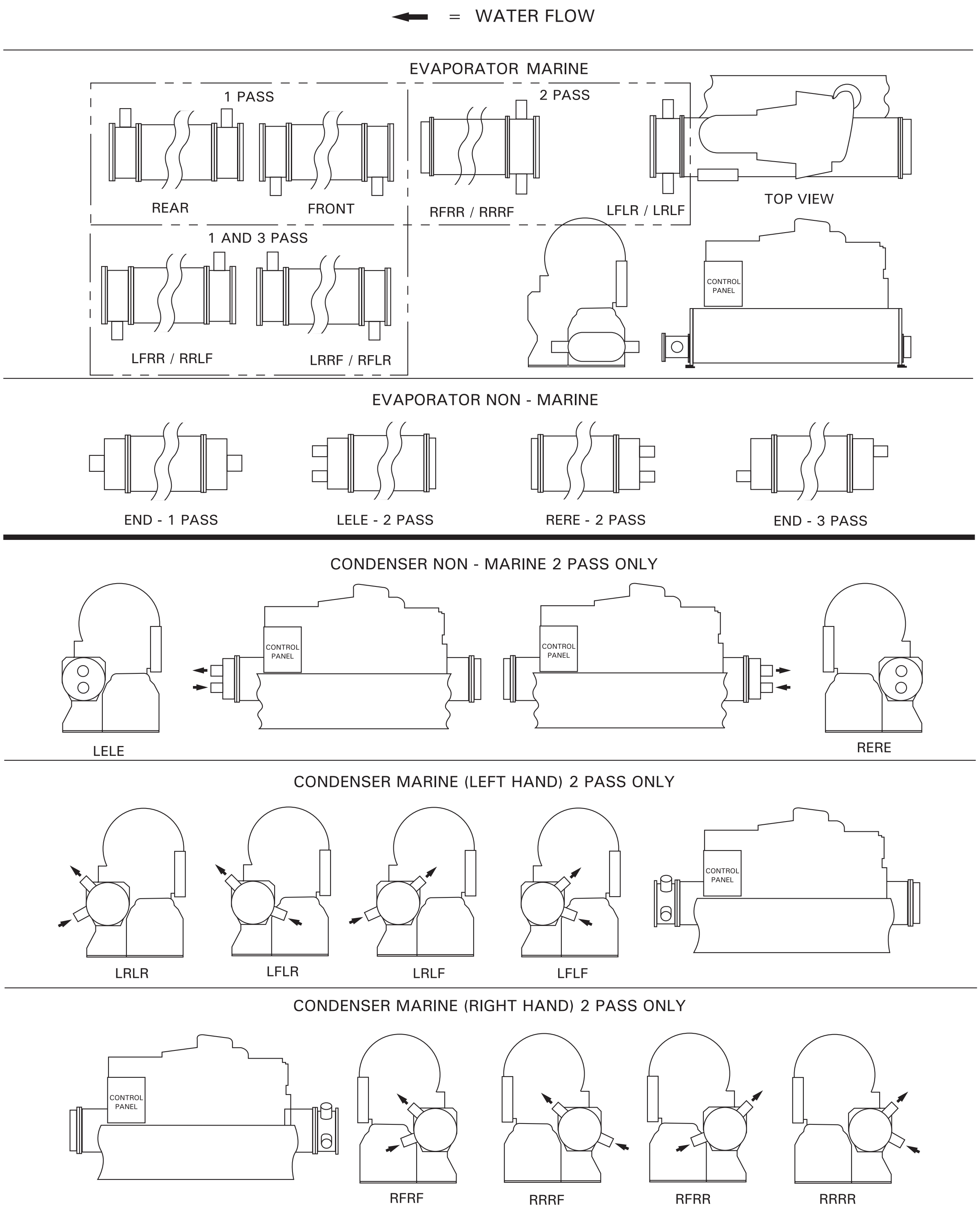
				METRIC UNITS								
				Envelope		Clearance		Unit Dimensions				
	COMP	Shell Size	Shell Arrange-ment	EL	W/O Unit Mounted Starters EW	With Unit Mounted Starters EW	Tube Pull CL1	CL2	Length	Height	W/O Unit Mounted Starters Width	With Unit Mounted Starters Width
	230-320	320	SS	8052	3207	3467	3581	1041	3429	2380	1759	2019
	230-320	320	SL & LL	10344	3207	3467	4724	1041	4578	2380	1759	2019
	230-320	500	SS	8087	3470	3832	3581	1076	3429	2494	2022	2384
C	230-320	500	SL & LL	10379	3470	3832	4724	1076	4578	2494	2022	2384
V	360-500	500	SS	8087	3470	3797	3581	1076	3429	2502	2022	2350
H	360-500	500	SL & LL	10379	3470	3797	4724	1076	4578	2502	2022	2350
E	360-500	800	SS	8338	3867	4080	3581	1327	3429	2905	2419	2632
	360-500	800	SL & LL	10630	3867	4080	4724	1327	4578	2905	2419	2632
	350-485	500	SS	8087	3470	3797	3581	1076	3429	2540	2022	2350
	350-485	500	SL & LL	10379	3470	3797	4724	1076	4578	2540	2022	2350
	350-485	800	SS	8338	3867	4080	3581	1327	3429	2908	2419	2632
	350-485	800	SL & LL	10630	3867	4080	4724	1327	4578	2908	2419	2632
	555 & 640	500	SS	8087	3470	3804	3581	1076	3429	2624	2022	2356
C	555 & 640	500	SL & LL	10379	3470	3804	4724	1076	4578	2624	2022	2356
V	555 & 640	800	SS	8338	3867	4080	3581	1327	3429	2946	2419	2632
H	555 & 640	800	SL & LL	10630	3867	4080	4724	1327	4578	2946	2419	2632
F	650-910	800	SS	8338	3912	4235	3581	1327	3429	2915	2540	2788
	650-910	800	SL & LL	10630	3912	4235	4724	1327	4578	2915	2540	2788
	650-910	1420	ML & LL	10754	4413	4594	4724	1499	4578	3077	3042	3146
	1060-1280	1420	ML &LL	10754	4413	4594	4724	1499	4578	3077	3042	3146
	1060-1280	1420	EL	11909	4413	4594	5309	1499	5150	3077	3042	3146
	1060-1280	2100	LL	10801	4667	4750	4724	1499	4578	3375	3296	3302
	1060-1280	2500	EL	11069	5055	5055	5309	1578	5150	3477	3645	3645
	1470	2100	LL	10801	4667	4750	4724	1499	4578	3479	3296	3302
	1470	2500	EL	11069	5055	5055	5309	1578	5150	3585	3645	3645

CL1 CAN BE AT EITHER END OF MACHINE AND IS REQUIRED FOR TUBE PULL CLEARANCE.
CL2 IS ALWAYS AT THE OPPOSITE END OF MACHINE FROM CL1 AND IS REQUIRED FOR SERVICE CLEARANCE.

CENTRAVAC WATER CONNECTION PIPE SIZE						
Water	Shell Size					
Passes	032	050	080	142	210	250
EVAPORATOR	Metric Pipe Size (Millimeters)					
1 PASS	DN200	DN250	DN300	DN400	DN400	DN400
2 PASS	DN150	DN200	DN250	DN300	DN350	DN350
3 PASS	DN125	DN150	DN200	DN250	DN300	DN300
CONDENSER 2 PASS	DN150	DN200	DN250	DN300	DN350	DN350

Physical Dimensions

Waterbox Connection Arrangement



These graphics are intended to help you visualize the possible connections/combinations that may be available for your unit. You must contact your local Trane office who can configure your selection as an as-built drawing to confirm it is available and to provide appropriate dimensions.

Physical Dimensions

Waterbox Lengths – English Units

SHELL	PRESSURE	EVAP	PASSES	LENGTH	RETURN LENGTH	COND	NO. PASSES	LENGTH	RETURN LENGTH
320	150 PSIG	MAR	1	16.12		MAR	2	16.674	6.125
320	150 PSIG	MAR	2	16.12	6.94	NMAR	2	9.25 cast	6.125
320	150 PSIG	MAR	3	16.12					
320	150 PSIG	NMAR	1	12.94					
320	150 PSIG	NMAR	2	12.94	6.94				
320	150 PSIG	NMAR	3	12.94					
320	300 PSIG	MAR	1	16.12		MAR	2	17	8
320	300 PSIG	MAR	2	16.12	6.94	NMAR	2	13.28/20.28	8
320	300 PSIG	MAR	3	16.12					
320	300 PSIG	NMAR	1	12.94					
320	300 PSIG	NMAR	2	12.94	6.94				
320	300 PSIG	NMAR	3	12.94					
500	150 PSIG	MAR	1	18.5		MAR	2	16.31	7.875
500	150 PSIG	MAR	2	18.5	6.73	NMAR	2	10.5 cast	7.875
500	150 PSIG	MAR	3	18.5					
500	150 PSIG	NMAR	1	12.73					
500	150 PSIG	NMAR	2	12.73	6.73				
500	150 PSIG	NMAR	3	12.73					
500	300 PSIG	MAR	1	19		MAR	2	18.363	7.6
500	300 PSIG	MAR	2	19	6.73	NMAR	2	12.86/20.46	7.6
500	300 PSIG	MAR	3	19					
500	300 PSIG	NMAR	1	12.73					
500	300 PSIG	NMAR	2	12.73	6.73				
500	300 PSIG	NMAR	3	12.73					
800	150 PSIG	MAR	1	23.225		MAR	2	23.75	8.32
800	150 PSIG	MAR	2	21.225	7.21	NMAR	2	14.2	8.32
800	150 PSIG	MAR	3	19.225					
800	150 PSIG	NMAR	1	13.19					
800	150 PSIG	NMAR	2	13.19	7.21				
800	150 PSIG	NMAR	3	13.19					
800	300 PSIG	MAR	1	25		MAR	2	28.14	8.93
800	300 PSIG	MAR	2	23	7.96	NMAR	2	14.4/23.27	8.93
800	300 PSIG	MAR	3	21					
800	300 PSIG	NMAR	1	13.96					
800	300 PSIG	NMAR	2	13.96	7.96				
800	300 PSIG	NMAR	3	13.96					
1420	150 PSIG	MAR	1	28.25		MAR	2	28.25	9.25
1420	150 PSIG	MAR	2	25	9.33	NMAR	2	16	9.25
1420	150 PSIG	MAR	3	23					
1420	150 PSIG	NMAR	1	15.41					
1420	150 PSIG	NMAR	2	15.41	9.33				
1420	150 PSIG	NMAR	3	15.41					
1420	300 PSIG	MAR	1	31.056		MAR	2	33.16	10.06
1420	300 PSIG	MAR	2	27.8	9.84	NMAR	2	15.79	10.06
1420	300 PSIG	MAR	3	25.8					
1420	300 PSIG	NMAR	1	15.59					
1420	300 PSIG	NMAR	2	15.59	9.84				
1420	300 PSIG	NMAR	3	15.59					
210	150 PSIG	MAR	1	N/A	N/A	MAR	2	29.632	9.382
210	150 PSIG	MAR	2	27.25	8.88	NMAR	2	16.38	9.382
210	150 PSIG	MAR	3	25.25					
210	150 PSIG	NMAR	1	15.88					
210	150 PSIG	NMAR	2	15.88	8.88				
210	150 PSIG	NMAR	3	15.88					
210	300 PSIG	MAR	1	N/A		MAR	2	35	10.71
210	300 PSIG	MAR	2	29.64	9.84	NMAR	2	17.71	10.71
210	300 PSIG	MAR	3	29.64					
210	300 PSIG	NMAR	1	16.84					
210	300 PSIG	NMAR	2	16.84	9.84				
210	300 PSIG	NMAR	3	16.84					
250	150 PSIG	MAR	1	N/A		MAR	2	32	10.75
250	150 PSIG	MAR	2	N/A	N/A	NMAR	2	17.75	10.75
250	150 PSIG	MAR	3	N/A					
250	150 PSIG	NMAR	1	18.75					
250	150 PSIG	NMAR	2	18.75	11.75				
250	150 PSIG	NMAR	3	18.75					
250	300 PSIG	MAR	1	N/A		MAR	2	38.3	11.75
250	300 PSIG	MAR	2	N/A	N/A	NMAR	2	18.75	11.75
250	300 PSIG	MAR	3	N/A					
250	300 PSIG	NMAR	1	20.25					
250	300 PSIG	NMAR	2	20.25	13.25				
250	300 PSIG	NMAR	3	20.25					

Physical Dimensions

Waterbox Lengths – Metric Units

SHELL	PRESSURE	EVAP	PASSES	LENGTH	RETURN LENGTH	COND	NO. PASSES	LENGTH	RETURN LENGTH
320	150 PSIG	MAR	1	409		MAR	2	424	156
320	150 PSIG	MAR	2	409	176	NMAR	2	235 cast	156
320	150 PSIG	MAR	3	409					
320	150 PSIG	NMAR	1	329					
320	150 PSIG	NMAR	2	329	176				
320	150 PSIG	NMAR	3	329					
320	300 PSIG	MAR	1	409		MAR	2	432	203
320	300 PSIG	MAR	2	409	176	NMAR	2	337/515	203
320	300 PSIG	MAR	3	409					
320	300 PSIG	NMAR	1	329					
320	300 PSIG	NMAR	2	329	176				
320	300 PSIG	NMAR	3	329					
500	150 PSIG	MAR	1	470		MAR	2	414	200
500	150 PSIG	MAR	2	470	171	NMAR	2	267 cast	200
500	150 PSIG	MAR	3	470					
500	150 PSIG	NMAR	1	323					
500	150 PSIG	NMAR	2	323	171				
500	150 PSIG	NMAR	3	323					
500	300 PSIG	MAR	1	483		MAR	2	466	193
500	300 PSIG	MAR	2	483	171	NMAR	2	327/520	193
500	300 PSIG	MAR	3	483					
500	300 PSIG	NMAR	1	323					
500	300 PSIG	NMAR	2	323	171				
500	300 PSIG	NMAR	3	323					
800	150 PSIG	MAR	1	590		MAR	2	603	211
800	150 PSIG	MAR	2	539	183	NMAR	2	361	211
800	150 PSIG	MAR	3	488					
800	150 PSIG	NMAR	1	335					
800	150 PSIG	NMAR	2	335	183				
800	150 PSIG	NMAR	3	335					
800	300 PSIG	MAR	1	635		MAR	2	871	227
800	300 PSIG	MAR	2	584	202	NMAR	2	366/591	227
800	300 PSIG	MAR	3	533					
800	300 PSIG	NMAR	1	355					
800	300 PSIG	NMAR	2	355	202				
800	300 PSIG	NMAR	3	355					
1420	150 PSIG	MAR	1	718		MAR	2	718	235
1420	150 PSIG	MAR	2	635	237	NMAR	2	406	235
1420	150 PSIG	MAR	3	584					
1420	150 PSIG	NMAR	1	391					
1420	150 PSIG	NMAR	2	391	237				
1420	150 PSIG	NMAR	3	391					
1420	300 PSIG	MAR	1	789		MAR	2	842	256
1420	300 PSIG	MAR	2	706	250	NMAR	2	401	256
1420	300 PSIG	MAR	3	655					
1420	300 PSIG	NMAR	1	396					
1420	300 PSIG	NMAR	2	396	250				
1420	300 PSIG	NMAR	3	396					
210	150 PSIG	MAR	1	N/A	N/A	MAR	2	753	238
210	150 PSIG	MAR	2	692	226	NMAR	2	416	238
210	150 PSIG	MAR	3	641					
210	150 PSIG	NMAR	1	403					
210	150 PSIG	NMAR	2	403	226				
210	150 PSIG	NMAR	3	403					
210	300 PSIG	MAR	1	N/A		MAR	2	889	272
210	300 PSIG	MAR	2	753	250	NMAR	2	450	272
210	300 PSIG	MAR	3	753					
210	300 PSIG	NMAR	1	428					
210	300 PSIG	NMAR	2	428	250				
210	300 PSIG	NMAR	3	428					
250	150 PSIG	MAR	1	N/A		MAR	2	813	273
250	150 PSIG	MAR	2	N/A	N/A	NMAR	2	451	273
250	150 PSIG	MAR	3	N/A					
250	150 PSIG	NMAR	1	476					
250	150 PSIG	NMAR	2	476	298				
250	150 PSIG	NMAR	3	476					
250	300 PSIG	MAR	1	N/A		MAR	2	973	298
250	300 PSIG	MAR	2	N/A	N/A	NMAR	2	476	298
250	300 PSIG	MAR	3	N/A					
250	300 PSIG	NMAR	1	514					
250	300 PSIG	NMAR	2	514	337				
250	300 PSIG	NMAR	3	514					

Mechanical Specification

Compressor

Guide Vanes

Fully modulating variable inlet guide vanes provide capacity control. The guide vanes are controlled by an externally mounted electric vane operator in response to refrigeration load on the evaporator.

Impellers

Fully shrouded impellers are high strength aluminum alloy and directly connected to the motor rotor shaft operating at 3,600 rpm (60 hertz), 3,000 rpm (50 hertz). Impellers are dynamically balanced and over-speed tested at 4,500 rpm; the motor-compressor assembly is balanced to a maximum vibration of .15 inch/second at 3600 rpm as measured on the motor housing.

Compressor Casing

Separate volute casings of refrigerant-tight, close-grained cast iron are used on the centrifugal compressor; each incorporating a parallel wall diffuser surrounded by a collection scroll. The diffuser passages are machined to ensure high efficiency. All casings are proof-tested and leak-tested.

Motor

Compressor motors are hermetically sealed two-pole, low-slip squirrel cage, induction-type. They are built in accordance with Trane specifications and guaranteed by the manufacturer for continuous operation at the nameplate rating. A load limit system provides protection against operation in excess of this rating. The rotor shaft is of heat-treated carbon steel and designed such that the first critical speed is well above the operating
speed. The control circuit prevents motor energization unless positive oil pressure is established. Impellers are keyed directly to the motor shaft and locked in position. Nonferrous, labyrinth-type seals minimize recirculation and gas leakage between the stages of the compressor. 200- through 600-volt, three-phase, 60-hertz and 380 through 415 volt three phase 50 hertz motors are supplied with six terminal posts for full voltage (across-the-line) or reduced voltage (Star-Delta or autotransformer) starting. For low voltage, full voltage starting — connecting links are furnished to convert the motor to a 3-lead motor. 2,300- through 4,160-volt, three-phase, 60-hertz and 3300 through 6600 volt three phase 50 hertz motors are supplied with three terminal posts for full voltage (across-the-line) or reduced voltage (primary reactor or autotransformer) starting. Motor terminal pads are supplied. A removable sheet metal terminal box encloses the terminal board area.

Motor Cooling

Cooling is accomplished by liquid refrigerant pumped through the motor with a patented refrigerant pump. The refrigerant circulates uniformly over the stator windings and between the rotor and stator. The windings of all motors are specifically insulated for operation within a refrigerant atmosphere.

Lubrication

A direct-drive system, positive-displacement oil pump driven by a low voltage 3/4 horsepower, 120/60/1 or 120/50/1 motor is submerged in the oil sump to assure a positive oil supply to the two compressor bearings at all times. A low watt-density heater maintains the oil temperature which minimizes its affinity for refrigerant. Oil cooling is provided by refrigerant.

Evaporator

Shell and Waterboxes

The evaporator shell is formed of carbon steel plate and incorporates a carbon rupture disc in accordance with the ANSI/ASHRAE 15 Safety Code. A refrigerant temperature coupling is provided for customer use or for use with a low limit controller.

For all units, pass arrangements are available at 150 psig or 300 psig water side working pressures, with grooved connections. Flanged connections are also available. Marine-type waterboxes are available.

Tube Sheets

A thick carbon steel tube sheet is welded to each end of the shell and is drilled and reamed to accommodate the tubes.

Three annular grooves are machined into each tube hole to provide a positive liquid and vapor seal between the refrigerant and water side of the shell after tube rolling. Intermediate tube support sheets are positioned along the length of the shell to avoid contact and relative motion between adjacent tubes.

Tubes

Individually replaceable externally finned seamless copper tubing, either internally enhanced (one-inch nominal diameter) or (three-quarter inch nominal diameter) is utilized as the evaporator heat transfer surface. Tubes are mechanically expanded into the tube sheets (and affixed to the intermediate support sheets with the clips) to provide a leak-free seal and eliminate tube contact and abrasion due to relative motion.

Eliminators

Multiple layers of metal mesh screen form the eliminators and are installed over the tube bundle along the entire length of the evaporator to prevent liquid refrigerant carryover into the compressor.

Refrigerant Distribution

A refrigerant distribution compartment in the base of the evaporator assures uniform wetting of the heat transfer surface over the entire length of the shell and under varying loads. High velocity refrigerant spray impingement on the tubes is prevented through this design.

Refrigerant Flow Control

A multiple orifice flow control system maintains the correct pressure differential between the condenser, economizer and evaporator over the entire range of loading. This patented system contains no moving parts.

Shell Tests

The refrigerant side of the evaporator shell, complete with tubes, but without waterbox covers, is proof-tested at 45 psig, vacuum leak-tested and pressure leak-tested. The water side of the shell, with waterboxes in place, is hydrostatically tested at one and one-half times the design working pressure, but not less than 225 psig. (These tests are not to be repeated at installation).

Mechanical Specification

Condenser/Heat Recovery Condenser

Shell and Waterboxes
The condenser shell is formed of carbon steel plate designed and constructed in accordance with ANSI/ASHRAE 15 Safety Code. For all units, all pass arrangements are available at 150 psig or 300 psig water side working pressures with grooved connections. Flanged connections are also available. Marine-type waterboxes are available.

Tube Sheets
A thick carbon steel tube sheet is welded to each end of the shell and is drilled and reamed to accommodate the tubes. Three annular grooves are machined into each tube hole to provide a positive liquid and vapor seal between the refrigerant and water sides of the shell after tube rolling. Intermediate tube support sheets are positioned along the length of the shell to avoid contact and relative motion between adjacent tubes.

Tubes
Individually replaceable externally finned seamless copper tubing, either internally enhanced (one-inch nominal diameter) or (three-quarter inch nominal diameter), is utilized as the condenser heat transfer surface.

Refrigerant Gas Distribution
A baffle between the tube bundle and the condenser shell distributes the hot gas longitudinally throughout the condenser downward over the tube bundle preventing direct impingement of high velocity compressor discharge gas upon the tubes.

Shell Tests
The refrigerant side of the condenser shell with tubes, but without waterbox covers, is proof-tested at 45 psig, vacuum leak-tested and pressure leak- tested. The water side of the shell with waterboxes in place is hydrostatically tested at one and a half times the design working pressure, but not less than 225 psig. (These tests are not to be repeated at installation).

Economizer
The CVHE/CVHG style CenTraVac™ two-stage economizer (single-stage economizer on CVHF style units) is a series of interstage pressure chambers which utilize a multiple orifice system to maintain the correct pressure differential between the condenser, economizer and evaporator over the entire range of loading. This patented system contains no moving parts.

Purge System
The CenTraVac chiller utilizes a purge system operating with a 120/60/1 or 120/50/1 power supply. The purge system, using an air-cooled condensing unit, operates automatically to remove any noncondensables and water vapor which may be present in the refrigerant system. Normal operating efficiency does not exceed 0.002 lbs. of refrigerant lost per pound of dry air removed. Noncondensable discharge and refrigerant return are automatic functions of the purge. The purge can be operated at any time independent of chiller operation. ASHRAE GUIDELINE 3 recommends that the purge should be able to run even while the chiller is idle.

Purge unit includes lights to indicate condenser running, fault indication and service operation. An elapsed time meter is included as standard to monitor any amount of leak rate and running time.

Unit Control Panel
The microcomputer control panel is factory installed and tested on the CenTraVac™ unit. All controls necessary for the safe and reliable operation of the chiller are provided including oil management, purge operation, and interface to the starter. The control system is powered by a control power transformer included in the starter panel. The microcomputer control system processes the leaving evaporator fluid temperature sensor signal to satisfy the system requirements across the entire load range.

The microprocessor controller is compatible with reduced voltage or full voltage electromechanical starters, variable speed drives, or solid state starters. Depending on the applicability, the drives may be factory-mounted or remote mounted.

The controller will load and unload the chiller via control of the stepper- motor/actuator which drives the inlet guide vanes open or closed. The load range can be limited either by a current limiter or by an inlet guide vane limit (whichever controls the lower limit). It will also control the evaporator and condenser pumps to insure proper chiller operation.

The panel features machine protection shutdown requiring **manual** reset for:
- low evaporator refrigerant temperature
- high condenser refrigerant pressure
- low evaporator/condenser differential pressure
- low differential oil pressure
- low oil flow
- high oil temperature
- critical sensor or detection circuit faults
- motor overload
- high motor winding temperature
- high compressor discharge temperature (option)
- starter contactor fault
- starter transition failure
- compressor failure to accelerate
- external and local emergency stop
- electrical distribution faults: phase loss, phase unbalance, phase reversal
- inter-processor communications lost
- high bearing temperature (optional)
- free-cooling valve closure failure (free-cooling applications only)
- extended compressor surge
- actuator drive circuit fault

Over 100 diagnostic checks are made and displayed when a fault is detected. The display indicates the fault, the type of reset required, the time and date the diagnostic occurred, the mode in which the machine was operating at the time of the diagnostic, and a help message. A diagnostic history will display the last 10 diagnostics with the time and date of their occurrence.

Mechanical Specification

The display also provides over 20 reports that are organized into four groupings: Custom Report, Chiller Report, Refrigerant Report, and Compressor Report. Each report contains data that is accessed by scrolling through the menu items.

Each grouping will have a heading which describes the type of data in that grouping. This data includes:

- All water temperatures and setpoints (as standard factory mounted temperature sensors)
- Current chiller operating mode
- Diagnostic history
- Control source (i.e. local panel, external source, remote BAS)
- Current limit setpoint
- Water flows (optional)
- Water pressure drops (optional)
- Outdoor air temperature (optional)
- Saturated refrigerant temperatures and pressures
- Purge suction temperature
- Evaporator refrigerant liquid level
- Condenser liquid refrigerant temperature
- Compressor starts and hours running
- Phase currents
- Phase voltages (optional)
- Watts and power factor (optional)
- Oil temperature and flow
- Motor winding temperatures
- Bearing temperatures (optional)
- Refrigerant detection external to chiller in ppm (optional)

All necessary settings and setpoints are programmed into the microprocessor controller via the keypad of the operator interface. The controller is capable of receiving signals from a variety of control sources (which are not mutually exclusive — i.e. any combination of control sources can coexist simultaneously) and of being programmed at the keypad as to which control source has priority. Control sources can be:

- The local operator interface (standard)
- The remote operator interface (optional)
- A 4-20 mA or 2-10 vdc signal from an external source (interface optional) (control source not supplied by chiller manufacturer)
- Tracer™ (interface optional) (Tracer supplied by Trane)
- Process computer (interface optional) (control source not supplied by chiller manufacturer)
- Generic BAS (interface optional) (control source not supplied by chiller manufacturer)

The control source with priority will then determine the active setpoints via the signal that is sent to the control panel.

Isolation Pads

Isolation pads are supplied with each CenTraVac™ chiller for placement under all support points. They are constructed of molded neoprene.

Refrigerant and Oil Charge

A full charge of refrigerant and oil is supplied with each unit. The oil ships in the unit's oil sump and the refrigerant ships directly to the jobsite from refrigerant suppliers.

Thermometer Wells and Sight Glasses

In addition to the thermowells provided for use with the standard unit safety controls, a well is provided for measurement of the liquid refrigerant condensing temperature and a coupling for the evaporating temperatures. Sight glasses are provided for monitoring oil charge level, oil flow, compressor rotation and purge condenser drum.

Insulation

Factory applied insulation is available on all units. All low temperature surfaces are covered with 3/4-inch Armaflex II or equal (thermal conductivity = 0.28 Btu/hr-ft^2), including the evaporator, waterboxes and suction elbow. The economizer and motor cooling lines are insulated with 3/8″ and 1/2″ insulation respectively.

Refrigerant Pumpout/ Reclaim Connections

Connections are factory provided as standard to facilitate refrigerant reclaim/ removal required during maintenance or overhaul in accordance with ANSI/ ASHRAE 15.

Painting

All painted CenTraVac surfaces are coated with two coats of air-dry beige primer-finisher prior to shipment.

Unit Mounted Starter Option

The unit mounted starter can either be a star-delta or a solid-state starter in a NEMA 1 type enclosure. The starter is factory mounted and completely prewired to the compressor motor and the control panel. The CenTraVac chiller/ starter assembly is factory tested.

Starter is provided with a 3 KVA control power transformer (120 volt secondary). The starter door is designed to accommodate a padlock.

Available options include:

- Circuit Breaker — A standard interrupting capacity circuit breaker is available. The circuit breaker is mechanically interlocked to disconnect line power from starter when the starter door is open.
- High Interrupting Capacity Circuit Breaker — High interrupting capacity circuit breaker is available. This breaker is also interlocked to disconnect line power from the starter when the starter door is open.
- Circuit Breaker with Ground Fault — Ground fault protection is available with either standard or high interrupting capacity circuit breakers. An indicator light is provided to indicate if ground fault has occurred.
- Current Limiting Circuit Breaker — A standard circuit breaker incorporating three current limiters with fuse links is available. A fault current in excess of the circuit breaker capacity will blow the fuse links and interrupt the fault current. The circuit breaker cannot be reset until the blown current limiters are replaced.

Mechanical Specification

Trane Adaptive Frequency™ Drive (AFD)

The Trane AFD is a closed-loop, liquid-cooled, microprocessor based PWM design that converts fixed utility voltage and frequency to a variable voltage and frequency via a two-step operation. The AFD is both voltage and current regulated. Output power devices: IGBT transistors.

The AFD is factory mounted on the chiller and ships completely assembled, wired and tested.

Patented Trane AFD control logic is specifically designed to interface with the centrifugal water chiller controls. AFD control adapts to the operating ranges and specific characteristics of the chiller, and chiller efficiency is optimized by coordinating compressor motor speed and compressor inlet guide vane position. Chilled water control and AFD control work together to maintain the chilled water setpoint, improve efficiency and avoid surge. If a surge is detected, AFD surge avoidance logic will make adjustments to move away from and avoid surge at similar conditions in the future.

AFD is capable of operating at an altitude of 3300 feet rated output current. For every 300 feet above 3300 feet, the rated output current will be decreased by 1%.

AFD Design Features

- NEMA 1 ventilated enclosure with a hinged, locking door and door-mounted circuit breaker with shunt trip, is tested to a short circuit withstand rating of 65,000 amps per UL 508. The entire package is UL/CUL listed.
- Digital keypad displays DC bus voltage, drive output motor current; output frequency (Hz); RPM; kW; percent motor torque; and elapsed time. LED's also display drive status: running, remote, jog, auto, forward, reverse or program.
- One programmable analog output signal, (0-10 Vdc or 4-20 mA) for customer use.
- Three programmable relay outputs for customer use.
- Simple modular construction.
- The drive is rated for 480/60/3 input power, +/-10%, with a motor thermal overload capability of 110% continuous for 25 minutes to 150% for 60 seconds, linear between 110 and 150.
- Input displacement power factor will exceed .96 regardless of speed and load.
- Minimum efficiency of 97% at rated load and 60 hertz.
- Soft-start; linear acceleration/coast to stop.
- Standard DC bus filter choke to limit harmonic distortion.
- All control circuit voltages are physically and electrically isolated from power circuit voltage.
- 150% instantaneous torque available for improved surge control.
- Critical frequency avoidance.
- Output line-to-line and line-to-ground short circuit protection.
- Restart into a rotating motor.
- AFD can be started without a motor connected.

Chiller Unit Control Features for AFD

The chiller unit control panel standard control capabilities provide for the control/configuration interface to, and the retrieval/display of the collaterally additional AFD related data. AFD standard design features controlled through the starter module of UCP2 include:

- Current limited to 100%.
- Auto restart after an interruption of power limited to four starts per hour, 30 seconds between starts.
- Output speed reference signal 2-10 vdc.
- Digital display on UCP2 panel: output speed in hertz, output speed in rpm, fault, amps, input line voltage.
- Motor overload protection.
- Loss of follower signal – in the event of loss of input speed signal the AFD will default to 38 hertz or hold speed based on last reference received.
- Phase loss, reversal, imbalance protection.
- Power loss ride through.
- Overvoltage/undervoltage protection.
- Motor overtemperature protection.

Environmental ratings:

- 32°F to 104°F (0°C to 40°F) operating temperature
- Altitude to 3300 feet (1000 m)
- Humidity, 95% non-condensing

Input Line Reactor Option

Field installed option mounts on the input side of the AFD to reduce harmonic distortion and help meet IEEE-519 guidelines. NEMA 1 enclosure; 5% impedance.

The Trane Company is
a participant in the
Green Seal Program

ISO 9001
Quality System
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La Crosse
Business Unit

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