



# Installation, Operation, and Maintenance **CVHM Water-Cooled CenTraVac™ Chillers**

With Tracer® AdaptiView™ Control and  
AdaptiSpeed™ Technology

CVHM



X39641318004

## **▲ SAFETY WARNING**

Only qualified personnel should install and service the equipment. The installation, starting up, and servicing of heating, ventilating, and air-conditioning equipment can be hazardous and requires specific knowledge and training. Improperly installed, adjusted or altered equipment by an unqualified person could result in death or serious injury. When working on the equipment, observe all precautions in the literature and on the tags, stickers, and labels that are attached to the equipment.

April 2020

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TRANE  
TECHNOLOGIES



# Introduction

Read this manual thoroughly before operating or servicing this unit.

## Warnings, Cautions, and Notices

Safety advisories appear throughout this manual as required. Your personal safety and the proper operation of this machine depend upon the strict observance of these precautions.

The three types of advisories are defined as follows:



Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It could also be used to alert against unsafe practices.



Indicates a situation that could result in equipment or property-damage only accidents.

## Important Environmental Concerns

Scientific research has shown that certain man-made chemicals can affect the earth's naturally occurring stratospheric ozone layer when released to the atmosphere. In particular, several of the identified chemicals that may affect the ozone layer are refrigerants that contain Chlorine, Fluorine and Carbon (CFCs) and those containing Hydrogen, Chlorine, Fluorine and Carbon (HCFCs). Not all refrigerants containing these compounds have the same potential impact to the environment. Trane advocates the responsible handling of all refrigerants-including industry replacements for CFCs and HCFCs such as saturated or unsaturated HFCs and HCFCs.

## Important Responsible Refrigerant Practices

Trane believes that responsible refrigerant practices are important to the environment, our customers, and the air conditioning industry. All technicians who handle refrigerants must be certified according to local rules. For the USA, the Federal Clean Air Act (Section 608) sets forth the requirements for handling, reclaiming, recovering and recycling of certain refrigerants and the equipment that is used in these service procedures. In addition, some states or municipalities may have additional requirements that must also be adhered to for responsible management of refrigerants. Know the applicable laws and follow them.

### ⚠ WARNING

#### Proper Field Wiring and Grounding Required!

Failure to follow code could result in death or serious injury.

All field wiring **MUST** be performed by qualified personnel. Improperly installed and grounded field wiring poses **FIRE** and **ELECTROCUTION** hazards. To avoid these hazards, you **MUST** follow requirements for field wiring installation and grounding as described in **NEC** and your local/state/national electrical codes.

### ⚠ WARNING

#### Personal Protective Equipment (PPE) Required!

Failure to wear proper PPE for the job being undertaken could result in death or serious injury. Technicians, in order to protect themselves from potential electrical, mechanical, and chemical hazards, **MUST** follow precautions in this manual and on the tags, stickers, and labels, as well as the instructions below:

- Before installing/servicing this unit, technicians **MUST** put on all PPE required for the work being undertaken (Examples; cut resistant gloves/sleeves, butyl gloves, safety glasses, hard hat/bump cap, fall protection, electrical PPE and arc flash clothing). **ALWAYS** refer to appropriate Safety Data Sheets (SDS) and OSHA guidelines for proper PPE.
- When working with or around hazardous chemicals, **ALWAYS** refer to the appropriate SDS and OSHA/GHS (Global Harmonized System of Classification and Labelling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection and handling instructions.
- If there is a risk of energized electrical contact, arc, or flash, technicians **MUST** put on all PPE in accordance with OSHA, NFPA 70E, or other country-specific requirements for arc flash protection, **PRIOR** to servicing the unit. **NEVER PERFORM ANY SWITCHING, DISCONNECTING, OR VOLTAGE TESTING WITHOUT PROPER ELECTRICAL PPE AND ARC FLASH CLOTHING. ENSURE ELECTRICAL METERS AND EQUIPMENT ARE PROPERLY RATED FOR INTENDED VOLTAGE.**

**⚠ WARNING****Follow EHS Policies!**

Failure to follow instructions below could result in death or serious injury.

- All Trane personnel must follow the company's Environmental, Health and Safety (EHS) policies when performing work such as hot work, electrical, fall protection, lockout/tagout, refrigerant handling, etc. Where local regulations are more stringent than these policies, those regulations supersede these policies.
- Non-Trane personnel should always follow local regulations.

**⚠ WARNING****Refrigerant May Be Under Positive Pressure!**

Failure to follow instructions below could result in an explosion which could result in death or serious injury or equipment damage.

System contains refrigerant and may be under positive pressure; system may also contain oil. Recover refrigerant to relieve pressure before opening the system. See unit nameplate for refrigerant type. Do not use non-approved refrigerants, refrigerant substitutes, or non-approved refrigerant additives.

**NOTICE****Equipment Damage!**

Mixing refrigerants or oils could result in equipment damage including bearing damage, introduction of acids into the chiller, or continuous purge pump-out in high-head/high ambient applications.

CenTraVac chillers are manufactured with different refrigerant/oil systems: 1) chillers using R-123 refrigerant and OIL00022 compressor oil, and 2) chillers using R-514A refrigerant and OIL00334/OIL00335 compressor oil.

Verify proper refrigerant and oil for your chiller and do NOT mix refrigerants or oils!

This *Installation, Operation, and Maintenance* manual applies to CenTraVac™ chillers with R-514A refrigerant and OIL00334/OIL00335 compressor oil.

**Important:** Verify proper refrigerant and compressor oil for your chiller before proceeding!

**NOTICE****Do Not Use Non-Compatible Parts or Materials!**

Use of non-compatible parts or materials could result in equipment damage.

Only genuine Trane® replacement components with identical Trane part numbers should be used in Trane CenTraVac chillers. Trane assumes no responsibility for damages resulting from the use of non-compatible parts or materials.

**Factory Warranty Information**

Compliance with the following is required to preserve the factory warranty:

**All Unit Installations**

Startup MUST be performed by Trane, or an authorized agent of Trane, to VALIDATE this WARRANTY. Contractor must provide a two-week startup notification to Trane (or an agent of Trane specifically authorized to perform startup).

**Additional Requirements for Units Requiring Disassembly and Reassembly**

When a new chiller is shipped and received from our Trane manufacturing location and, for any reason, it requires disassembly or partial disassembly, and reassembly— which could include but is not limited to the evaporator, condenser, control panel, compressor/motor, economizer, purge, factory-mounted starter or any other components originally attached to the fully assembled unit— compliance with the following is required to preserve the factory warranty:

- Trane, or an agent of Trane specifically authorized to perform start-up and warranty of Trane® products, will perform or have direct on-site technical supervision of the disassembly and reassembly work.
- The installing contractor must notify Trane—or an agent of Trane specifically authorized to perform startup and warranty of Trane® products—two weeks in advance of the scheduled disassembly work to coordinate the disassembly and reassembly work.
- Start-up must be performed by Trane or an agent of Trane specifically authorized to perform startup and warranty of Trane® products.

Trane, or an agent of Trane specifically authorized to perform start-up and warranty of Trane® products, will provide qualified personnel and standard hand tools to perform the disassembly and reassembly work at a location specified by the contractor. The contractor shall provide the rigging equipment such as chain falls, gantries, cranes, forklifts, etc. necessary for the disassembly and reassembly work and the required qualified personnel to operate the necessary rigging equipment.



## Introduction

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### Factory Training

Factory training is available through Trane University™ to help you learn more about the operation and

maintenance of your equipment. To learn about available training opportunities contact Trane University™.

Online: [www.trane.com/traneuniversity](http://www.trane.com/traneuniversity)

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### Revision History

- Updated Installation Requirements section in Electrical Requirements chapter.
- Added Determining Supply Ground Type section in Power Supply Wiring chapter.
- Updated the Chiller start-up tasks list to be performed by Trane.



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## Unit Nameplate

The unit nameplate is located on the right side of the control panel. A typical unit nameplate is illustrated in the following figure and contains the following information:

- Unit model and size descriptor
- Unit electrical requirements
- Correct operating charge and refrigerant type
- Unit test pressures and maximum operating pressures
- Unit literature

**Serial Number.** The unit serial number provides the specific chiller identity. Always provide this serial number when calling for service or during parts identification.

**Service Model Number.** The service model represents the unit as built for service purposes. It identifies the selections of variable unit features required when ordering replacements parts or requesting service.

**Note:** *Unit-mounted Adaptive Frequency™ Drives (AFDs) are identified by a separate number found on the AFD.*

**Product Description Block.** The CenTraVac™ chiller models are defined and built using the Product Definition and Selection (PDS) system. This system describes the product offerings using a product coding block which is made up of feature categories and codes that identify all characteristics of a unit.







# Model Number Descriptions

## Digit 1, 2 – Unit Function

**CV** = CenTraVac™ Hermetic Chiller

## Digit 3 – Drive

**H** = Direct Drive

## Digit 4 – Development Sequence

**M**

## Digit 5, 6, 7 – Nominal Compressor Tonnage

**300** = 300 Nominal Tons

**SSS** = Special

## Digit 8 – Unit Motor Voltage

**D** = 380V-60Hz

**E** = 440V-60Hz

**F** = 460V-60Hz

**G** = 480V-60Hz

**R** = 380V-50Hz

**T** = 400V-50Hz

**U** = 415V-50Hz

**S** = Special

## Digit 9 – Unit Type

**A** = Cooling Condenser

**S** = Special

## Digit 10, 11 – Design Sequence

**AA** = Original Design

## Digit 12 – Hot Gas Bypass

**0** = Without HGB

**S** = Special

## Digit 13 – Control Enclosure

**C** = Standard Control Enclosure

**D** = Standard Control Enclosure with Tracer® SC

**S** = Special

## Digit 14, 15, 16, 17 – Compressor Motor Power (kW) (See Note 1)

**0210** = 210 CPKW

## Digit 18, 19, 20, 21 – Compressor Impeller Cutback Stage 1 (See Note 2)

**1540** = 15.40-in. Diameter

**SSSS** = Special

## Digit 22, 23, 24, 25 – Compressor Impeller Cutback Stage 2 (See Note 3)

**1620** = 16.20-in. Diameter

**SSSS** = Special

## Digit 26 – Evaporator Shell Size

**C** = 300-Ton Short Evaporator Shell (030A)

**D** = 300-Ton Long Evaporator Shell (030B)

**S** = Special

## Digit 27 – Evaporator Waterbox

**A** = 150 psi Marine, 1-Pass Std

**B** = 150 psi Marine, 2-Pass Std

**C** = 300 psi Marine, 1-Pass Std

**D** = 300 psi Marine, 2-Pass Std

**E** = 150 psi Non-Marine, 1-Pass Std

**F** = 150 psi Non-Marine, 2-Pass Std

**G** = 300 psi Non-Marine, 1-Pass Std

**H** = 300 psi Non-Marine, 2-Pass Std

**S** = Special

## Digit 28 – Condenser Shell Size

**C** = 300-Ton Short Condenser Shell (030A)

**D** = 300-Ton Long Condenser Shell (030B)

**S** = Special

## Digit 29 – Condenser Waterbox

**A** = 150 psi Marine, 1-Pass Std

**B** = 150 psi Marine, 2-Pass Std

**C** = 300 psi Marine, 1-Pass Std

**D** = 300 psi Marine, 2-Pass Std

**E** = 150 psi Non-Marine, 1-Pass Std

**F** = 150 psi Non-Marine, 2-Pass Std

**G** = 300 psi Non-Marine, 1-Pass Std

**H** = 300 psi Non-Marine, 2-Pass Std

**S** = Special

## Digit 30 – Heat Recovery Condenser Waterbox

**0** = None

**S** = Special

## Digit 31 – Auxiliary Condenser Size and Waterbox

**0** = None

**S** = Special

## Digit 32 – Unit Option

**0** = None

**A** = Insulation Package Only

**B** = Insulation Package and 3-in. RuptureGuard™

**C** = Insulation Package and 4-in. RuptureGuard™

**D** = 3-in. RuptureGuard™ Only

**E** = 4-in. RuptureGuard™ Only

**F** = Extra-thick Insulation and 3-in. RuptureGuard™

**G** = Extra-thick Insulation and 4-in. RuptureGuard™

**H** = Extra-thick Insulation Only

## Digit 33 – Control: Generic BAS

**0** = None

**G** = Generic BAS

## Digit 34 – Control: Extended Operation

**0** = None

**1** = Extended Operation

## Digit 35 – Tracer® Communication Interface

**0** = None

**1** = Tracer® Comm 4

**2** = Tracer® Comm 5

**3** = Tracer® MODBUS®

**4** = Tracer® BACnet®

## Digit 36 – Control: Condenser Refrigerant Pressure

**0** = None

**C** = Condenser Refrigerant Pressure

## Digit 37 – Special Options

**0** = None

**S** = Special Option

## Digit 38 – Control: Water Flow Control

**0** = None

**W** = Water Flow Control

## Digit 39 – Control: Chilled Water Reset

**0** = None

**1** = Chilled Water Reset

## Digit 40 – Control: Heat Recovery Temperature Sensors

**0** = None

## Digit 41 – Control: Operating Status

**0** = None

**1** = Operating Status

## Digit 42 – Industrial Chiller Package (INDP)

**0** = Without INDP

## Digit 43 – Control Power Transformer (CPTR)

**0** = Without CPTR

**S** = Special

**Digit 44 — Thermal Dispersion Water Flow Proving**

**0** = None, Customer to Provide Device for Condenser and Evaporator

**A** = Thermal Dispersion Water Flow Proving Selected for Condenser and Evaporator

**B** = Thermal Dispersion Water Flow Proving Selected for Condenser Only

**C** = Thermal Dispersion Water Flow Proving Selected for Evaporator Only

**Digit 45 — Manufacturing Location**

**L** = La Crosse, Wisconsin

**T** = Taicang, China

**Model Number Notes****Notes:**

1. Digits 14–17 represents the actual CPKW value; if the CPKW is only three digits, digit 14 is "0."
2. Cutbacks are done in 0.40-in. dimensions; i.e., if digits 18–21 = 1540, the cutback diameter is 15.40.
3. Cutbacks are done in 0.40-in. dimensions; i.e., if digits 22–25 = 1620, the cutback diameter is 16.20.



# Pre-Installation

## ASHRAE Standard 15 Compliance

Trane recommends that indoor CenTraVac™ chiller installations fully meet or exceed the guidelines of the current version of ASHRAE Standard 15, in addition to any applicable national, state, or local requirements. This typically includes:

- A refrigerant monitor or detector that is capable of monitoring and alarming within the acceptable exposure level of the refrigerant, and that can actuate mechanical ventilation.
- Audible and visual alarms, activated by the refrigerant monitor, inside the equipment room and outside of every entrance.
- The equipment room should be properly vented to the outdoors, using mechanical ventilation that can be activated by the refrigerant monitor.
- The purge discharge and the rupture disk must be properly piped to the outdoors.
- If required by local or other codes, a self-contained breathing apparatus should be available in close proximity to the equipment room.

Refer to the latest copy of ASHRAE Standard 15 for specific guidelines. Trane assumes no responsibility for any economic, health, or environmental issues that may result from an equipment room's design or function.

## Unit Shipment

Inspect unit while it is still on the truck for any shipping damage. The chiller ships shrink-wrapped in a 0.010-in. (0.254 mm) recyclable film protective covering. Do NOT remove shrink-wrap for inspection! Inspect for damage to the shrink-wrap and determine if physical damage has occurred.

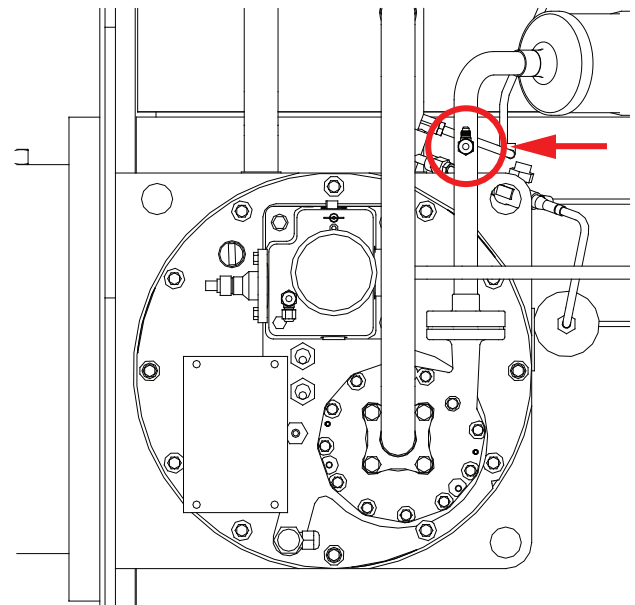
Each chiller ships from the factory as a hermetically assembled package; it is factory-assembled, -wired, and -tested. All openings except for the waterbox vent and drain holes are covered or plugged to prevent contamination during shipment and handling. "Unit Components," p. 15 shows an illustration of a typical unit and its components. As soon as the unit arrives at the job site, inspect it thoroughly for damage and material shortages. In addition:

1. Verify the hermetic integrity of the unit by checking the chiller pressure for an indication of holding charge pressure.
2. To prevent damaging moisture from entering the unit and causing corrosion, each chiller is pressurized with 3 to 5 psig (20.7 to 34.5 kPaG) of dry nitrogen before shipment.

**Note:** The holding charge should register approximately 5 psig (34.5 kPaG) at 72°F (22.2°C). Place a gauge on the access valve provided (indicated by arrow and circle in the following figure) on the refrigerant pump discharge line to verify the holding charge. If the charge has escaped, contact your local Trane sales office for instructions.

3. The loose parts box and isolator pads ship strapped to the shear plate between the condenser and the evaporator.
4. Check the oil sump sight glasses to verify that the sump was factory-charged with 9 gallons (34.1 L) of oil. If no oil level is visible, contact your local Trane sales office.

**Figure 2. Refrigerant pump discharge line access valve**



## Installation Requirements and Contractor Responsibilities

A list of the contractor responsibilities typically associated with the unit installation process is provided in the following table.

<p><b>⚠ WARNING</b></p> <p><b>Combustible Material!</b></p> <p>Failure to follow instructions below could result in death or serious injury or equipment damage. Shrink-wrap is a combustible material. Avoid open flames and hot sparks.</p>
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**Note:** The chiller should remain within its protective shrink-wrap covering during storage.

Type of Requirement	Trane Supplied Trane Installed	Trane Supplied Field Installed	Field Supplied Field Installed
Foundation			<ul style="list-style-type: none"> <li>Meet foundation requirements</li> </ul>
Rigging			<ul style="list-style-type: none"> <li>Safety chains</li> <li>Rigging shackles</li> <li>Lifting beam</li> </ul>
Disassembly/Reassembly (as required)	<ul style="list-style-type: none"> <li>Trane will perform or have direct on-site supervision of the disassembly and reassembly work (contact your local Trane office for pricing)</li> </ul>		
Isolation		<ul style="list-style-type: none"> <li>Isolation pads or spring isolators</li> </ul>	<ul style="list-style-type: none"> <li>Isolation pads or spring isolators</li> <li>Optional spring isolators, when required, are installed by others; do NOT overload springs and do NOT install isolation springs if they block serviceable parts such as the oil tank system, service valves, etc.</li> </ul>
Electrical	<ul style="list-style-type: none"> <li>Circuit breakers</li> <li>Unit-mounted Adaptive Frequency™ Drive (AFD)</li> <li>Passive harmonic filter</li> </ul>	<ul style="list-style-type: none"> <li>Temperature sensor (optional outdoor air)</li> <li>Flow switches (may be field supplied); for installation instructions for the ifm efector® flow detection controller and sensor, refer to "Water Flow Detection Controller and Sensor," p. 25 or Trane literature that shipped with the device</li> <li>Tracer® AdaptiView™ display and mounting arm</li> <li>Field-installed AFD (optional)</li> </ul>	<ul style="list-style-type: none"> <li>Electrical connections to unit-mounted AFD</li> <li>Wiring sizes per submittal and National Electric Code (NEC)</li> <li>Ground connection(s)</li> <li>Ground type specified (Center grounded-Y or not)</li> <li>BAS wiring (optional)</li> <li>Control voltage wiring (optional)</li> <li>Oil pump interlock wiring (AFD only)</li> <li>Chilled water pump contactor and wiring including interlock</li> <li>Condenser water pump contactor and wiring including interlock</li> <li>Option relays and wiring</li> <li>Tracer® SC communication wiring (optional)</li> </ul>
Water piping		<ul style="list-style-type: none"> <li>Flow sensing devices (may be field supplied)</li> </ul>	<ul style="list-style-type: none"> <li>Taps for flow sensing devices</li> <li>Taps for thermometers and gauges</li> <li>Thermometers</li> <li>Strainers (as required)</li> <li>Water flow pressure gauges</li> <li>Isolation and balancing valves in water piping</li> <li>Vents and drain on waterbox valves (one each per pass)</li> <li>Pressure relief valves (for waterboxes as required)</li> </ul>
Relief	<ul style="list-style-type: none"> <li>Rupture disk assembly</li> </ul>	<ul style="list-style-type: none"> <li>RuptureGuard™ (optional); refer to <i>Installation, Operation, and Maintenance: RuptureGuard Pressure Relief System Option (CTV-SVX06*-EN)</i></li> </ul>	<ul style="list-style-type: none"> <li>Vent line and flexible connector and vent line from rupture disk to atmosphere</li> </ul>
Insulation	<ul style="list-style-type: none"> <li>Insulation (optional)</li> </ul>		<ul style="list-style-type: none"> <li>Insulation</li> <li>Chiller feet insulation</li> </ul>
Water Piping Connection Components	Flanged (optional) <ul style="list-style-type: none"> <li>Welded on flange for 300 psig (2068.4 kPaG) waterboxes</li> </ul>	Flanged (optional) <ul style="list-style-type: none"> <li>Victaulic® to flange adapter for 150 psig (1034.2 kPaG) waterboxes</li> </ul>	Victaulic® <ul style="list-style-type: none"> <li>Victaulic® coupling for 150 psig (1034.2 kPaG) and 300 psig (2068.4 kPaG) waterboxes</li> <li>Fasteners for flanged-type connections (optional)</li> </ul>
Other Materials			<ul style="list-style-type: none"> <li>Trace gas (1 lb [0.45 kg] maximum per machine as needed to perform leak testing)</li> <li>Material and equipment to perform leak testing</li> <li>Dry nitrogen (8 psig [55.2 kPaG] maximum per machine as needed)</li> </ul>



## Pre-Installation

Type of Requirement	Trane Supplied Trane Installed	Trane Supplied Field Installed	Field Supplied Field Installed
"Appendix B: CenTraVac™ Chiller Installation Completion and Request for Trane Service," p. 89 (CTV-ADF001*-EN; refer to "Appendix A: Forms and Check Sheets," p. 88)			<ul style="list-style-type: none"> <li>To be completed by installing contractor prior to contacting Trane for start-up</li> </ul>
Chiller start-up commissioning <sup>(a)</sup>	<ul style="list-style-type: none"> <li>Trane, or an agent of Trane specifically authorized to perform start-up of Trane® products</li> </ul>		
Post-commissioning transport of empty refrigerant containers for return or recycling			<ul style="list-style-type: none"> <li>Move empty refrigerant containers to an easily accessible point of loading</li> </ul>

<sup>(a)</sup> Start-up must be performed by Trane or an agent of Trane specifically authorized to perform start-up and warranty of Trane® products. Contractor shall provide Trane (or an agent of Trane specifically authorized to perform start-up) with notice of the scheduled start-up at least two weeks prior to the scheduled start-up.

## Storage Requirements

**Note:** If the chiller is stored outdoors for any amount of time, **do NOT remove ANY shipping coverings. Protect the chiller from the elements and protect against freezing, especially if any shipping materials have been removed.**

### NOTICE

#### Equipment Damage!

Failure to protect the unit from freezing could result in equipment damage.

If fluid has been added to the piping, the unit must be protected from freezing. Freeze damage from an unheated equipment room is not the Trane company's responsibility. These are indoor units.

### NOTICE

#### Insulation Damage!

Failure to follow these instructions could result in insulation damage.

To prevent damage to factory installed insulation:

- Do not allow the insulation to be exposed to excessive sunlight. Store indoors or cover with canvas to prevent exposure.
- Do not use thinners and solvents or other types of paint. Use only water base latex.

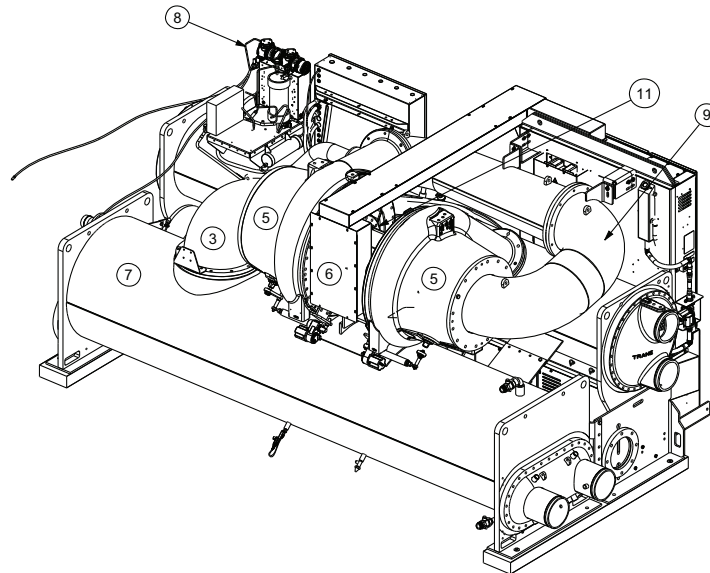
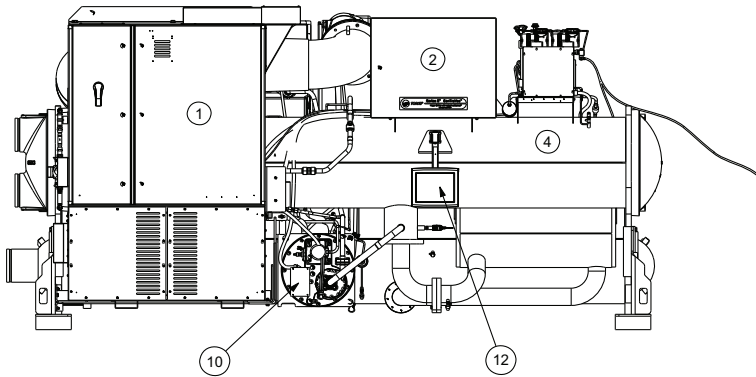
Less than 1 month	1–6 months	Greater than 6 months
Location requirements: <ul style="list-style-type: none"> <li>Solid foundation</li> <li>Vibration free</li> <li>Dry</li> <li>Temperature range -40°F to 158°F (-40°C to 70°C)</li> </ul>	Location requirements: <ul style="list-style-type: none"> <li>Solid foundation</li> <li>Vibration free</li> <li>Dry</li> <li>Temperature range -40°F to 158°F (-40°C to 70°C)</li> </ul>	Location requirements: <ul style="list-style-type: none"> <li>Solid foundation</li> <li>Vibration free</li> <li>Dry</li> <li>Temperature range -40°F to 158°F (-40°C to 70°C)</li> </ul>
<ul style="list-style-type: none"> <li>Do not remove any plastic coverings</li> </ul>	<ul style="list-style-type: none"> <li>Do not remove any plastic coverings</li> </ul>	<ul style="list-style-type: none"> <li>Do not remove any plastic coverings</li> </ul>
<ul style="list-style-type: none"> <li>Do not charge the chiller with refrigerant</li> <li>If additional refrigerant is on site, follow manufacturer's storage requirements</li> </ul>	<ul style="list-style-type: none"> <li>Do not charge the chiller with refrigerant</li> <li>If additional refrigerant is on site, follow manufacturer's storage requirements</li> </ul>	<ul style="list-style-type: none"> <li>Do not charge the chiller with refrigerant</li> <li>If additional refrigerant is on site, follow manufacturer's storage requirements</li> </ul>
<ul style="list-style-type: none"> <li>Verify dry nitrogen pressure using gauge located on the evaporator shell reads 3 to 5 psig (20.7 to 34.5 kPaG)</li> <li>Notify the local Trane office if charge has escaped</li> </ul>	<ul style="list-style-type: none"> <li>Verify dry nitrogen pressure using gauge located on the evaporator shell reads 3 to 5 psig (20.7 to 34.5 kPaG)</li> <li>Notify the local Trane office if charge has escaped</li> </ul>	<ul style="list-style-type: none"> <li>Verify dry nitrogen pressure using gauge located on the evaporator shell reads 3 to 5 psig (20.7 to 34.5 kPaG)</li> <li>Notify the local Trane office if charge has escaped</li> </ul>
<ul style="list-style-type: none"> <li>Do not operate purge unit</li> </ul>	<ul style="list-style-type: none"> <li>Do not operate purge unit</li> </ul>	<ul style="list-style-type: none"> <li>Do not operate purge unit</li> </ul>
	<ul style="list-style-type: none"> <li>Verify waterbox and tube bundles are clean and dry</li> </ul>	<ul style="list-style-type: none"> <li>Verify waterbox and tube bundles are clean and dry</li> </ul>

Less than 1 month	1–6 months	Greater than 6 months
		<ul style="list-style-type: none"> <li>• Conduct an oil analysis and verify no oil breakdown<sup>(a)</sup></li> <li>• Repeat yearly</li> <li>• Replace oil if breakdown has occurred</li> <li>• If no oil analysis program has been followed, replace oil prior to start-up</li> </ul>
		<ul style="list-style-type: none"> <li>• Every six months, check unit pressure or vacuum and take note of changes that could indicate a leak; contact your local Trane office if any leaks occur</li> <li>• If the chiller will be stored for more than six months after production, contact your local Trane Service Agency for <i>required</i> extended storage actions to minimize impact to the chiller and preserve the warranty.</li> <li>• Chillers stored five years or longer should be inspected for leaks every five years by a qualified service organization</li> </ul>

<sup>(a)</sup> If the chiller will be stored for more than six months after production, contact your local Trane Service Agency for *required* extended storage actions to minimize impact to the chiller and preserve the warranty.

## Unit Components

**Note:** *The control panel side of the unit is always designated as the front side of the unit.*

**Figure 3. Typical CVHM CenTraVac™ chiller**


1. Drive Panel
2. Control Panel
3. Suction Elbow
4. Condenser
5. Compressor
6. Power Transition Box
7. Evaporator
8. Purge
9. Wrap Around Tube
10. Oil Tank Assembly
11. Compressor Motor Housing
12. Display Panel





# Unit Clearances and Weights

## Recommended Unit Clearances

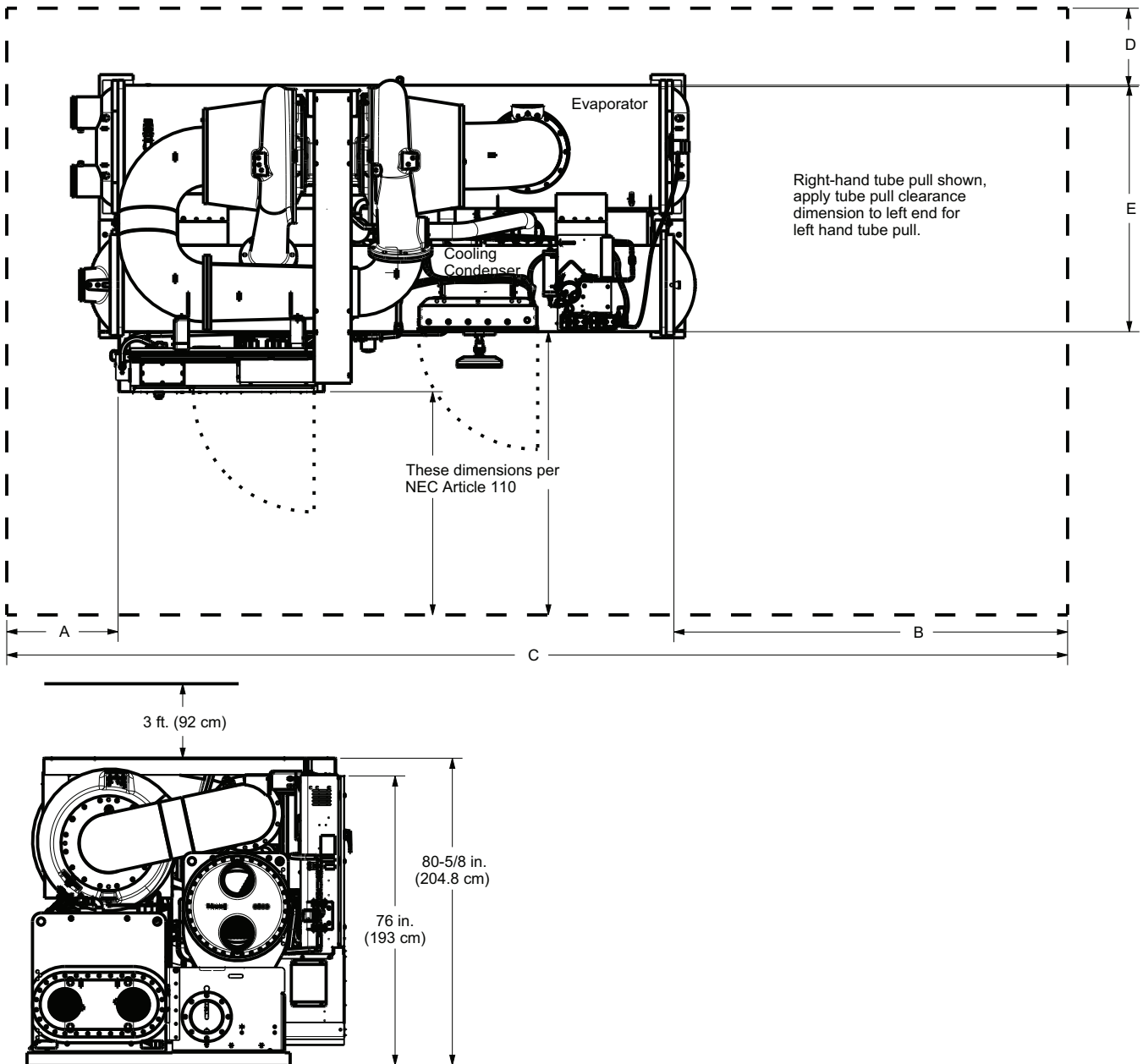
Adequate clearances around and above the chiller are required to allow sufficient access for service and maintenance operations. Specific unit clearance requirements are indicated in the submittal package provided for your unit.

- Do NOT install piping or conduit above the compressor motor assembly or behind the suction elbow of the unit.

- Minimum vertical clearance above the unit is 3 ft (92 cm).
- Use a housekeeping pad to provide better service clearances; refer to submittal for more information.

Refer to NEC and local electrical codes for starter and control panel clearance requirements.

Figure 4. Clearance requirements





## Unit Clearances and Weights

**Table 1. Clearance requirements**

EVSZ	CDSZ	A		B		C		D <sup>(a)</sup>		E	
		in.	cm	in.	cm	in.	cm	in.	cm	in.	cm
030A	030A	46.26	117.50	156	396.24	353.75	898.53	20	50.8	70	177.8
030B	030B	46.26	117.50	186	472.44	413.75	1050.93	20	50.8	70	177.8

**Notes:**

1. All dimensions are approximate; refer to the unit submittal package for exact dimensions for your unit.
2. Determine bundle size by looking at unit nameplate. EVSZ is evaporator size and CDSZ is condenser size; A is short and B is long.

<sup>(a)</sup> 20-in. clearance is required for routine maintenance and housekeeping. Compressor service will require additional space either at the back of the chiller or overhead.

## General Weights

### Weights (lb)

**Important:** The weight information provided here should be used for general information only. For specific weights for your chiller, refer to your submittal package.

**Table 2. Representative weights, 60 Hz chillers (lb)**

Model	Comp Size	CPKW	Evap Size	Cond Size	Weights without Starters		Weights with Starters	
	NTON		EVSZ	CDSZ	Operating	Shipping	Operating	Shipping
CVHM	300	210	030A	030A	—	—	22430	19870
	300	210	030B	030B	—	—	23822	20931

**Notes:**

1. TECU tubes, 0.028 in. tube wall thickness.
2. 300 psig marine waterboxes.
3. Heaviest possible bundle and motor combination.
4. Operating weights assume the largest possible refrigerant charge.
5. Weights with starters assume the heaviest possible starter (AFD when it's an allowed option).
6. Industrial Control Panel (INDP) option, add 50 lb.
7. Control Power Transformer (CPTR) option, add 130 lb.
8. Supplemental Motor Protection (SMP) option, add 500 lb.

### Weights (kg)

**Important:** The weight information provided here should be used for general information only. For specific weights for your chiller, refer to your submittal package.

**Table 3. Representative weights, 60 Hz chillers (kg)**

Model	Comp Size	CPKW	Evap Size	Cond Size	Weights without Starters		Weights with Starters	
	NTON		EVSZ	CDSZ	Operating	Shipping	Operating	Shipping
CVHM	300	210	030A	030A	—	—	10111	8950
	300	210	030B	030B	—	—	10742	9431

**Notes:**

1. TECU tubes, 0.71 mm tube wall thickness.
2. 2068.4 kPaG non-marine waterboxes.
3. Heaviest possible bundle and motor combination.
4. Operating weights assume the largest possible refrigerant charge.
5. Weights with starters assume the heaviest possible starter (AFD when it's an allowed option).
6. Industrial Control Panel (INDP) option, add 23 kg.
7. Control Power Transformer (CPTR) option, add 59 kg.
8. Supplemental Motor Protection (SMP) option, add 227 kg.



# Installation: Mechanical

## Operating Environment

### Important:

- The standard chiller is designed for **INDOOR USE ONLY** and as such has NEMA Type 1 enclosures.
- For chillers in unheated equipment rooms, contact your local Trane Service Agency for methods to ensure that the oil temperature is maintained suitable for proper operation of the chiller.

**NOTICE**

**Equipment Damage!**  
Failure to protect the unit from freezing could result in equipment damage. If fluid has been added to the piping, the unit must be protected from freezing. Freeze damage from an unheated equipment room is not the Trane company's responsibility. These are indoor units.

**NOTICE**

**Equipment Failure!**  
Unit operating at ambient temperatures exceeding 104°F (40°C) could result in AFD/starter component damage due to the panel's inability to dissipate heat adequately. For CDHF, CDHG, CVHE, CVHF, CVHG, CVHL, CVHM, and CVHS CenTraVac chillers, units operating at these temperatures could also fatigue the unit's rupture disk, causing it to break at a reduced refrigerant pressure (<15 psig [ $<103.4$  kPaG]). If any of these adverse operating conditions are present, take necessary action to improve the equipment room environment.

To ensure that electrical components operate properly, do NOT locate the chiller in an area exposed to dust, dirt, corrosive fumes, or excessive heat and humidity. The ambient temperature range for chiller operation is 34°F to 104°F (1.1°C to 40°C).

## Foundation Requirements

Chiller mounting surface must be:

- rigid non-warping mounting pads or a concrete foundation, and
- able to support the chiller at its full operating weight (including completed piping and full operating charges of refrigerant, oil, and water).

For proper unit operation, the chiller must be level within 1/16 in. (1.6 mm) over its length and width when set into place on the mounting surface. Refer to "Leveling the Unit," p. 22 for more information. For approximate weights for various chiller sizes and

options in pounds and kilograms, refer to "Weights (lb)," p. 18 and "Weights (kg)," p. 18, respectively.

**Note:** For specific weight information, refer to the unit submittal package.

**Important:** Trane will not assume responsibility for equipment problems resulting from an improperly designed or constructed foundation.

## Rigging

Lifting is the recommended method for moving chillers. Suggested lifting arrangements for standard units are described in "Standard Chiller Lift," p. 19.

**Note:** The lifting beam used for CVHM CenTraVac™ chillers must be at least 12.5 ft (3.8 m) long.

**⚠ WARNING**

**Heavy Object!**  
Failure to follow instructions below could result in unit dropping which could result in death or serious injury, and equipment or property-only damage. Ensure that all the lifting equipment used is properly rated for the weight of the unit being lifted. Each of the cables (chains or slings), hooks, and shackles used to lift the unit must be capable of supporting the entire weight of the unit. Lifting cables (chains or slings) may not be of the same length. Adjust as necessary for even unit lift.

**⚠ WARNING**

**Improper Unit Lift!**  
Failure to properly lift unit in a LEVEL position could result in unit dropping and possibly crushing operator/technician which could result in death or serious injury, and equipment or property-only damage. Test lift unit approximately 24 inches (61 cm) to verify proper center of gravity lift point. To avoid dropping of unit, reposition lifting point if unit is not level.

**NOTICE**

**Wiring Damage!**  
Damage to unit wiring could result in equipment failure. Care must be taken during rigging, assembly and disassembly to avoid damaging unit wiring.

## Standard Chiller Lift

1. Insert rigging shackles at the points indicated in the following figure. A 2 in. (50.8 mm) 1.25 in. (31.8 mm) diameter lifting hole is provided at each of these

points.

2. Attach the lifting chains or cables.
3. After the lifting cables are in place, attach a safety chain or cable between the first-stage suction elbow of the compressor and the lifting beam.

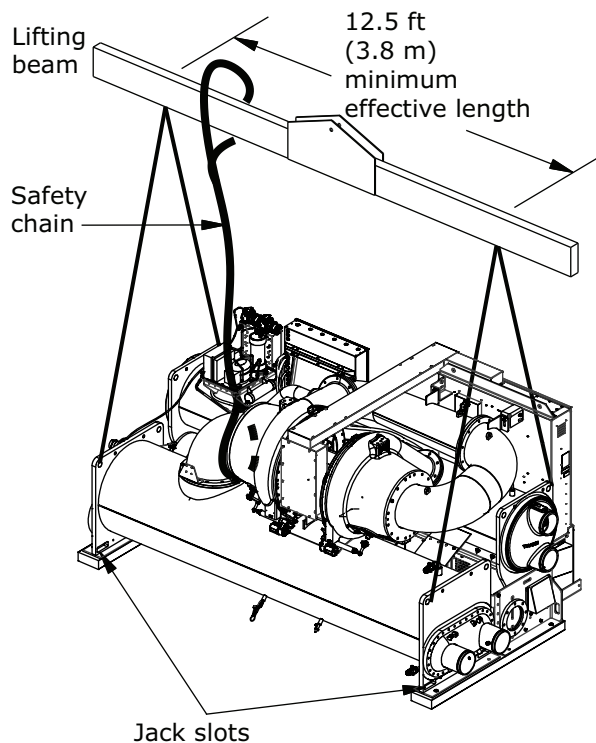
**Important:** *There should NOT be tension on this safety cable; the cable is used only to prevent the unit from rolling during the lift.*

4. Remove both skid boards from chiller feet.
5. Position isolator pads or spring isolators beneath the chiller feet (refer to "Unit Isolation," p. 21 for instructions).

**Note:** *Follow instructions provided by the spring isolator manufacturer, being careful to not damage isolator adjustment screw.*

6. Once the isolators are in place, lower the chiller—working from end to end—in small increments to maintain stability.
7. When lift is complete, detach the rigging shackles and safety chain.

**Figure 5. Typical rigging arrangements**



## Special Lift Requirements

### NOTICE

#### Oil Loss!

Failure to prevent oil migration out of the oil tank could result in equipment failure or property-only damage.

To prevent oil migration out of the oil tank during lifting procedures, remove the oil from the oil tank if the unit will be lifted at any angle greater than 15° from horizontal end-to-end. If oil is allowed to run out of the oil tank into other areas of the chiller, it will be extremely difficult to return the oil to the oil tank even during operation.

### NOTICE

#### Equipment Damage!

Moving the chiller using a fork lift could result in equipment or property-only damage.

**Do not use a fork lift to move the chiller!**

If the chiller cannot be moved using a standard chiller lift, consider the following:

- When job site conditions require rigging of the chiller at an angle greater than 45° from horizontal (end-to-end), the unit may require removal of the compressor. Contact Trane or an agent of Trane specifically authorized to perform start-up and warranty of Trane® products regarding the disassembly and reassembly work. For more information, refer to "Factory Warranty Information," p. 3.  
**Note:** *Disassembly and reassembly work includes removing the compressor from the unit. Contact Trane or an agent of Trane specifically authorized to perform start-up and warranty of Trane® products for specific rigging instructions. Do NOT attempt to rotate the chiller onto its side.*
- When lifting the chiller is either impractical or undesirable, attach cables or chains to the jacking slots shown in the figure in "Standard Chiller Lift," p. 19; then push or pull the unit across a smooth surface. Should the chiller be on blocks, it is not necessary to remove the blocks from the chiller before moving it into place.
- In cases where the unit is being installed through restricted spaces, the oil tank filter may need to be temporarily removed. Prior to removal of the filter, switch the regulator to the "change filter" setting. After the filter has been removed from the regulator block, the opening must be sealed to ensure no contaminants are allowed into the system. Due to the hygroscopic nature of the oil, install a new filter after the chiller has passed through the restricted space.

- If removal of the Adaptive Frequency™ drive (AFD) is necessary to move the chiller to the operating location, refer to “Adaptive Frequency Drive Removal and Installation,” p. 84. Also refer to “Factory Warranty Information,” p. 3.

## Unit Isolation

To minimize sound and vibration transmission through the building structure and to ensure proper weight distribution over the mounting surface, always install isolation pads or spring isolators under the chiller feet.

**Note:** Isolation pads (refer to the figure in “Isolation Pads,” p. 21) are provided with each chiller unless spring isolators are specified on the sales order.

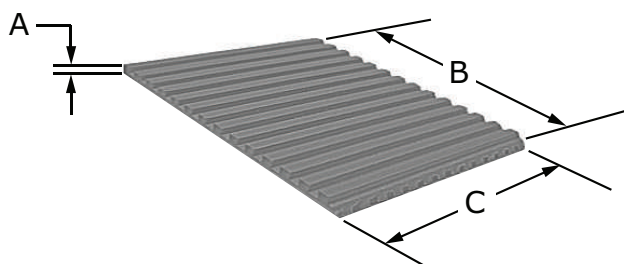
Specific isolator loading data is provided in the unit submittal package. If necessary, contact your local Trane sales office for further information.

**Important:** When determining placement of isolation pads or spring isolators, remember that the control panel side of the unit is always designated as the front side of the unit.

## Isolation Pads

When the unit is ready for final placement, position isolation pads (18-in. [457.2-mm] sides) end for end under the full length of the chiller leg. The pads measure 9 in. x 18 in. (228.6 mm x 457.2 mm) and on some units there may be small gaps between pads. Pads are provided to cover entire foot. Place pad flush with the outside edge of the chiller foot and leave excess material under the chiller.

**Figure 6. Isolation pad and dimensions**



A = 3/8 in. (9.5 mm)

B = 18 in. (457.2 mm)

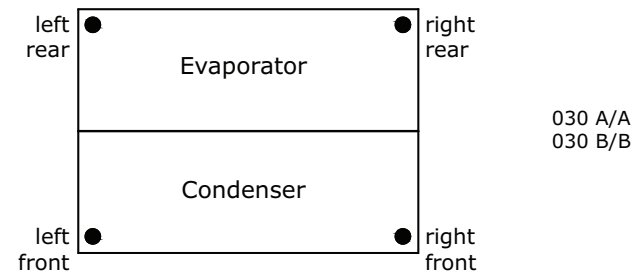
C = 9 in. (228.6 mm)

Remember that the chiller must be level within 1/16 in. (1.6 mm) over its length and width after it is lowered onto the isolation pads. In addition, all piping connected to the chiller must be properly isolated and supported so that it does not place any stress on the unit.

## Spring Isolators

Spring isolators should be considered whenever chiller installation is planned for an upper story location. Base isolator placement is shown in the following figure.

**Figure 7. Isolation spring placement by shell size, and evaporator and condenser length**



Spring isolators typically ship assembled and ready for installation. To install and adjust the isolators properly, follow the provided instructions.

**Note:** Do NOT adjust the isolators until the chiller is piped and charged with refrigerant and water.

**Important:** Do NOT block any serviceable components such as the lubrication system with field-installed devices such as spring isolators.

1. Position the spring isolators under the chiller as shown in the preceding figure. Ensure that each isolator is centered in relation to the tube sheet.

**Note:** Spring isolators shipped with the chiller may not be identical. Compare the data provided in the unit submittal package to determine proper isolator placement.

2. Set the isolators on the sub-base; shim as necessary to provide a flat, level surface at the same elevation for the end supports.

**Important:** Support the full underside of the isolator base plate; do NOT straddle gaps or small shims.

3. If required, screw the isolators to the floor through the slots provided, or cement the pads.

**Note:** Fastening the isolators to the floor is not necessary unless specified.

4. If the chiller must be fastened to the isolators, insert cap screws through the chiller base and into holes drilled and tapped in the upper housing of each isolator.

**Important:** Do NOT allow the screws to protrude below the underside of the isolator upper housing, or interfere with the adjusting screws. An alternative method of fastening the chiller to the isolators is to cement the neoprene pads.

5. Set the chiller on the isolators; refer to “Standard Chiller Lift,” p. 19. The weight of the chiller will

## Installation: Mechanical

force down the upper housing of each isolator, and could cause it to rest on the isolator's lower housing (refer to the following figure).

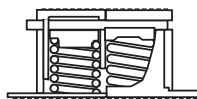
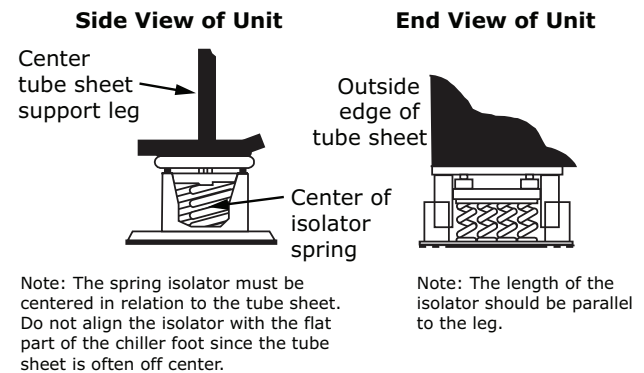
- Check the clearance on each isolator. If this dimension is less than 1/4 in. (6.35 mm) on any isolator, use a wrench to turn the adjusting screw one complete revolution upward.

**Note:** When the load is applied to the isolators (refer to [Step 5](#)), the top plate of each isolator moves down to compress the springs until either the springs support the load or the top plate rests on the bottom housing of the isolator. If the springs are supporting the load, screwing down on the adjusting screw (refer to [Step 7](#)) will raise the chiller.

- Turn the adjusting screw on each of the remaining isolators to obtain the required minimum clearance of 1/4 in. (6.35 mm).
- Once the minimum required clearance is obtained on each of the isolators, level the chiller by turning the adjusting screw on each of the isolators on the low side of the unit. Work from one isolator to the next.

**Important:** The chiller must be level to within 1/16 in. (1.6 mm) over its length and width, and the clearance of each isolator must be at least 1/4 in. (6.35 mm).

**Figure 8. Chiller foot and isolator orientation**



**Important:** Do NOT install spring isolators or brackets in such a way that they could inhibit chiller servicing such as charging or evacuation, oil tank service, etc.

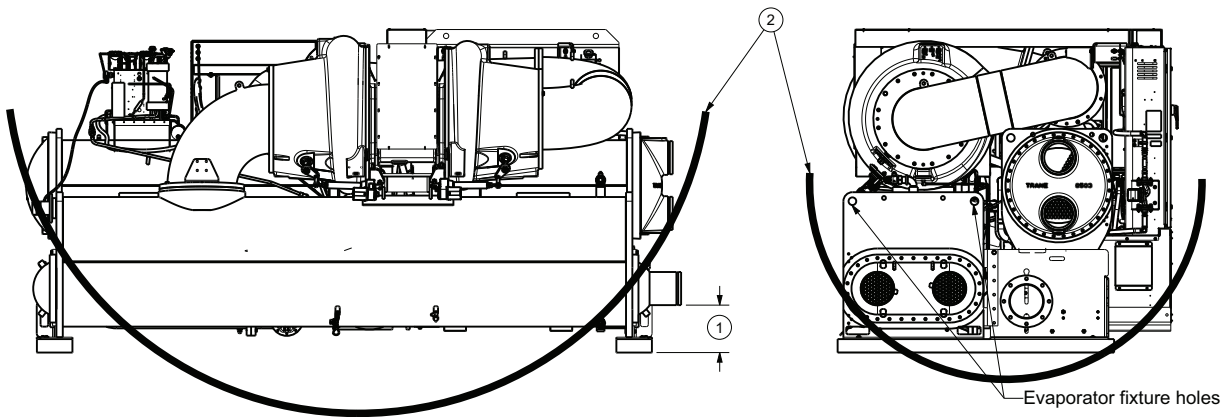
## Leveling the Unit

The chiller must be set level within 1/16 in. (1.6 mm).

- Measure and make a punch mark an equal distance up from the bottom of each foot of the chiller.
- Suspend a clear plastic tube along the length of the chiller as shown in the following figure.
- Fill the tube with water until the level aligns with the punch mark at one end of the chiller.
- Check the water level at the opposite mark. If the water level does not align with the punch mark, use full length shims to raise one end of the chiller until the water level at each end of the tube aligns with the punch marks at both ends of the chiller.
- Once the unit is level across its length, repeat the first three steps to level the unit across its width.

Use of a laser level is an acceptable alternative method to level the unit. The evaporator fixture holes (refer to the following figure) can be used as reference points to level off.

**Figure 9. Leveling the chiller**



**Important:** Immediately report any unit damage incurred during handling or installation at the job site to the Trane sales office.



# Installation: Water Piping

## Overview

The following water piping circuits must be installed and connected to the chiller:

- Pipe the evaporator into the chilled water circuit.
- Pipe the condenser into the cooling tower water circuit.

**Note:** Piping must be arranged and supported to avoid stress on the equipment. It is strongly recommended that the piping contractor does not run pipe closer than 3 ft (0.9 m) minimum to the equipment. This will allow for proper fit upon arrival of the unit at the job site. Any adjustment that is necessary can be made to the piping at that time. Expenses that result from a failure to follow this recommendation will NOT be paid by Trane.

Piping suggestions for each of the water circuits listed above are outlined in “Evaporator and Condenser Water Piping,” p. 26. General recommendations for the installation of field-supplied piping components (e.g., valves, flow switches, etc.) common to most chiller water circuits are listed in the following sections.

## Water Treatment

The use of untreated or improperly treated water in a CenTraVac™ chiller may result in inefficient operation and possible tube damage.

**Important:** Trane strongly recommends using the services of a qualified water treatment specialist to determine necessary water treatment. A label with a customer disclaimer note is affixed to each unit.

### NOTICE

#### Proper Water Treatment Required!

The use of untreated or improperly treated water could result in scaling, erosion, corrosion, algae or slime.

Use the services of a qualified water treatment specialist to determine what water treatment, if any, is required. Trane assumes no responsibility for equipment failures which result from untreated or improperly treated water, or saline or brackish water.

## Water Pressure Gauges

Locate pressure gauge taps in a straight length of pipe. Place each tap a minimum of one pipe diameter downstream of any elbow, orifice, etc. For example, for a 6 in. (16 cm) pipe, the tap would be at least 6 in. (16 cm) from any elbow, orifice, etc.

## Valves—Drains and Vents

### NOTICE

#### Waterbox Damage!

Failure to follow instructions could result in damage to the waterbox.

Do not over-tighten or use excessive Teflon® pipe tape when installing valves, drains, plugs and vents on waterboxes.

1. Install field-supplied air vents and drain valves on the waterboxes. Each waterbox is provided with a National Pipe Thread Female (NPTF) vent and drain connection; depending on the waterbox types ordered, the openings may be 1/4 in. (6.35 mm), 1/2 in. (12.7 mm), or 3/4 in. (19.05 mm).

### NOTICE

#### Waterbox Damage!

Failure to follow instructions could result in damage to the waterbox due to hydrostatic expansion.

Install pressure-relief valves in the condenser and evaporator water circuits.

### NOTICE

#### Equipment Damage!

Failure to follow instructions could result in equipment damage.

Do NOT allow chiller to freeze! Bundles must be drained and air-blown dry if chiller is stored in an unheated equipment room.

2. If necessary for the application, install pressure-relief valves at the drain connections on the evaporator and condenser waterboxes. To do so, add a tee with the relief valve attached to the drain valve.

To determine whether or not pressure relief valves are needed for a specific application, keep in mind that:

- a. Vessels with close-coupled shutoff valves may cause high potentially damaging hydrostatic pressures as fluid temperature rises.
- b. Relief valves are required by American Society of Mechanical Engineers (ASME) codes when the shell waterside is ASME. Follow ASME guidelines or other applicable codes to ensure proper relief valve installation.



## Strainers

### NOTICE

#### Water Born Debris!

To prevent components damage, pipe strainers must be installed in the water supplies to protect components from water born debris. Trane is not responsible for equipment-only-damage caused by water born debris.

Install a strainer in the entering side of each piping circuit to avoid possible tube plugging in the chiller with debris.

## Required Flow-Sensing Devices

The ifm efector® flow detection controller and sensor (refer to “[Water Flow Detection Controller and Sensor](#),” p. 25) is used to verify evaporator and condenser water flows.

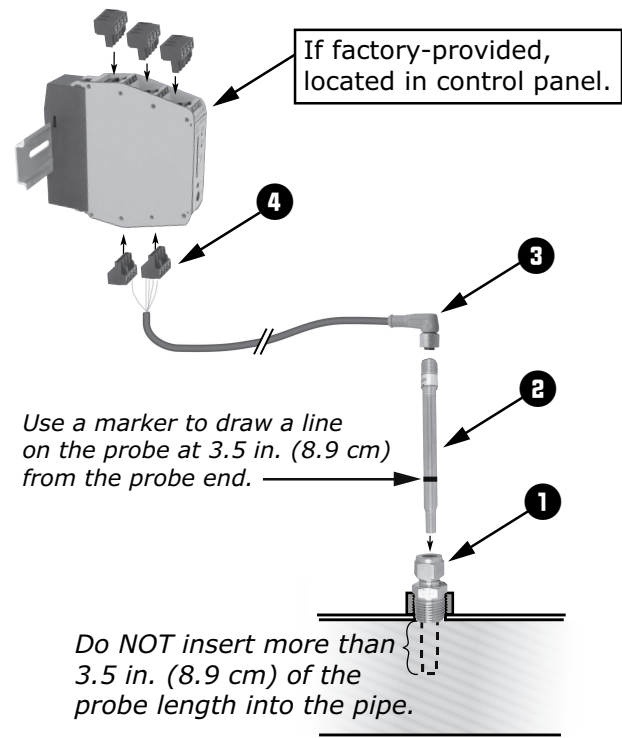
If a customer-supplied flow sensing device is used to ensure adequate chiller flow protection, refer to the wiring diagrams that shipped with the unit for specific electrical connections.

Be sure to follow the manufacturer’s recommendations for device selection and installation.

## Water Flow Detection Controller and Sensor

**Important:** Before installing the ifm efector® flow detection controller and sensor, use a marker to draw a line on the probe at 3.5 in. (8.9 cm) from the end of the probe. Do NOT insert more than 3.5 in. (8.9 cm) of the probe length into the pipe. Refer to the following figure.

Figure 10. Installation of ifm efector flow detection controller and sensor



1. Mount the 1/2-in. NPT adapter in a horizontal or vertical section of pipe. The maximum distance from the control panel must not exceed 29.5 ft (9 m) (see item labeled “1” in the preceding figure). Allow at least five pipe diameters straight run of pipe upstream of the sensor location, and three pipe diameters straight run of pipe downstream of the sensor location.

**Note:** In the case of a horizontal pipe, mounting the sensor in the side of the pipe is preferred. In the case of a vertical pipe, mounting the sensor in a place where the water flows upwards is preferred.

### NOTICE

#### Overtightening!

Do not exceed torque specifications as it could result in equipment damage.

2. Insert the flow sensor probe (see item labeled “2” in the preceding figure) through the 1/2-in. NPT adapter so that 3 to 3.5 in. (7.6 to 8.9 cm) of the probe’s length extends into the pipe. Tighten the 1/2-in. NPT adapter as needed to prevent leakage and keep the probe from backing out under pressure. **Do NOT exceed 40 ft·lb (54.2 N·m) of torque on the fitting. Sensor damage can occur if it is overtightened.**

**Note:** When installed, the tip of the ifm efector® sensor probe must be at least 1 in. (2.54 cm) away from any pipe wall. Do NOT insert more than 3.5 in. (8.9 cm) of the probe length into the pipe.

- Install the Micro DC Cable by inserting it through the wire openings on the back side of the control panel (see item labeled "3" in the preceding figure). Install the supplied Micro DC Cable (29.5 ft [9 m] in length) to the Flow Probe and hand-tighten the connector nut.
- Plug the other end of the Micro DC Cable into the Flow Control Monitor with the Combicon connector (see item labeled "4" in the preceding figure). Refer to the following figure for cable wiring.

**NOTICE**

**Do Not Apply Electrical Power to a Unit in a Vacuum!**

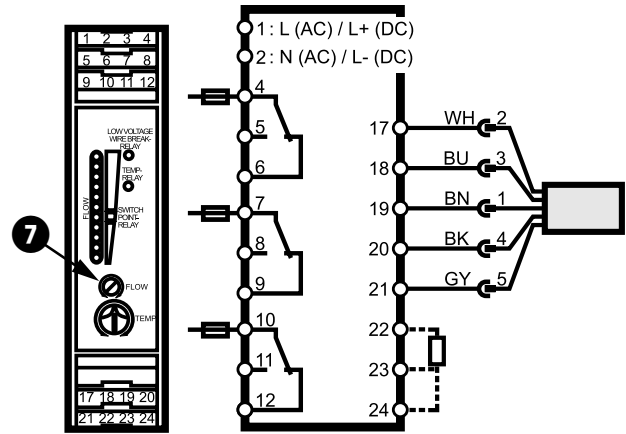
Failure to follow instructions below could result in motor and compressor damage. Do not apply electrical power to a motor in a vacuum.

- Apply power to the chiller control panel to verify the Flow Control Monitor has power and the Low Volt Broken Wire Relay light is NOT lit.
- Remove all air from the piping circuit prior to adjusting the low water flow setpoint.
- Reduce the water flow to the minimum allowable flow and adjust the Flow setting on the Flow Control Monitor (see item labeled "7" in the following figure). Adjusting the "Flow" potentiometer clockwise (+) reduces the flow setting cutout and adjusting counterclockwise (-) increases the flow setting cutout.

**Note:** The "Temp" potentiometer on the ifm efector® control module has no effect in Trane application. It is NOT necessary to make adjustments to the "Temp" potentiometer.

- After the cutout setting is adjusted, the cutout setpoint will be indicated with a yellow light on the Flow Control Monitor LED bar graph display. When the water flows are higher than the cutout, a green light will indicate proper flow status. If the flows fall below the cutout setpoint, a red light will indicate low/no flow status.

**Figure 11. ifm efector® flow sensing device terminal connection**



**NOTICE**

**Proof of Flow Switch!**

Failure to provide flow switches or jumping-out of switches could result in severe equipment damage.

Evaporator and condenser water circuits require proof of flow switches.

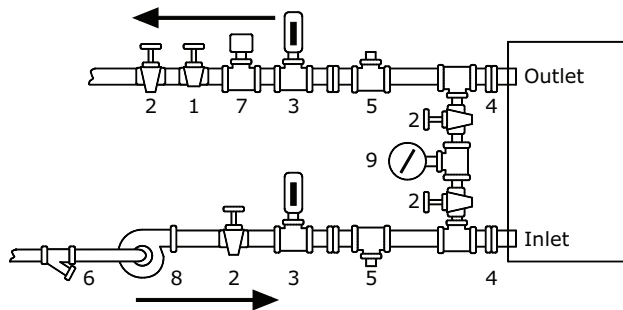
- Failure to include the proof of flow devices and/or jumping out these devices could cause the unit to stop on a secondary level of protection.
- Frequent cycling on these higher level diagnostic devices could cause excessive thermal and pressure cycling of unit components (O-rings, gaskets, sensors, motors, controls, etc.) and/or freeze damage, resulting in premature failure of the chiller.

Evaporator and condenser proof of flow switches are required. These switches are used with control logic to confirm flow prior to starting a unit and to stop a running unit if flow is lost. For troubleshooting, a viewable diagnostic is generated if a proof of flow switch does not close when flow is required.

## Evaporator and Condenser Water Piping

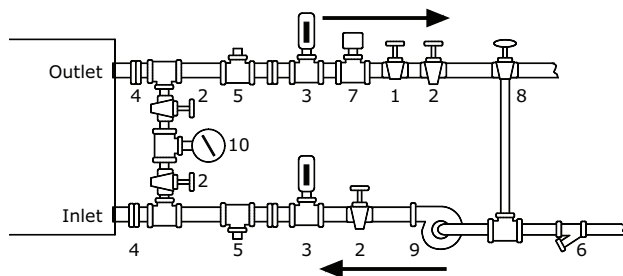
The following two figures illustrate the recommended (typical) water piping arrangements for the evaporator and condenser.

**Figure 12. Typical evaporator water piping circuit**



1. Balancing valve.
2. Gate (Isolation) valve or ball valve.
3. Thermometer (if field supplied).
4. Waterbox nozzle connection.
5. Drain, vent, and anode.
6. Strainer.
7. Chilled water flow switch (5S1). Flow switch 5S1 may be installed in either the entering or leaving leg of the chilled water circuit.
8. Pump.
9. Pressure gauge. It is recommended to pipe the gauge between entering and leaving pipes. A shutoff valve on each side of the gauge allows the operator to read either entering or leaving water pressure.

**Figure 13. Typical condenser water piping circuits**



1. Balancing valve.
2. Gate (isolation) valve or ball valve.
3. Thermometer (if field supplied).
4. Waterbox nozzle connection.
5. Drain, vent, and anode.
6. Strainer.
7. Condenser water flow switch (5S2). Flow switch 5S2 may be installed in either the entering or leaving leg of the chilled water circuit.
8. Three-way valve (optional).
9. Condenser water pump.
10. Pressure gauge. It is recommended to pipe a single gauge between entering and leaving pipes.

**Note:** On multiple-pass condensers, entering condenser water must enter at the lowest nozzle.

Piping must be arranged and supported to avoid stress on the equipment. It is strongly recommended that the piping contractor does not run pipe closer than 3 ft (0.9 m) minimum to the equipment. This will allow for proper fit upon arrival of the unit at the job site. Any adjustment that is necessary can be made to the piping at that time. Expenses that result from a failure to follow this recommendation will NOT be paid by Trane.

Water piping connection sizes and components are identified in the tables in “Water Piping Connections,” p. 28 and “Grooved Pipe Coupling,” p. 28. Remember that with many waterboxes, the entering and leaving evaporator water can be piped to either waterbox connection when the tube bundles are split vertically. However, large evaporator waterboxes with entering and leaving connections not at the same level must be connected with the entering water at the bottom and the leaving water at the top.

Waterboxes with multiple pass arrangements utilize a baffle to separate the passes. These baffles are designed for a maximum pressure of 20 psid (137.9 kPaD). If larger pressure drops are expected in the application, contact your local Trane representative to discuss special waterbox options.

**Important:** Water flows must be piped in accordance with nameplate designation.

Field-provided isolation valves for the evaporator and condenser water lines should be installed upstream and downstream of the heat exchangers, and be installed far enough away from the chiller to also provide practical service isolation for flow sensing devices, field thermometers, flexible connectors, and any removable pipe spools.

Ensure that the evaporator water piping is clear; check it after the chilled water pump is operated but before initial chiller start-up. If any partial blockages exist, they can be detected and removed to prevent possible tube damage resulting from evaporator freeze-up or erosion.

For condenser and large evaporator connections, arrange the water piping so that the water supply enters the shell at the lower connection and exits from the top connection. Operational problems may result if this piping is not correct. Some shells may be piped as desired since both connections are at the same level.

For applications that include an “infinite source” or “multiple-use” cooling condenser water supply, install a valved bypass “leg” (optional) between the supply and return pipes. This valved bypass allows the operator to short-circuit water flow through the cooling condenser when the supply water temperature is too low. For additional application information, refer to *Engineering Bulletin: Condenser Water Temperature Control - For CenTraVac Centrifugal Chiller Systems with Tracer AdaptiView Controls* (CTV-PRB006\*-EN).

**Note:** System refrigerant pressure differential must be maintained above 3 psid (20.7 kPaD) at all times. Failure to do so could result in operating problems.

## Water Piping Connections

All standard units use grooved-pipe connections. These are grooved-end NSP (Victaulic® style) pipe connections. Flanged connections are optional.

Piping joined using grooved type couplings, like all types of piping systems, requires proper support to carry the weight of pipes and equipment. The support methods used must eliminate undue stresses on joints, piping, and other components, allow movement where required, and provide for any other special requirements (i.e., drainage, etc.).

**Note:** If needed, plug-type sensor extension cables are available for purchase from Trane Parts Service. These sensor extension cables may be necessary if the waterboxes are changed or if the temperature sensors are moved out into the unit piping for better mixed temperature readings.

**Table 4. Evaporator water piping connection sizes**

EVSZ <sup>(a)</sup>	Nominal Pipe Size			
	1 Pass		2 Pass	
	in.	mm	in.	mm
030	10	273.0	8	219.1

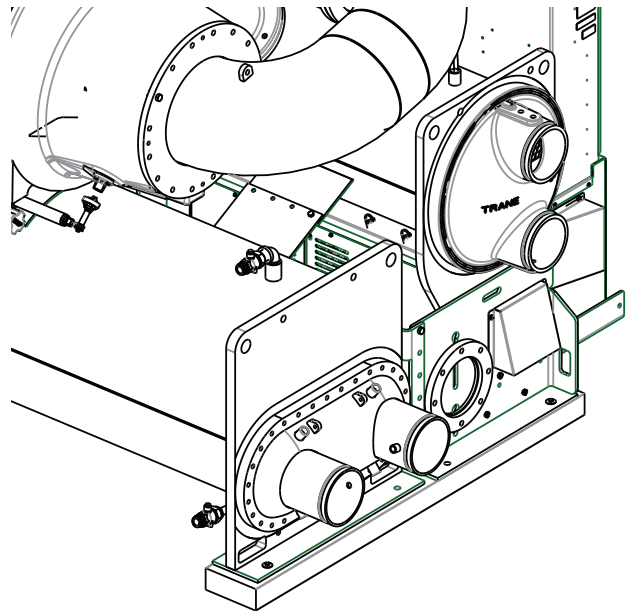
<sup>(a)</sup> EVSZ = Evaporator Shell Size; A = Short Shell, B = Long Shell

**Table 5. Condenser water piping connection sizes**

CDSZ <sup>(a)</sup>	Nominal Pipe Size	
	2 Pass	
	in.	mm
030	8	219.1

<sup>(a)</sup> CDSZ = Condenser Shell Size; A = Short Shell, B = Long Shell

**Figure 14. Typical grooved pipe connection**



## Waterbox Locations

If removal of waterboxes is necessary, refer to “Waterbox Removal and Installation,” p. 81.

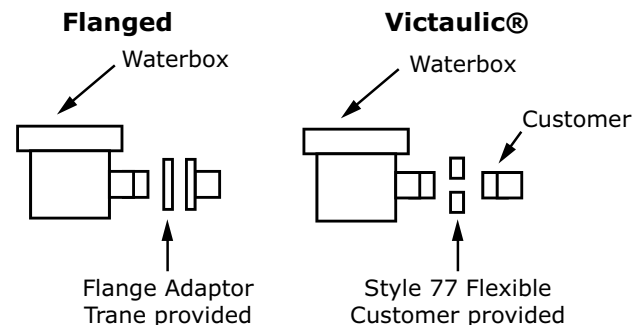
If the waterboxes on any of the shells are exchanged end-for-end, be sure to reinstall them right-side up to maintain the correct baffle arrangements. Use a new gasket with each waterbox cover.

## Grooved Pipe Coupling

A customer-supplied, standard flexible grooved pipe coupling (Victaulic® Style 77 or equivalent) should be used to complete the Victaulic® connection for both 150 psig (1034.2 kPaG) and 300 psig (2068.4 kPaG) waterboxes.

When a flexible coupling such as this is installed at the waterbox connections, other flexible piping connectors (i.e., braided-steel, elastomeric arch, etc.) are not usually required to attenuate vibration and/or prevent stress on the connections.

**Figure 15. Customer piping connection types**



### Notes:

- Refer to the coupling manufacturer's guidelines for specific information concerning proper piping system design and construction methods for grooved water piping systems.
- Flexible coupling gaskets require proper lubrication before installation to provide a good seal. Refer to the coupling manufacturer's guidelines for proper lubricant type and application.

## Flange-connection Adapters

### NOTICE

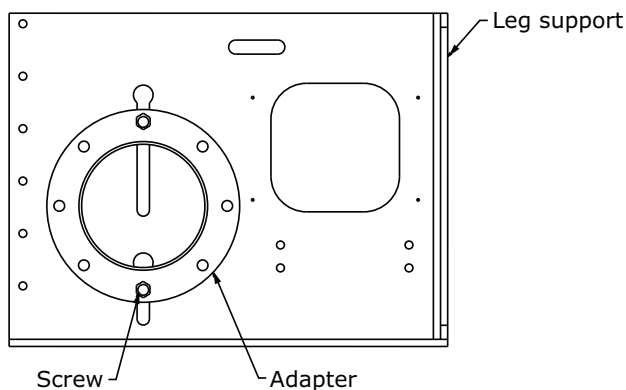
#### Never Weld to Cast Boxes!

Welding to cast boxes will result in equipment damage.

Adapters must be used to convert flanges.

When flat-face flange connections are specified, flange-to-groove adapters are provided (Victaulic® Style 741 for 150 psig [1034.2 kPaG] systems; Style 743 for 300 psig [2068.4 kPaG] systems). The adapters are shipped screwed to one of the chiller end-supports. Adapter descriptions are given in the tables in "Victaulic Gasket Installation," p. 29. The flange adapters provide a direct, rigid connection of flanged components to the grooved-pipe chiller waterbox connections.

Figure 16. Typical shipping location for flange



In this case, the use of flexible type connectors (i.e., braided steel, elastomeric arch, etc.) are recommended to attenuate vibration and prevent stress at the waterbox connections.

All flange-to-flange assembly screws must be provided by the installer. Hex head screw sizes and number required are included in the tables in "Victaulic Gasket Installation," p. 29. The Style 741 (150 psig [1034.2 kPaG]) flange adapter requires a smooth, hard surface for a good seal.

Connection to other type flange faces (i.e., raised, serrated, rubber, etc.) requires the use of a flange washer between the faces. Refer to the flange adapter manufacturer's guidelines for specific information.

The Style 743 (300 psig [2068.4 kPaG]) flange adapters are designed to mate with raised-face flanges. They can be used with flat-faced flanges, but only if the raised projections on the outside face of the adapter are removed; refer to the following figure. The flange-adapter gasket must be placed with the color-coded lip on the pipe and the other lip facing the mating flange.

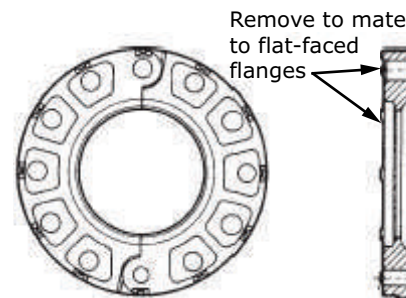
### NOTICE

#### Piping Connection Leaks!

Failure to provide effective seal could result in equipment or property-only damage.

To provide effective seal, gasket contact surfaces of adapter must be free of gouges, undulations or deformities.

Figure 17. Modifying 300 psig (2068.4 kPaG) flange adapters for flat-faced flange application



## Victaulic Gasket Installation

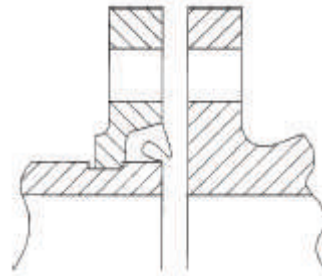
1. Inspect supplied gasket to be certain it is suited for intended service (code identifies gasket grade). Apply a thin coat of silicone lubricant to gasket tips and outside of gasket.
2. Install gasket, placing gasket over pipe end and making sure gasket lip does not overhang pipe end. Refer to the following figure for gasket configuration.
3. Align and bring two pipe ends together and slide gasket into position centered between the grooves on each pipe. No portion of the gasket should extend into the groove on either pipe.
4. Open fully and place hinged Victaulic® flange around the grooved pipe end with the circular key section locating into the groove.
5. Insert a standard hex head screw through the mating holes of the Victaulic® flange to secure the flange firmly in the groove.
6. Tighten fasteners alternately and equally until housing screw pads are firmly together (metal-to-metal); refer to "Screw-Tightening Sequence for Water Piping Connections," p. 30. Do NOT

## Installation: Water Piping

excessively tighten fasteners.

**Note:** Uneven tightening may cause the gasket to pinch.

**Figure 18. Typical Victaulic® flange gasket configuration**



**Table 6. Installation data for 150 psig (1034.2 kPaG) flange adapters (Style 741)**

Nominal Pipe Size		Assembly Screw Size <sup>(a)</sup>	Number of Assembly Screws Required	Screw Pattern Diameter		Weight	
in.	mm			in.	in.	mm	lb
8	219.1	3/4 x 3-1/2	8	11.75	298	16.6	7.5
10	273.0	7/8 x 1/44	12	14.25	362	24.2	11.0

<sup>(a)</sup> Screw size for conventional flange-to-flange connection. Longer screws are required when flange washer must be used. Grade 5 screws are recommended.

**Table 7. Installation data for 300 psig (2068.4 kPaG) flange adapters (Style 743)**

Nominal Pipe Size		Assembly Screw Size <sup>(a)</sup>	Number of Assembly Screws Required	Screw Pattern Diameter		Weight	
in.	mm			in.	in.	mm	lb
8	219.1	7/8 x 4-3/4	12	13	330	34.3	15.6
10	273.0	1 x 5-1/4	16	15.25	387	48.3	21.9

<sup>(a)</sup> Screw size for conventional flange-to-flange connection. Longer screws are required when flange washer must be used. Grade 5 screws are recommended.

## Screw-Tightening Sequence for Water Piping Connections

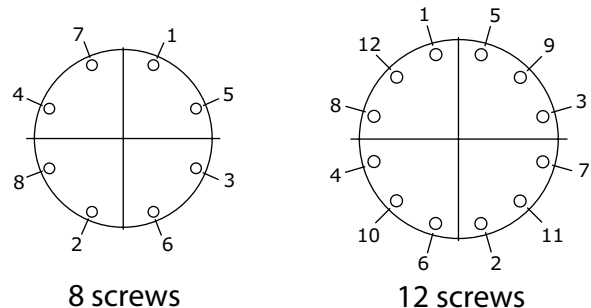
This section describes a screw-tightening sequence for flanges with flat gaskets or O-rings. Remember that improperly tightened flanges may leak.

**Note:** Before tightening any of the screws, align the flanges.

### Flanges with 8 or 12 Screws

Tighten all screws to a snug tightness, following the numerical sequence for the appropriate pattern as shown in the following figure. Repeat this sequence to apply the final torque to each screw.

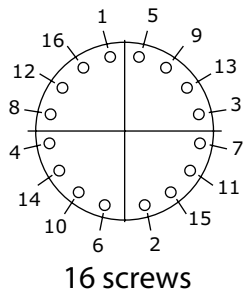
**Figure 19. Flange screw tightening sequence (8 or 12 screws)**



### Flanges with 16 Screws

Tighten only the first half of the total number of screws to a snug tightness, following the numerical sequence for the appropriate pattern as shown in the following figure. Next, sequentially tighten the remaining half of the screws in numerical order.

**Figure 20. Flange screw tightening sequence (16 screws)**



## Pressure Testing Waterside Piping

### **NOTICE**

#### **Equipment Damage!**

Failure to follow these instructions could result in equipment damage.

Do not over pressurize the system or exceed design pressure. Always perform a hydro pressure test with water present in piping and waterboxes.

Waterside design pressure is either 150 psig (1034.2 kPaG) or 300 psig (2068.4 kPaG); refer to unit nameplate or to submittal documentation.

## Eddy Current Testing

Trane recommends conducting an eddy current inspection of the condenser and evaporator tubes in water-cooled chillers every three years. Eddy current tests are intended to identify defects on or within the walls of heat exchanger tubing that could lead to in-service tube failures. Eddy current tests conducted before a chiller is put into service are considered "baseline" eddy current tests, and are intended to establish a reference point to aid in the interpretation of future eddy current test reports. Many of the anomalies that can be found through eddy current testing have no impact on tube life or performance, while others are severe enough to justify removing the affected tube from service. Ask your sales account manager for a copy of the engineering bulletin (CTV-PRB024\*-EN) for clarification of the role of eddy current testing in chiller maintenance by providing information about eddy current technology and heat exchanger tubing.



# Vent Piping

## Refrigerant Vent Line

### General Requirements

State and local codes, and ASHRAE Standard 15 contain requirements for venting the relief device on the chiller to the atmosphere outside of the building. These requirements include, but are not limited to, permitted materials, sizing, and proper termination.

**Note:** *The following information is a general outline of vent-line installation requirements based on ASHRAE Standard 15. Most codes contain similar requirements but may vary in some significant areas. The installer must check state and local codes and follow the specific requirements applicable to the location.*

### Purge Discharge

To comply with ASHRAE Standard 15, the discharge piping from purge units that remove non-condensable gas from refrigerating systems must conform to the ASHRAE Standard 15 requirements for relief piping. To help meet this requirement, the purge discharge is factory-piped to the relief device assembly.

### Vent Line Materials

All materials in the relief device vent system must be compatible with the refrigerant in use. Commonly used and accepted piping materials include steel and drain/waste/vent (DWV) copper. Consult local codes for restrictions on materials. Consult with the manufacturers of any field-provided components or materials for acceptable material compatibility.

**Note:** *PVC piping is compatible with the refrigerant but the glue that joins the sections of plastic pipe may not be. When considering a vent system constructed of plastic piping such as PVC, ensure that both the pipe material and the adhesive have been tested for refrigerant compatibility. In addition, verify that the local codes permit PVC for refrigerant vent lines; even though ASHRAE Standard 15 doesn't prohibit its use, some local codes do.*

Testing conducted in Trane laboratories has qualified the following materials for PVC pipe construction as being compatible with the refrigerant:

Primer/Cleaner:

- Hercules—PVC Primer #60-465
- RECTORSEAL® PVC Cleaner—Sam™ CL-3L

Adhesives:

- Hercules—Clear PVC, Medium Body/Medium Set, #60-020
- RECTORSEAL®—PVC Cement, Gene™ 404L

Flexible connection devices for vibration isolation must also be compatible with the vented refrigerant. A flexible stainless-steel pump connector (such as the stainless-steel type MFP, style HNE, flexible pump connector from Vibration Mounting and Control, Inc.) or equivalent is recommended.

### Vent Line Sizing

Vent line size must conform to local codes and requirements. In most cases, local codes are based on ASHRAE Standard 15. ASHRAE Standard 15 provides specific requirements for the discharge piping that allows pressure-relief devices to safely vent refrigerant to the atmosphere if over-pressurization occurs. In part, the standard mandates that:

- The minimum pipe size of the vent line must equal the size of the discharge connection on the pressure-relief device. A larger vent line size may be necessary, depending on the length of the run.
- Two or more relief devices can be piped together *only if* the vent line is sized to handle all devices that could relieve at the same time.
- When two or more relief devices share a common vent line, the shared line must equal or exceed the sum of the outlet areas of all upstream relief devices, depending on the resulting back pressure.

ASHRAE Standard 15 provides guidance for determining the maximum vent line length. It also provides the equation and data necessary to properly size the vent line at the outlet of a pressure-relief device or fusible plug (for more information, refer to "[Vent Line Sizing Reference](#)," p. 36).

The equation accounts for the relationship between pipe diameter, equivalent pipe length, and the pressure difference between the vent line inlet and outlet to help ensure that the vent line system provides sufficient flow capacity.

The table in "[Vent Line Sizing Reference](#)," p. 36 provides additional information based on ASHRAE Standard 15, including:

- Capacities of various vent line sizes and lengths. However, this data applies only to conventional pressure-relief valves and NOT to balanced relief valves, rupture members (as used on Trane® centrifugal chillers), fusible plugs, or pilot-operated valves.
- A simplified method to determine the appropriate vent-line size, using the figure in "[Vent Line Sizing Reference](#)," p. 36. Enter the figure with the total C value, read across to a pipe curve and down to find the maximum allowable length for that size pipe.



**Note:** To determine the total *C* value for a specific unit, add the appropriate *C* values for the evaporator, standard condenser, and economizer. If the unit is equipped with any options (e.g., heat recovery, free cooling, or an auxiliary condenser), add the applicable *C* value(s) for those options to the total as well.

**Note:** The table and figure in “Vent Line Sizing Reference,” p. 36 are applicable only for non-manifolded vent-line runs connected to a 15 psig (103.4 kPaG) rupture disk relief device. The pipe length provided by the table is in “equivalent feet.” The vent-line length in equivalent feet is the sum of the linear pipe length plus the equivalent length of the fittings (e.g., elbows).

## Vent Line Installation

**Important:** Before constructing the rupture disk vent line, consult local codes for applicable guidelines and constraints.

All CenTraVac™ centrifugal chillers are equipped with rupture disks. If refrigerant pressure within the evaporator exceeds 15 psig (103.4 kPaG), the rupture disk breaks and shell pressure is relieved as refrigerant escapes from the chiller.

A cross-section of the rupture disk assembly appears in the following figure (rupture disk location and cross section), along with an illustration indicating the location of the rupture disk on the suction elbow.

**Important:** If a RuptureGuard™ is to be installed, remove and discard the factory-installed rupture disk; for more information, refer to Installation, Operation, and Maintenance: RuptureGuard Pressure Relief System Option (CTV-SVX06\*-EN).

Several general recommendations for rupture disk vent line installation are outlined as follows.

**Note:** If the rupture disk was removed for service or vent-line piping installation, the rupture disk must be reinstalled (as shown in the following figure [rupture disk location and cross section]). Refer to the following procedure and contact CenTraVac™ Chiller Technical Service when reinstalling the rupture disk.

- Verify that the vacuum support side of the rupture disk is positioned as shown in the cross-section view that appears in the following figure (rupture disk location and cross section).
  - Install the two bottom hex head screws through the pipe flanges.
  - Install the rupture disk with a gasket on each side between the pipe flanges. Orient the disk with the reference arrow or vacuum support bar facing the chiller side as shown in the following figure (rupture disk location and cross section).
  - Install the two top hex head screws.

- Center the disk and gaskets to the flange bore.
- Hand-tighten all screws, assuring equal pressure.
- Use a torque wrench set to 240 in-lb (27.1 N-m) with a 9/16-in. socket.
- Tighten screws in a star pattern, one half turn each, to maintain even pressure on the disk.
- Final torque on all screws should be 240 in-lb (27.1 N-m).
- When attaching the vent line to the chiller, do NOT apply threading torque to the outside pipe of the rupture disk assembly.

### NOTICE

#### Rupture Disk Damage!

Failure to follow instruction could result in damage to the rupture disk assembly.

Do not apply threading torque to the outside pipe.

- Provide support as needed for the vent line. Do NOT use the rupture disk assembly to support the vent-line piping.
- Use a flexible connection between the vent line and the rupture disk assembly to avoid placing stress on the rupture disk. (Stress can alter rupture pressure and cause the disk to break prematurely.) The flexible connector used to isolate the rupture disk from excessive vent line vibration must be compatible with the refrigerant in use. Use a flexible, steel connector (such as the stainless-steel type MFP, style HNE, flexible pump connector from Vibration Mounting and Control, Inc.), or equivalent. Refer to the following figure (arrangement for rupture disk relief piping) for a recommended relief piping arrangement.
- An individual vent line is normally installed for each relief device. It is permissible to manifold the rupture disks of several machines into a common vent line provided that the appropriate ASHRAE Standards and local code requirements for manifolded relief devices are followed.

**Note:** The following figure (arrangement for rupture disk relief piping) does NOT apply for manifolded vent lines.

### ⚠ WARNING

#### Pressure-Relief Device Discharge Hazard!

An improper vent-line termination could result in death or serious injury or equipment damage.

When a pressure-relief device operates, it could discharge a large amount of fluid and/or vapor.

Units MUST be equipped with a vent-line termination that discharges outdoors in an area that will not spray refrigerant on anyone.

**NOTICE**

**Proper Refrigerant Vent Line Termination!**

Failure to properly terminate a refrigerant vent line could result in equipment damage. Improperly terminating a refrigerant vent line could allow rain to enter the line. Accumulated rainwater could cause the relief device to malfunction; or, in the case of a rupture disk, the rainwater pressure could cause the disk to rupture, allowing water to enter the chiller.

- Route the vent-line piping so that it discharges outdoors in an area that will not spray refrigerant on anyone. Position the vent-line discharge at least 15 ft (4.6 m) above grade level and at least 20 ft (6.1 m) from any building opening. Provide a vent-line termination that cannot be blocked by debris or accumulate rainwater.
- Provide a drip leg on the vent line (refer to the following figure [arrangement for rupture disk relief piping]). Provide a standard 1/4-in. FL x 1/4-in. NPT, capped refrigerant service valve to facilitate liquid removal.

**NOTICE**

**Equipment Damage!**

Failure to follow instructions below could result in equipment damage. All vent lines must be equipped with a drip leg of sufficient volume to hold the expected accumulation of water and/or refrigerant. The drip leg must be drained periodically to assure that it does not overflow and allow fluid to flow into the horizontal portion of the vent line. Trane assumes no responsibility for equipment damage caused by insufficient drainage of drip leg.

- Consult local regulations and codes for any additional relief line requirements and refer to appropriate refrigerant handling guidelines. Refer to *Installation, Operation, and Maintenance: R-514A Low-Pressure Refrigerant Handling Guidelines Conservation and Safe Handling of R-514A Refrigerant in Trane Chillers for Service Technicians* (CTV-SVX008\*-EN).

Figure 21. Rupture disk location and cross section of rupture disk

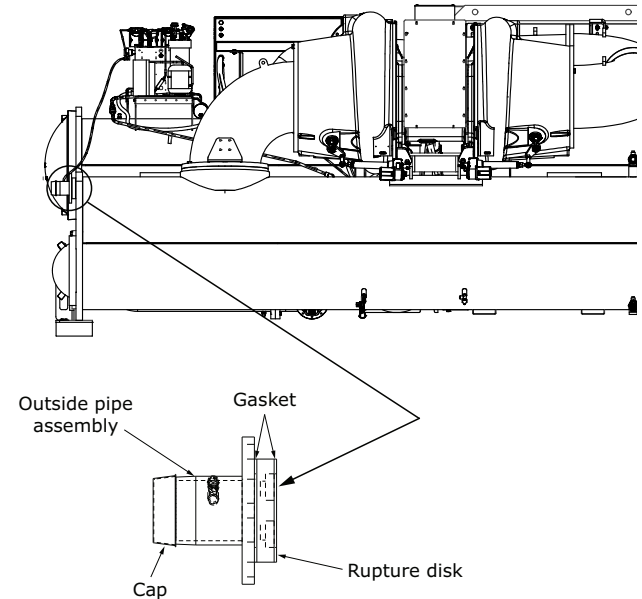
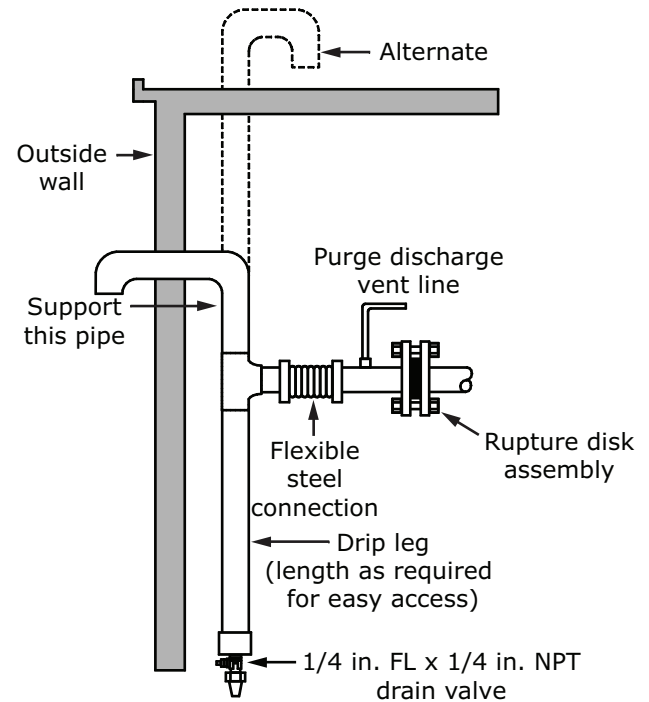


Figure 22. Arrangement for rupture disk relief piping

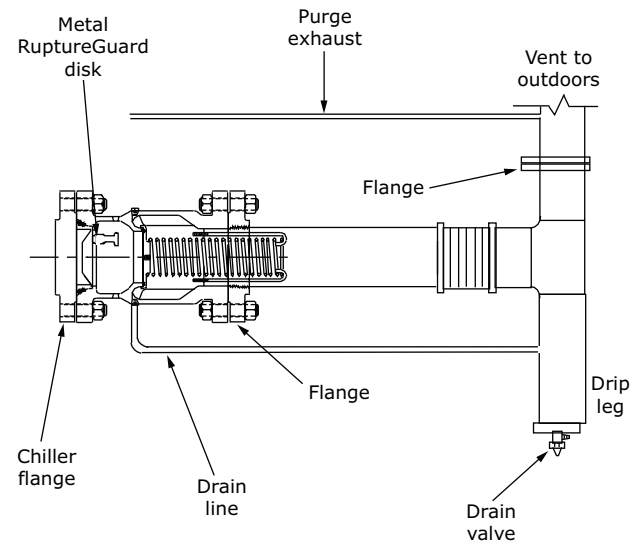


**Important:** On the purge discharge vent line, the purge exhaust connection point **MUST** be lower than the purge height. Do **NOT** create a U-trap; extend to drip leg if necessary to avoid a trap.

**Note:** The drip leg is **REQUIRED**. The drip leg should be a minimum of 1 gal (3.8 L) capacity and must be drained periodically for proper chiller purge operation.

**Notes:**

- If a RuptureGuard™ is to be installed, remove and discard the factory-installed rupture disk; for more information, refer to Installation, Operation, and Maintenance: RuptureGuard Pressure Relief System Option (CTV-SVX06\*-EN).
- The rated flow capacity of the RuptureGuard™ disk/valve assembly is based on having straight pipe extending past the spring mechanism downstream of the valve. Be sure there are no crosses (a derate on the rated flow capacity for this configuration is published in Engineering Bulletin: RuptureGuard Selection Guide [E/CTV-EB-10]), elbows, tees or any other obstructions within the first 9 in. (228.6 mm) of valve discharge. Refer to ASHRAE Standard 15 for additional requirements on piping rupture disk and relief valve vent lines.

**Figure 23. RuptureGuard external vent line and drip leg (not provided)**


**Important:** The purge exhaust line **MUST** be connected to the downstream side piping to vent purge exhaust out the vent line to the outdoors; it may need to be extended to the drip leg. Field-acquired tubing may be required to extend to the field-supplied vent piping, depending on distance. Do **NOT** create a U-trap in the purge exhaust line; this line **MUST** be sloped from purge (highest point toward field-supplied piping, lower point toward connection) to allow proper draining of any condensation.

**Notes:**

- Use Loctite® 242 or Loctite® 277 on all threaded joints on chillers charged with refrigerant; use of other pipe thread sealants is **NOT** recommended. Ensure all threaded pipe joints are properly cleaned and prepared before assembly. An alternative to the use of Loctite® is to thread and weld the inlet adapter to the pipe. Care must be taken to ensure that the flange mating surface remains flat. Do **NOT** weld on the Inlet Adapter flange while connected to the RuptureGuard™.
- The drip leg is **REQUIRED**. The drip leg should be a minimum of 1 gal (3.8 L) capacity and must be drained periodically for proper chiller purge operation.

**Important:** If a RuptureGuard™ is to be installed, it **MUST** be installed properly. Failure to properly install RuptureGuard™ will likely result in a start-up delays and required rework and expenses that result from a failure to properly install RuptureGuard™ will **NOT** be paid by Trane.



## Vent Line Sizing Reference

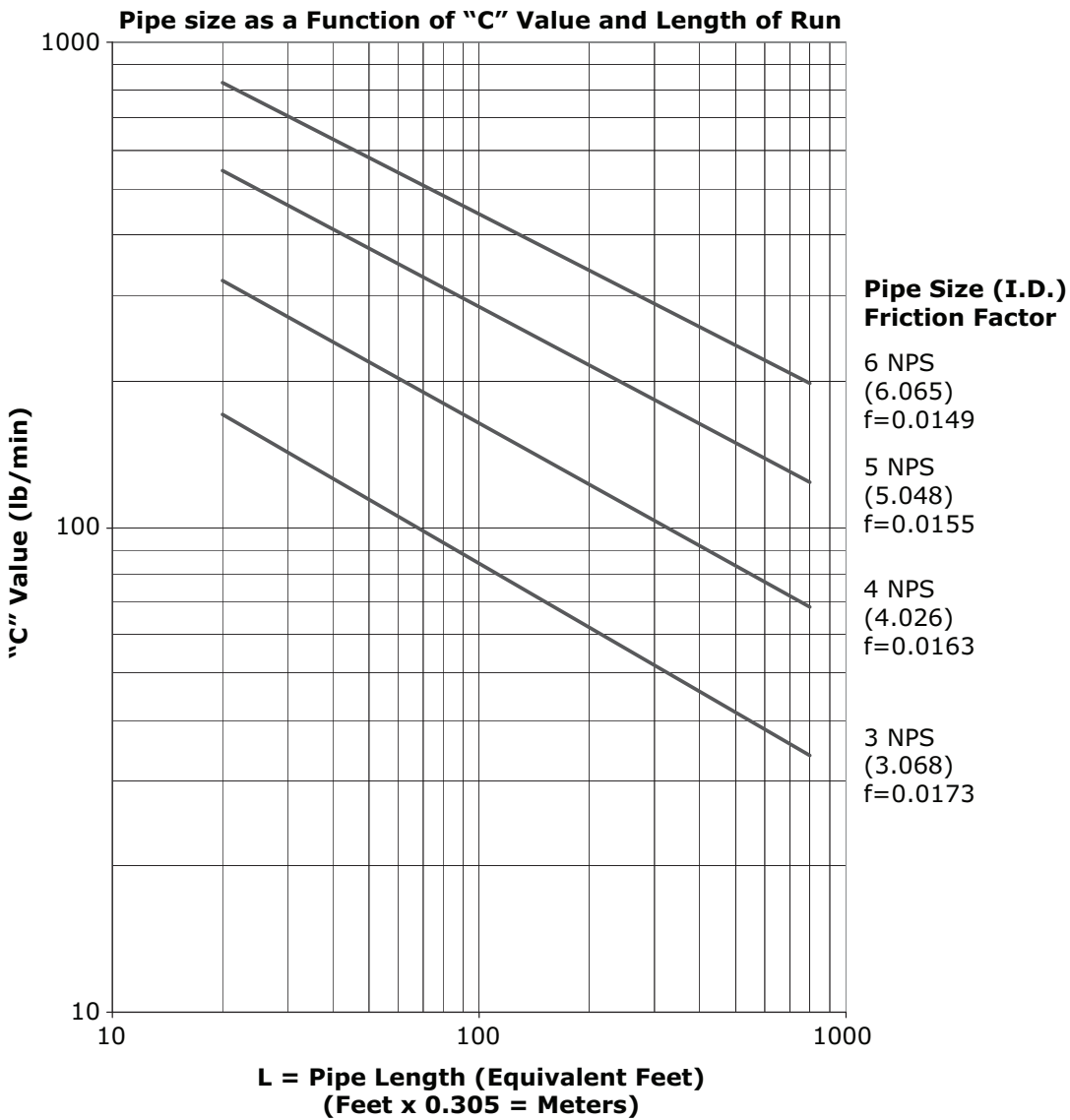
Table 8. "C" values used to determine rupture disk vent line sizes; for use with the following figure

Evap. Size (EVSZ)	Cond. Size (CDSZ)	Rupture Disk Diameter		"C" Values for Unit Components		
		in.	mm	Evap.	Cond.	Econ.
030 A	030 A	3	76	37.50	26.25	5.12
030 B	030 B	3	76	42.25	29.57	

Notes:

1. A = Short Shell; B = Long Shell
2. To determine the total "C" value for a specific unit, add the appropriate "C" values for the evaporator, standard condenser, and economizer. With this sum, refer to the following figure to determine the vent-line pipe diameter.
3. If piping multiple rupture disks (multiple units) to a common vent line, first determine the total "C" value for each unit, then add all "C" values together and apply the result to the following figure.

Figure 24. Rupture disk vent pipe sizing; for use with the preceding table



**Note:** The preceding figure, provided as a reference, is based on ASHRAE Standard 15. Vent line size is typically dictated by state or local code which may be different from ASHRAE Standard 15 requirements.

**ASHRAE Standard 15**

$$L = \frac{0.214d^5 (P_0^2 - P_2^2)}{fC_R^2} - \frac{d * \ln(P_0 / P_2)}{6f}$$

For CenTraVac™ chillers using a rupture disk relief:

- $L$  = equivalent length of discharge piping, ft (m)
- $C_R$  = rated capacity as stamped on the relief device in lb/min (kg/s), or SCFM multiplied by 0.0764 lb/min (convert multiplier in lb/min to kg/s for SI)  
 $C_R = C$  value from the preceding table (convert  $C$  in lb/min to kg/s for SI)
- $f$  = Moody friction factor in fully turbulent flow

- $d$  = inside diameter of pipe or tube, in. (mm)
- $\ln$  = natural logarithm
- $P_2$  = absolute pressure at outlet of discharge piping, psi (kPa)
- $P_0$  = allowed back pressure (absolute) at the outlet of pressure relief device, psi (kPa)  
 $P_0 = (0.50 P) + \text{atmospheric pressure}$

**Note:** For rupture disks on CenTraVac™ chillers,  $P$  is 15 lb (6.8 kg). Atmospheric pressure is at the elevation of the installation above sea level; a default value is the atmospheric pressure at sea level, 14.7 psi (101.34 kPa).



# Insulation

## Unit Insulation Requirements

Factory-installed insulation is available as an option for all units. Factory installation does NOT include insulation of the chiller feet; if required, insulation for chiller feet is provided by others. In applications where the chiller is not factory-insulated, install insulation over the areas outlined and highlighted with dashed lines as shown in the figure in “Factory-applied Insulation,” p. 38.

Insulate all 1/4-in. (6.35-mm) eductor lines, one from the suction cover and one from the evaporator, to prevent sweating.

The quantities of insulation required based on unit size and insulation thickness are listed in the following table. Insulation thickness is determined at normal design conditions which are:

- Standard comfort-cooling leaving chilled water temperature
- 85°F (29.4°C) dry bulb ambient temperature
- 75 percent relative humidity

Operation outside of normal design conditions as defined in this section may require additional insulation; contact Trane for further review.

**Note:** *If the unit is not factory-insulated, install insulation around the evaporator bulbwells and ensure that the bulbwells and connections for the waterbox drains and vents are still accessible after insulation is applied. The sensor modules (Low Level Intelligent Devices [LLIDs]) and interconnecting four-wire cable inter-processor communication (IPC) bus must be raised up above the field-installed insulation. Secure the IPC bus to the insulation top/outer surface after insulation is completed.*

**Important:** *Do NOT insulate the motor housing, unit wiring, or sensor modules.*

### NOTICE

#### Equipment Damage!

Failure to remove the strain relief with the sensor could result in equipment damage.

Do NOT attempt to pull sensor bulb through the strain relief; always remove the entire strain relief with the sensor.

Table 9. Evaporator insulation requirements

EVSZ	3/4 in. (19.05 mm) Insulation (Square Feet)
030 A	400
030 B	423

**Note:** 3/4-in. (19.05-mm) sheet insulation is installed on the evaporator, evaporator waterboxes, suction elbow, and suction cover. All liquid lines and other pipes require the use of 1/2-in. (12.7-mm) pipe insulation or 3/8-in. (9.525-mm) sheet insulation. Copper oil eductor tube lines require pipe insulation.

## Insulation Thickness Requirements

### Factory-applied Insulation

All low-temperature surfaces are covered with 3/4 in. (19.05 mm) Armaflex® II or equal (thermal conductivity = 0.28 Btu/h-ft<sup>2</sup> [1.59 W/m<sup>2</sup>-K]).

The insulation is Armaflex® or equivalent closed cell elastomeric insulation to prevent the formation of condensation up to a dew point rating of 74°F (23.3°C), K = 0.25. Chillers in high humidity areas or ice storage, low leaving water temperature (less than 36°F [2.2°C] chilled water temperature/glycol) units, may require double thickness to prevent formation of condensation.

### NOTICE

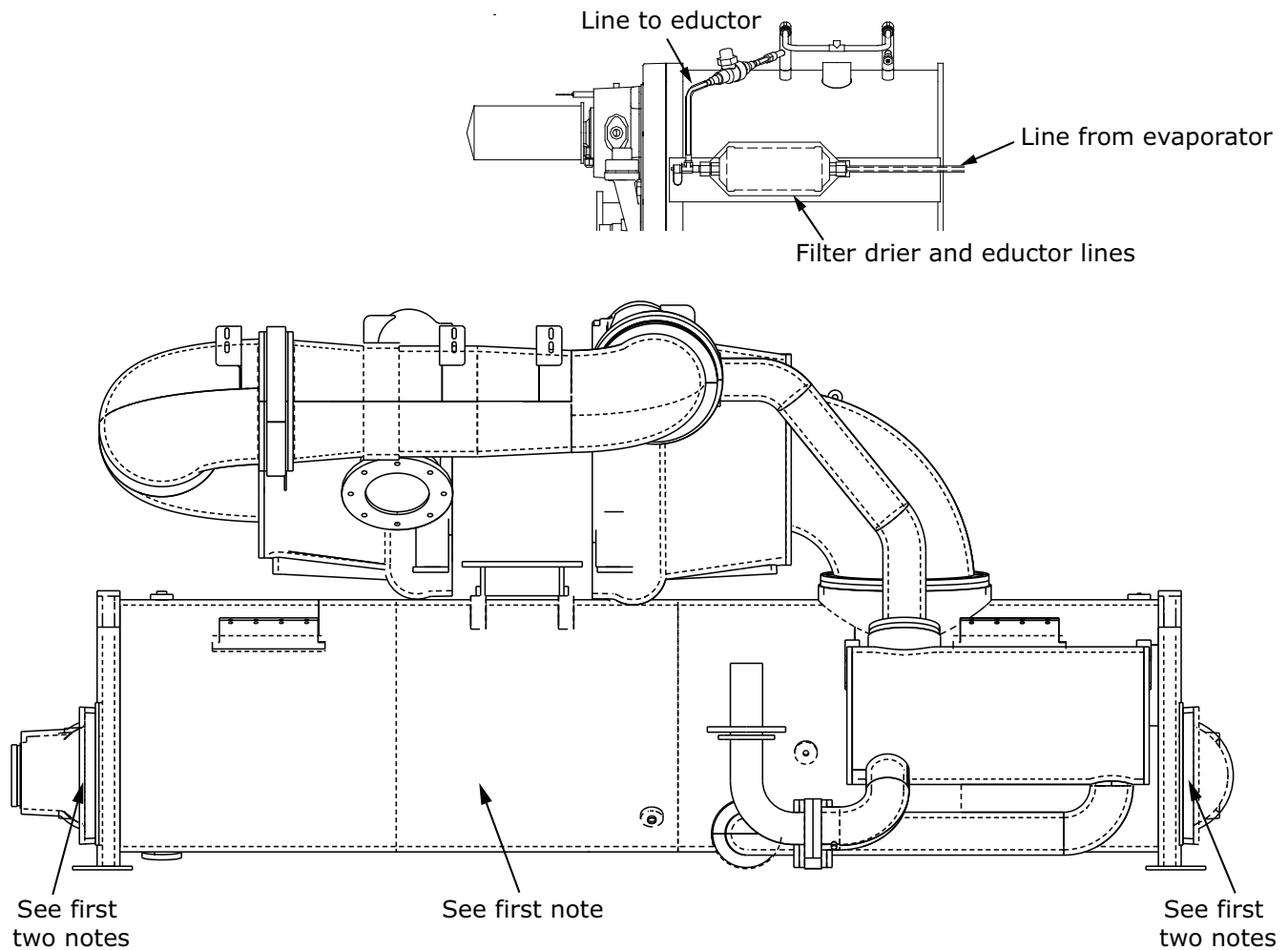
#### Insulation Damage!

Failure to follow these instructions could result in insulation damage.

To prevent damage to factory installed insulation:

- Do not allow the insulation to be exposed to excessive sunlight. Store indoors or cover with canvas to prevent exposure.
- Do not use thinners and solvents or other types of paint. Use only water base latex.

**Figure 25. Recommended area for unit insulation**



**Notes:**

- *Bulbwells, drain, and vent connections must be accessible after insulating.*
- *All units with evaporator marine waterboxes: wrap waterbox shell insulation with strapping and secure strapping with seal.*
- *Condenser not shown.*
- *Evaporators with ASME nameplates must have insulation cut out around the nameplate. Do NOT glue insulation to the nameplate.*
- *Apply 2-in. (50.8-mm) wide black tape on overlap joints. Where possible, apply 3-in. (76.2-mm) wide strip of 0.38-in. (9.652-mm) thick insulation over butt joint seams.*
- *Insulate all economizer supports.*



## Installation: Controls

This section covers information pertaining to the UC800 controller hardware. For information about the Tracer® AdaptiView™ display, which is used to interface with the internal chiller data and functions provided by the UC800, refer to *Tracer AdaptiView Display for Water-cooled CenTraVac Chillers Operations Guide* (CTV-SVU01\*-EN).

### UC800 Specifications

#### Power Supply

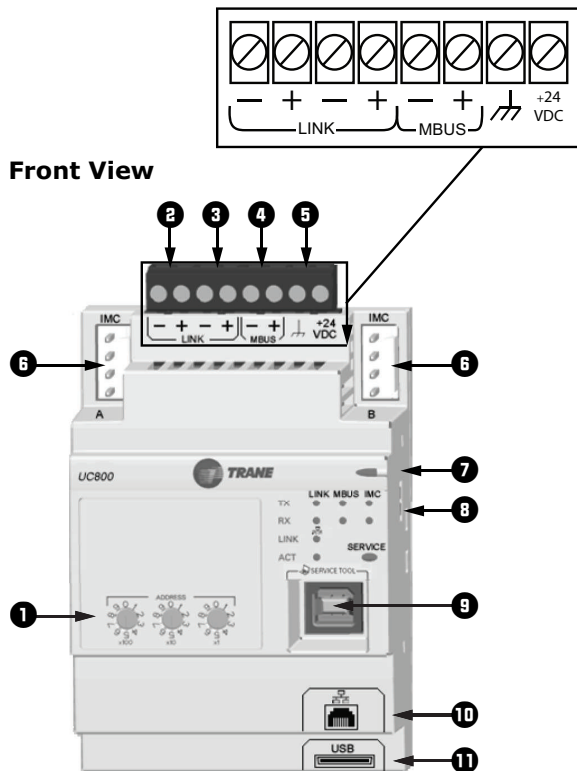
The UC800 (1A22) receives 24 Vac (210 mA) power from the 1A2 power supply located in the chiller control panel.

#### Wiring and Port Descriptions

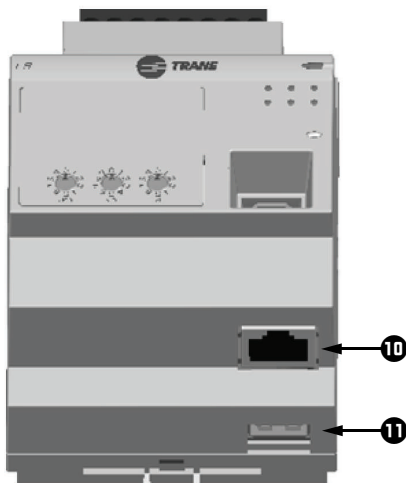
The following figure illustrates the UC800 controller ports, LEDs, rotary switches, and wiring terminals. The numbered list following the figure corresponds to the numbered callouts in the illustration.



**Figure 26. UC800 wiring locations and connection ports**



**Bottom View**



1. Rotary Switches for setting BACnet® MAC address or MODBUS® ID.
2. LINK for BACnet® MS/TP, or MODBUS® Slave (two terminals, ±). Field wired if used.
3. LINK for BACnet® MS/TP, or MODBUS® Slave (two terminals, ±). Field wired if used.
4. Machine bus for existing machine LLIDs (IPC3 Tracer bus). *IPC3 Bus: used for Comm 4 using TCI or LonTalk® using LCI-C.*

5. Power (210 mA at 24 Vdc) and ground terminations (same bus as Item 4). Factory wired.
6. Modbus connection to AFD.
7. Marquee LED power and UC800 Status indicator (refer to the table in “LED Description and Operation,” p. 41).
8. Status LEDs for the BAS link, MBus link, and IMC link.
9. USB device Type B connection for the service tool (Tracer® TU).
10. The Ethernet connection can *only* be used with the Tracer® AdaptiView™ display.
11. USB Host (not used).

**Communication Interfaces**

There are four connections on the UC800 that support the communication interfaces listed. Refer to the figure in “Wiring and Port Descriptions,” p. 40 for the locations of each of these ports.

- BACnet® MS/TP
- MODBUS® Slave
- LonTalk® using LCI-C (from the IPC3 bus)
- Comm 4 using TCI (from the IPC3 bus)

**Rotary Switches**

There are three rotary switches on the front of the UC800 controller. Use these switches to define a three-digit address when the UC800 is installed in a BACnet® or MODBUS® system (e.g., 107, 127, etc.).

**Note:** *Valid addresses are 001 to 127 for BACnet® and 001 to 247 for MODBUS®.*

**LED Description and Operation**

There are ten LEDs on the front of the UC800. The following figure shows the locations of each LED and the following table describes their behavior in specific instances.

Figure 27. LED locations

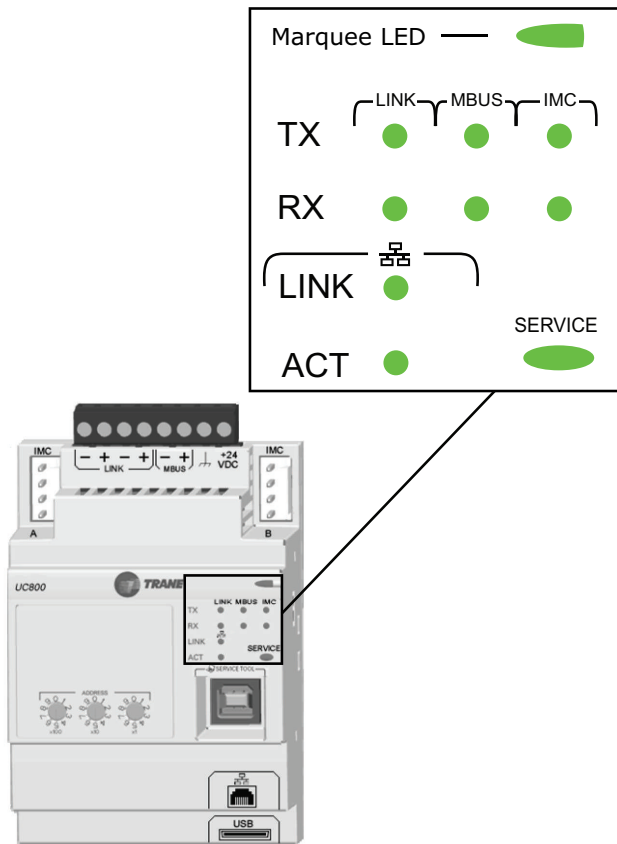
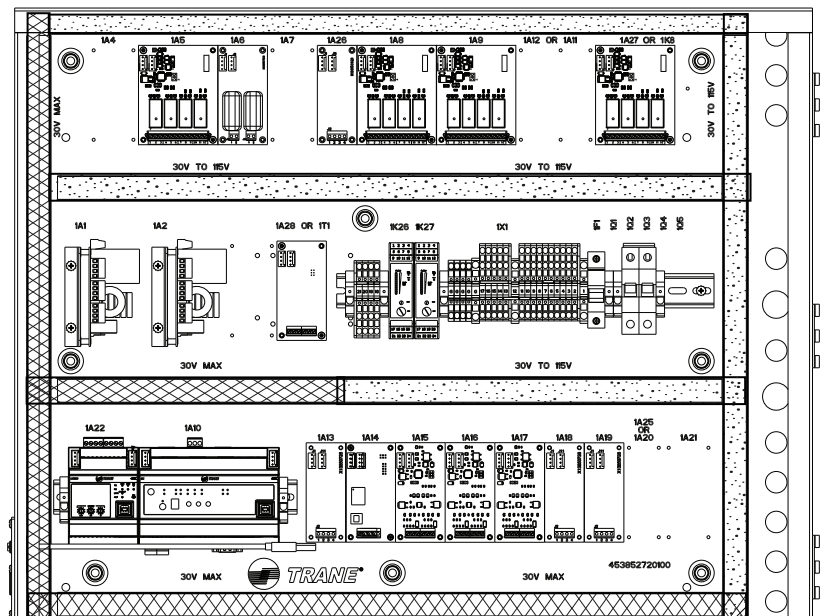
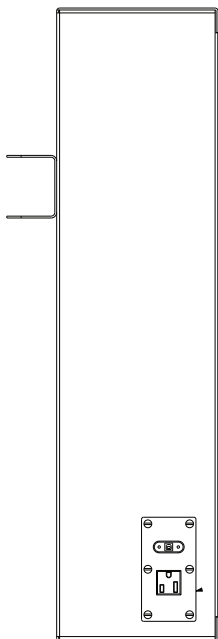
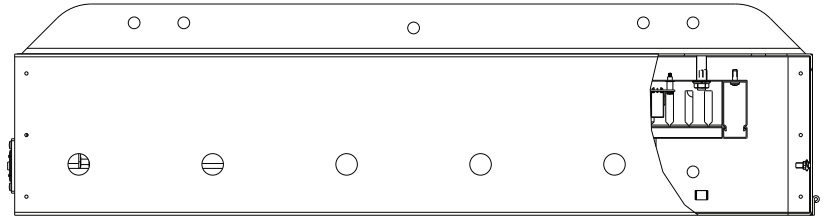



Table 10. LED behavior


LED	UC800 Status
Marquee LED	<b>Powered.</b> If the Marquee LED is green solid, the UC800 is powered and no problems exist.
	<b>Low power or malfunction.</b> If the Marquee LED is red solid, the UC800 is powered but there are problems present.
	<b>Alarm.</b> The Marquee LED blinks red when an alarm exists.
LINK, MBUS, IMC	The <b>TX</b> LED blinks green at the data transfer rate when the UC800 transfers data to other devices on the link.
	The <b>RX</b> LED blinks yellow at the data transfer rate when the UC800 receives data from other devices on the link.
Ethernet Link	The <b>LINK</b> LED is solid green if the Ethernet link is connected and communicating.
	The <b>ACT</b> LED blinks yellow at the data transfer rate when data flow is active on the link.
Service	The <b>Service</b> LED is solid green when pressed. For qualified service technicians only. Do NOT use.

**Important:** Maintain at least 6 in. (16 cm) between low-voltage (less than 30V) and high voltage circuits. Failure to do so could result in electrical noise that could distort the signals carried by the low-voltage wiring, including inter-processor communication (IPC).

Figure 28. Control panel: Tracer AdaptiView main unit assembly (showing low voltage and higher voltage areas for proper routing of field wiring)



 30 Volt Maximum

 30-115 Volt Maximum

## Installing the Tracer AdaptiView Display

During shipment, the Tracer® AdaptiView™ display is boxed, shrink-wrapped, and strapped to the shear plate between the evaporator and condenser. The display must be installed at the site.

**Important:** For best results, Trane, or an agent of Trane, must install the Tracer® AdaptiView™ display.

1. Unwrap the chiller. Locate the box containing the Tracer® AdaptiView™ display strapped to the shear plate between the condenser and the evaporator (see the following figure).

2. Remove the display from the box.

**Note:** Display screws are M4 (metric size 4), 6 to 8 mm long, and are shipped with the display.

3. Plug the power cable (labeled C in the following figure) and the Ethernet cable (labeled D in the following figure) into the bottom of the display.

**Note:** Both cables are already present and extend from the end of the display arm.

4. Adjust the Tracer® AdaptiView™ display support arm so the base plate that attaches to the display is horizontal.

### ⚠ CAUTION

#### Tension in Display Support Arm!

Failure to follow instructions below could result in unexpected movement of the spring-loaded support arm which could result in minor to moderate injury.

Ensure that the support arm is in the full upright position when removing the Tracer AdaptiView display from the support arm.

**Note:** Review “Adjusting the Tracer AdaptiView Display Arm,” p. 45 before attaching the display as some adjustments may be required prior to attaching the display to the support arm base.

5. Position the Tracer® AdaptiView™ display—with the LCD screen facing up—on top of the display support arm base plate.

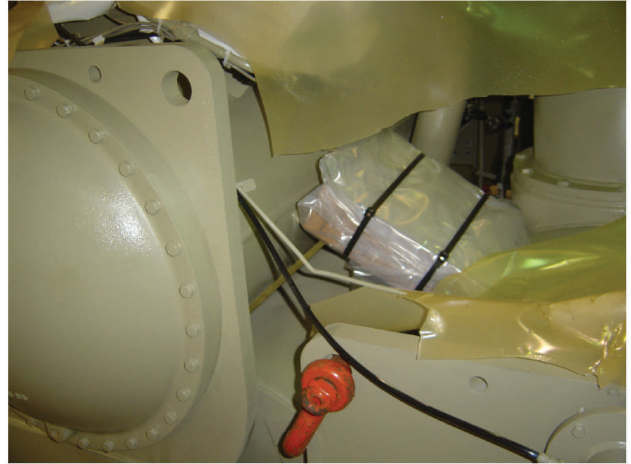
**Note:** Ensure the Trane logo is positioned so that it will be at the top when the display is attached to the display support arm.

**Important:** Use care when positioning the Tracer® AdaptiView™ display on top of the support arm base plate and do NOT drop the display.

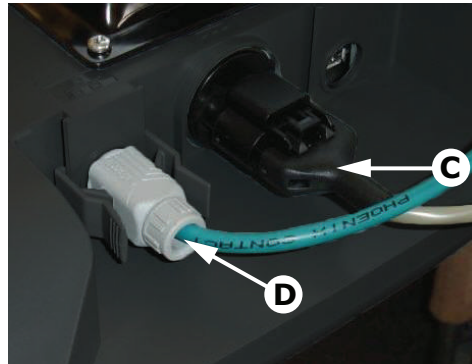
6. Align the four holes in the display with the screw holes in the display support arm base plate.
7. Attach the Tracer® AdaptiView™ display to the display support arm base plate (labeled E in the

following figure) using the M4 (metric size 4) screws referenced in step 3.

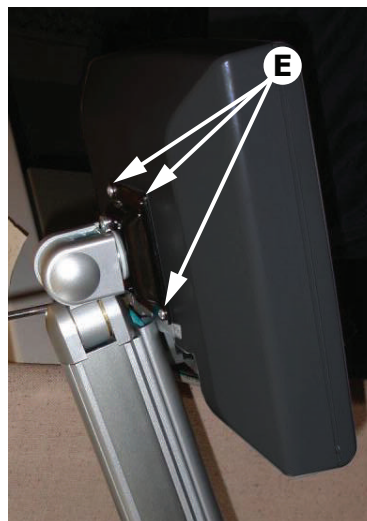
**Figure 29. Tracer AdaptiView shipping location**



**Figure 30. Power cable and Ethernet cable connections**



**Figure 31. Display attachments to the support arm base plate**



## Installing the Tracer AdaptiView Display—Alternate Location

There is an alternate location for mounting the Tracer® AdaptiView™ display on the back side of the chiller. The bracket is mounted to the base of the suction elbow (see the following figure).

**Figure 32. Alternate location for Tracer® AdaptiView™ display**



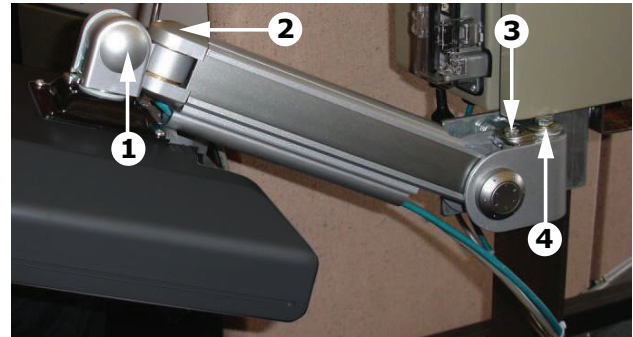
1. Remove the wires from the display arm.
2. Unscrew the display arm from the display mounting bracket on the front side of the chiller.
3. Screw the display arm to the suction elbow bracket, reusing the screws removed in the preceding step.
4. Reroute the wires and secure them to the display arm.

## Adjusting the Tracer AdaptiView Display Arm

The Tracer® AdaptiView™ display arm may become too loose or too tight and may need adjustment. There are three joints on the display arm that allow the display to be positioned at a variety of heights and

angles (refer to items labeled 1, 2, and 3 in the following figure).

**Figure 33. Joint locations on the display arm**



To adjust the tension on the display arm:

- At each joint in the display arm, there is either a hex bolt (1 and 2) or hex screw (3). Turn the hex bolt or screw in the proper direction to increase or decrease tension.
 

**Note:** Each hex bolt or screw is labeled with *loosen/tighten* or *+/-* indicators.
- Joint 3 has a 6 mm hex screw controlling the tension on a gas spring, which allows the Tracer® AdaptiView™ display to tilt up and down.
- Joints 1 and 2 are covered by a plastic cap. Remove the plastic cap to access the screw. Adjust using a 13 mm wrench as necessary.
- To adjust the swivel rotation tension of the Tracer® AdaptiView™ display, adjust the screw located in the support arm base plate, as described in the final step in [“Installing the Tracer AdaptiView Display,” p. 44](#). *This adjustment must be done prior to attaching the display to the support arm base.* Use a 14 mm wrench to adjust the tension.
- To adjust the left/right swivel of the entire display arm, use a 13 mm wrench to adjust the screw labeled 4 in the preceding figure.



# Electrical Requirements

## Installation Requirements

### ⚠ WARNING

#### Proper Field Wiring and Grounding Required!

Failure to follow code could result in death or serious injury.

All field wiring **MUST** be performed by qualified personnel. Improperly installed and grounded field wiring poses **FIRE** and **ELECTROCUTION** hazards. To avoid these hazards, you **MUST** follow requirements for field wiring installation and grounding as described in NEC and your local/state/national electrical codes.

Unit-mounted Adaptive Frequency™ Drives (AFDs) are standard on all units. While this option eliminates most field-installed wiring requirements, the electrical contractor must still complete the electrical connection for the following:

- power supply wiring to the AFD
- identify whether or not the solid center ground Wye (Y) grounding type is brought to the chiller. For use in configuring the AFD Power Jumpers, refer to “Determining Supply Ground Type,” p. 50
- other unit control options present
- any field-supplied control devices

**Important:** If the AFD ships separate or needs to be removed in the field, refer to “Adaptive Frequency Drive Removal and Installation,” p. 84.

As you review this manual along with the wiring instructions presented in this section, keep in mind that:

- All field-installed wiring must conform to National Electric Code (NEC) guidelines, and any applicable local, state, and national codes. Be sure to satisfy proper equipment grounding requirements per NEC.
- Compressor motor and unit electrical data (including motor kW, voltage utilization range, rated load amps, and locked rotor amps) is listed on the chiller nameplate.
- All field-installed wiring must be checked for proper terminations, and for possible shorts or grounds.

**Note:** Always refer to the actual wiring diagrams that shipped with the chiller or the unit submittal for specific as-built electrical schematic and connection information.

### NOTICE

#### Adaptive Frequency Drive (AFD)/ Starter Component Damage!

Failure to remove debris from inside the AFD/ starter panel could result in an electrical short and could cause serious AFD/starter component damage.

Do NOT modify or cut enclosure to provide electrical access. Removable panels have been provided, and any modification should be done away from the enclosure. If the AFD enclosure must be cut to provide electrical access, exercise care to prevent debris from falling inside the enclosure. Refer to submittal drawings.

## Electrical Requirements

Before wiring begins, observe the following electrical requirements:

- Follow all lockout/tagout procedures prior to performing installation and/or service on the unit.
- Always wear appropriate personal protective equipment.
- Wait the required time to allow the capacitor(s) to discharge; this could be up to 30 minutes.
- Verify that all capacitors are discharged prior to service using a properly rated volt meter.
- Use appropriate capacitor discharge tool when necessary.
- Comply with the safety practices recommended in PROD-SVB06\*-EN.

### ⚠ WARNING

#### Hazardous Voltage w/Capacitors!

Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.

Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. For variable frequency drives or other energy storing components provided by Trane or others, refer to the appropriate manufacturer’s literature for allowable waiting periods for discharge of capacitors. Verify with a CAT III or IV voltmeter rated per NFPA 70E that all capacitors have discharged.

For additional information regarding the safe discharge of capacitors, see PROD-SVB06\*-EN.

**⚠ WARNING****Personal Protective Equipment (PPE) Required!**

Failure to wear PPE and follow proper handling guidelines could result in death or serious injury. Always wear appropriate personal protective equipment in accordance with applicable regulations and/or standards to guard against potential electrical shock and flash hazards.

**⚠ WARNING****Live Electrical Components!**

Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

When it is necessary to work with live electrical components, have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks.

# Power Supply Wiring

## ⚠ WARNING

### Proper Field Wiring and Grounding Required!

Failure to follow code could result in death or serious injury.

All field wiring **MUST** be performed by qualified personnel. Improperly installed and grounded field wiring poses **FIRE** and **ELECTROCUTION** hazards. To avoid these hazards, you **MUST** follow requirements for field wiring installation and grounding as described in NEC and your local/state/national electrical codes.

## Three-Phase Power

Review and follow the guidelines in this section to properly install and connect the power supply wiring to the Adaptive Frequency™ Drive (AFD) panel:

- Verify that the AFD nameplate ratings are compatible with the power supply characteristics and with the electrical data on the unit nameplate.

## NOTICE

### Adaptive Frequency Drive (AFD)/ Starter Component Damage!

Failure to remove debris from inside the AFD/ starter panel could result in an electrical short and could cause serious AFD/starter component damage.

## NOTICE

### Use Copper Conductors Only!

Failure to use copper conductors could result in equipment damage as the equipment was not designed or qualified to accept other types of conductors.

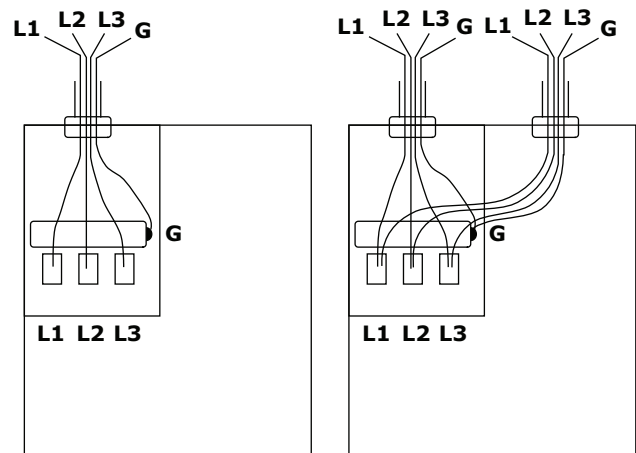
- Do NOT modify or cut enclosure to provide electrical access. Removable panels have been provided and any modification should be done away from the enclosure. If the AFD enclosure must be cut to provide electrical access, exercise care to prevent debris from falling inside the enclosure.
- Use copper conductors to connect the three-phase power supply to the AFD panel.
- Flexible conduit connections are recommended to enhance serviceability and minimize vibration transmission.
- Size the power supply wiring in accordance with National Electric Code (NEC), using the RLA value stamped on the chiller nameplate and transformer load on L1 and L2.

- Confirm that wire size is compatible with lug size stated in unit submittal.
- Make sure that the incoming power wiring is properly phased; each power supply conduit run to the AFD must carry the correct number of conductors to ensure equal phase representation.

**Note:** Connect L1, L2, and L3 (shown in the following figure) per starter diagram provided with chiller.

- When installing the power supply conduit, ensure that the position of the conduit does not interfere with the serviceability of any of the unit components, or with structural members and equipment. Ensure that the conduit is long enough to simplify any servicing that may be necessary in the future (e.g., AFD).

**Figure 34. Proper phasing for starter power supply wiring**



## Circuit Breakers and Fused Disconnects

Any field-supplied circuit breaker or fused disconnect installed in power supplied to the chiller must be sized in compliance with National Electric Code (NEC) or local guidelines.

## Installing AFD Input Power Wiring Standard Cabinet

Use the following steps to connect AC input power to the cabinet.



## ⚠ WARNING

### Hazardous Voltage w/Capacitors!

Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.

Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. For variable frequency drives or other energy storing components provided by Trane or others, refer to the appropriate manufacturer's literature for allowable waiting periods for discharge of capacitors. Verify with a CAT III or IV voltmeter rated per NFPA 70E that all capacitors have discharged.

*For additional information regarding the safe discharge of capacitors, see PROD-SVB06\*-EN.*

1. Turn off, lock out, and tag the input power to the drive.
2. Remove the panel from the top left of the drive enclosure.

## NOTICE

### Equipment Failure!

Debris falling inside of adaptive frequency drive could cause failure of electronic components.

**Do not cut holes in adaptive frequency drive enclosure.**

3. After removing the panel, drill the wire routing holes in the panel. These wire routing holes are the *only* entry points for input power wiring into the cabinet.
4. Install the appropriate conduit hubs.
5. Reinstall the cabinet's top panel.
6. Connect the three-phase input power leads to circuit breaker terminals L1, L2, and L3. Tighten these connections to 275 in-lb (31.1 N·m). Use only copper-conductors for the input power leads.

Input power wiring should be copper and should be sized according to applicable codes to handle the drive's continuous rated input current.

Refer to submittals for power lug sizes and location along with control wiring specifics for the controller.

**Important:** *Power connections should be re-torqued after the first three to six months of operation and on an annual basis thereafter.*

## Torquing Electrical Power Connections

Use a torque wrench to tighten power connections. A torque wrench eliminates the human element and provides proper hardware tightening.

Proper torque for connections depends on both the screw materials and the metals being connected. Strand migration will occur when the copper is under prolonged pressure.

Electrical power terminations should be rechecked for tightness when the apparatus is first installed and periodically afterwards. The conductor could flow under prolonged pressure. Thermal cycling will be greater during the first few months in operation.

Most hardware used for making a screwed electrical joint will be low carbon steel. The hardware does not carry electrical current but holds the two conducting surfaces together under pressure. When properly torqued, the slight elongation of the screw acts to maintain pressure on the electrical joint. The thermal expansion of steel is less than that of the conducting metals, which is usually copper.

The pressure at the electrical joint will vary slightly during thermal cycling and reduces somewhat when there is cold flow in the conducting metals. Re-torquing will re-establish the surface pressure, which is essential to keeping a low resistance drop between the two conducting surfaces and avoiding eventual failure.

**Note:** *Connection from the Adaptive Frequency™ Drive (AFD) output to the motor is made with flexible cable. PROPER TORQUE IS CRITICAL. Refer to the label inside the AFD cabinet for proper torque values.*

## NOTICE

### Equipment Damage!

Failure to follow instructions below could result in equipment damage.

**The IGBTs are connected to the other end of the terminal bar. When tightening connections at the drive terminals, take care to avoid stressing the IGBTs.**

## Cabinet Wire Routing

All wiring should be installed in conformance with the applicable local, state, national, and international codes (for example, NEC/CEC). Control wiring enters the cabinet through the right side and terminates at the drive panel's terminal block. Tighten the control wire connections to 7.1 to 8.9 in-lb (0.8 to 1.0 N·m).

## Grounding the Cabinet

**Note:** *Follow applicable codes! The user is responsible for conforming to all applicable local, national, and international codes. Failure to observe this precaution could result in damage to, or destruction of, the equipment.*

## Power Supply Wiring

Use the following steps to ground the cabinet:

1. Open the left-hand enclosure door of the drive. The grounding stud is located just above and to the left of the breaker.
2. Run a suitable earth ground (completed by field) to the cabinet's ground connection point. The grounding lug is capable of accepting up to 4Ø–500 MCM wire. Tighten ground connections to 375 in·lb (42.4 N·m).

### ⚠ WARNING

#### Proper Field Wiring and Grounding Required!

Failure to follow code could result in death or serious injury.

All field wiring **MUST** be performed by qualified personnel. Improperly installed and grounded field wiring poses **FIRE** and **ELECTROCUTION** hazards. To avoid these hazards, you **MUST** follow requirements for field wiring installation and grounding as described in NEC and your local/state/national electrical codes.

### NOTICE

#### Equipment Damage!

Failure to follow instructions below could cause interference with drive operation and result in damage to the equipment.

Route signal and control wiring separately and in different conduit from power wiring.

An input disconnect circuit breaker is factory-installed in the cabinet. Verify that the available fault current is less than the interrupting rating on the circuit breaker nameplate, which is 65000 amps.

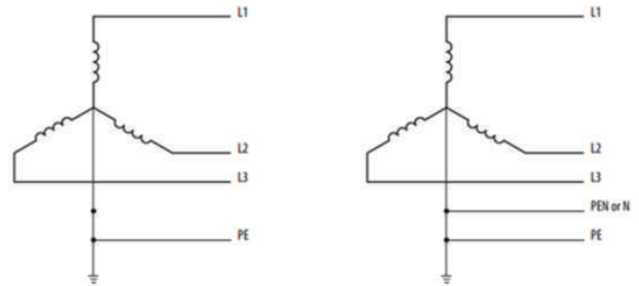
### Determining Supply Ground Type

The AFD contains protective MOVs and common mode capacitor circuits that are referenced to ground. To guard against drive damage and/or operation problems, these devices must be properly configured by Trane at commissioning.

The customer's grounding type is usually indicated on the buildings one-line diagram or referencing the nameplate of the supply transformer to the chiller. For reference, the most common power distribution types

are shown in the below figures. Contact the end use customer's electrical engineer who is responsible for the power distribution connected to the chiller to determine the type of grounding.

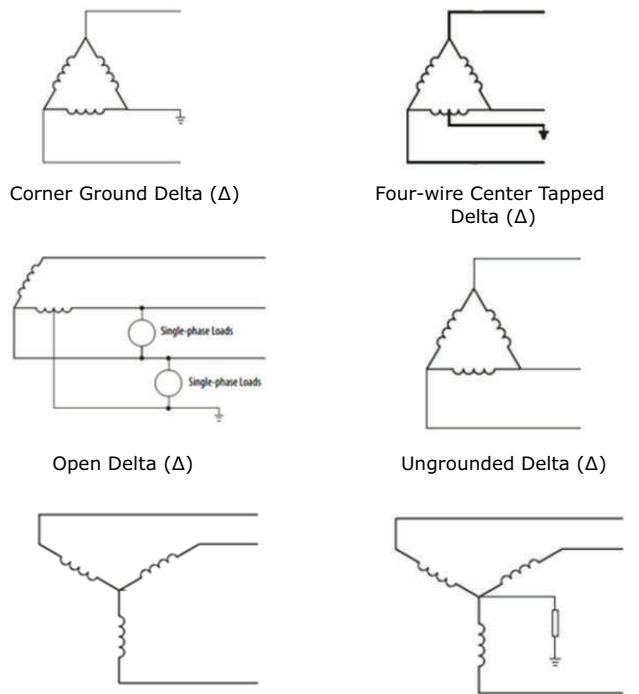
**Figure 35. Solid ground type**



Center Ground Wye (Y)

Center Ground Wye (Y) with neutral

**Figure 36. Non-solid ground type**



Corner Ground Delta (Δ)

Four-wire Center Tapped Delta (Δ)

Open Delta (Δ)

Ungrounded Delta (Δ)

Ungrounded Wye (Y)

High Impedance Wye (Y)



# System Control Circuit Wiring (Field Wiring)

Figure 37. CVHM CenTraVac chiller field wiring (page 1 of 2)

**NOTES:**

1. DASHED LINES INDICATE RECOMMENDED FIELD WIRING BY OTHERS. CHECK SALES ORDER TO DETERMINE IF WIRING IS REQUIRED FOR SPECIFIC OPTIONS.
2. CAUTION - DO NOT ENERGIZE UNIT UNTIL CHECK-OUT AND START-UP PROCEDURES HAVE BEEN COMPLETED.

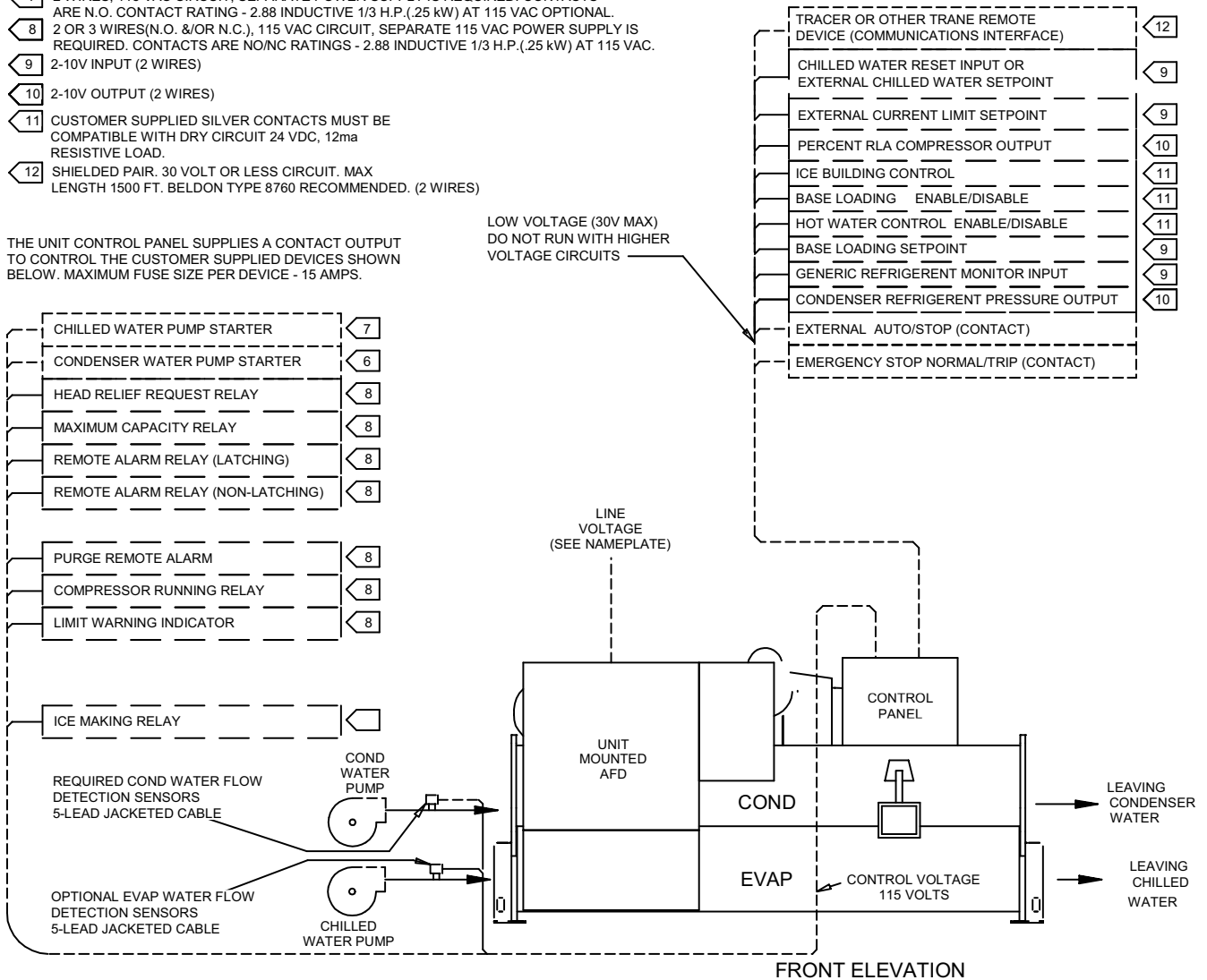
**REQUIRED**

3. ALL CUSTOMER CONTROL CIRCUIT WIRING MUST HAVE A MINIMUM RATING OF 150 VOLTS.
4. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE (NEC), STATE AND LOCAL REQUIREMENTS. OUTSIDE THE UNITED STATES, OTHER COUNTRIES APPLICABLE NATIONAL AND/OR LOCAL REQUIREMENTS SHALL APPLY.
5. EVAPORATOR AND CONDENSER FLOW SWITCHES ARE REQUIRED. THEY MUST BE INSTALLED AND WIRED TO THE TRANE PANEL BY THE INSTALLING CONTRACTOR. PURCHASE OF SWITCHES FROM TRANE IS OPTIONAL.

- 6 2 WIRES, 115 VAC CIRCUIT, SEPARATE POWER SUPPLY IS REQUIRED. MINIMUM CONTACT RATING AT 115 VAC - 2.88 INDUCTIVE 1/3 H.P. (.25 kW) AT 115 VAC REQUIRED.
- 7 2 WIRES, 115 VAC CIRCUIT, SEPARATE POWER SUPPLY IS REQUIRED. CONTACTS ARE N.O. CONTACT RATING - 2.88 INDUCTIVE 1/3 H.P. (.25 kW) AT 115 VAC OPTIONAL.
- 8 2 OR 3 WIRES (N.O. &/OR N.C.), 115 VAC CIRCUIT, SEPARATE 115 VAC POWER SUPPLY IS REQUIRED. CONTACTS ARE NO/NC RATINGS - 2.88 INDUCTIVE 1/3 H.P. (.25 kW) AT 115 VAC.
- 9 2-10V INPUT (2 WIRES)
- 10 2-10V OUTPUT (2 WIRES)
- 11 CUSTOMER SUPPLIED SILVER CONTACTS MUST BE COMPATIBLE WITH DRY CIRCUIT 24 VDC, 12ma RESISTIVE LOAD.
- 12 SHIELDED PAIR. 30 VOLT OR LESS CIRCUIT. MAX LENGTH 1500 FT. BELDON TYPE 8760 RECOMMENDED. (2 WIRES)

THE UNIT CONTROL PANEL SUPPLIES A CONTACT OUTPUT TO CONTROL THE CUSTOMER SUPPLIED DEVICES SHOWN BELOW. MAXIMUM FUSE SIZE PER DEVICE - 15 AMPS.

LOW VOLTAGE (30V MAX)  
DO NOT RUN WITH HIGHER  
VOLTAGE CIRCUITS

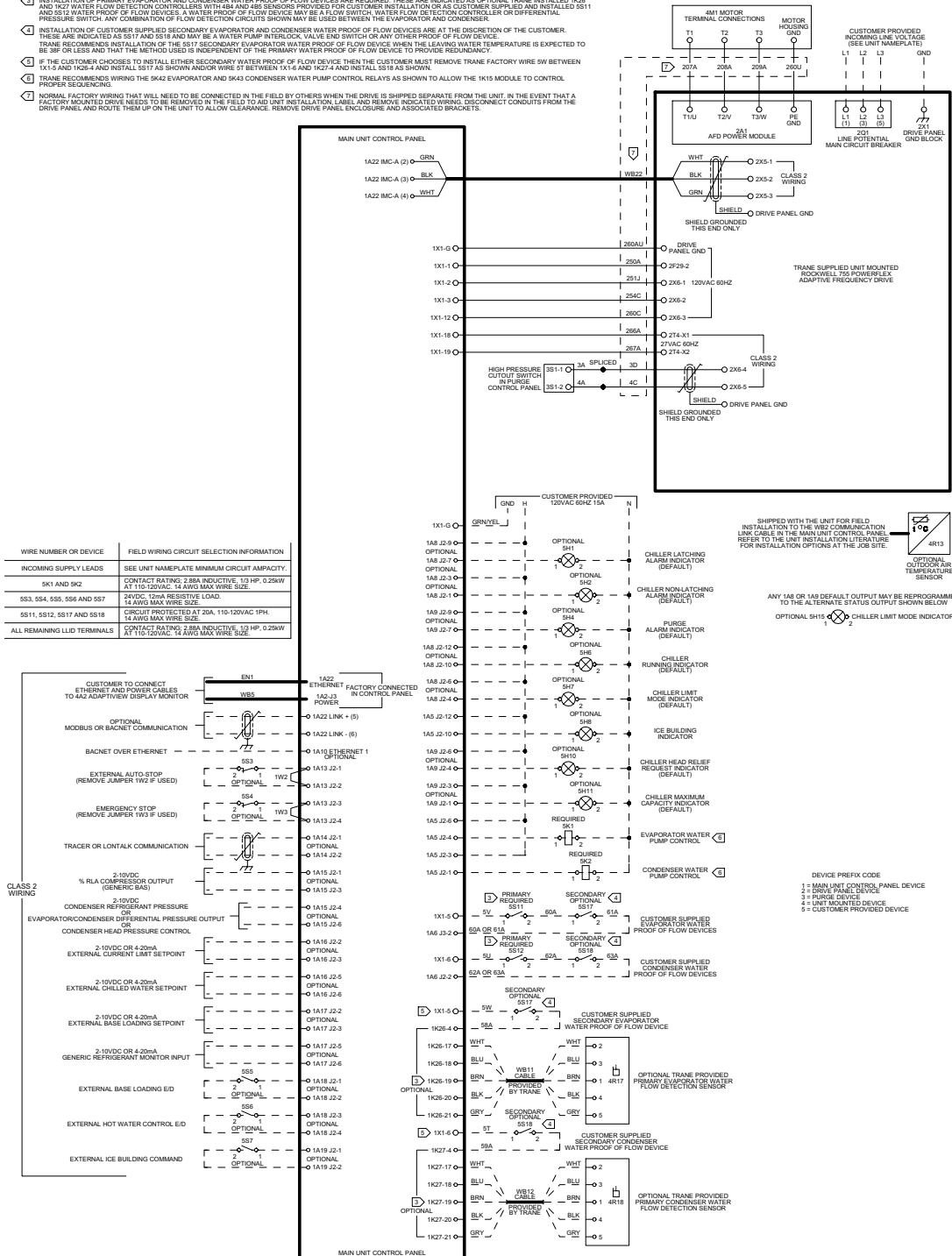


# System Control Circuit Wiring (Field Wiring)

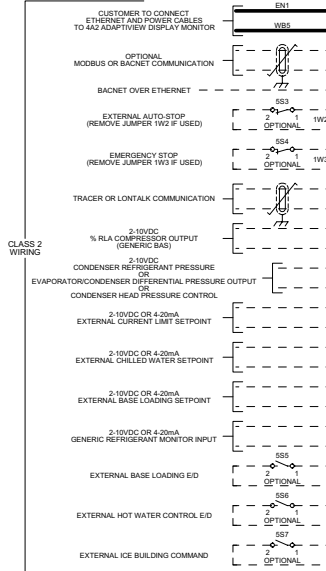
**Figure 38. CVHM CenTraVac chiller field wiring (page 2 of 2)**

**NOTES:**

1. DASHED LINES INDICATE FIELD WIRING BY OTHERS. WIRE NUMBERS SHOWN ARE RECOMMENDED BY TRANE. REFER TO THE UNIT TO DETERMINE WHICH OPTIONS ARE PRESENT.
2. DO NOT ROUTE LOW VOLTAGE (90V) WITH CONTROL VOLTAGE (120V) AND DO NOT POWER UNIT UNTIL CHECK OUT AND START UP PROCEDURES HAVE BEEN COMPLETED.
3. INSTALLATION OF PRIMARY EVAPORATOR AND CONDENSER WATER PROOF OF FLOW DEVICES ARE REQUIRED. THESE ARE INDICATED AS OPTIONAL TRANE INSTALLED 1K08 AND 1K27 WATER FLOW DETECTION CONTROLLERS WITH 48A AND 48S SENSORS PROVIDED FOR CUSTOMER INSTALLATION OR AS CUSTOMER SUPPLIED AND INSTALLED 5S11 AND 5S12 WATER PROOF OF FLOW DEVICES. A WATER PROOF OF FLOW DEVICE MAY BE A FLOW SWITCH, WATER FLOW DETECTION CONTROLLER OR DIFFERENTIAL PRESSURE SWITCH. ANY COMBINATION OF FLOW DETECTION CIRCUITS SHOWN MAY BE USED BETWEEN THE EVAPORATOR AND CONDENSER.
4. INSTALLATION OF CUSTOMER SUPPLIED SECONDARY EVAPORATOR AND CONDENSER WATER PROOF OF FLOW DEVICES ARE AT THE DISCRETION OF THE CUSTOMER. THESE ARE INDICATED AS 5S17 AND 5S18 AND MAY BE A WATER PUMP INTERLOCK VALVE END SWITCH OR ANY OTHER PROOF OF FLOW DEVICE. TRANE RECOMMENDS INSTALLATION OF THE 5S17 SECONDARY EVAPORATOR WATER PROOF OF FLOW DEVICE. WHEN THE LEAVING WATER TEMPERATURE IS EXPECTED TO BE 38F OR LESS AND THAT THE METHOD USED IS INDEPENDENT OF THE PRIMARY WATER PROOF OF FLOW DEVICE TO PROVIDE REDUNDANCY.
5. IF THE CUSTOMER WISHES TO INSTALL EITHER SECONDARY WATER PROOF OF FLOW DEVICE THEN THE CUSTOMER MUST REMOVE TRANE FACTORY WIRE SW BETWEEN 1K16 AND 1K24 AND INSTALL 5S17 AS SHOWN AND/OR WIRE ST BETWEEN 1K16 AND 1K24 AND INSTALL 5S18 AS SHOWN.
6. TRANE RECOMMENDS CHOOSING THE 5K42 EVAPORATOR AND 5K43 CONDENSER WATER PUMP CONTROL RELAYS AS SHOWN TO ALLOW THE 1K15 MODULE TO CONTROL PROPER REDUNDANCY.
7. NORMAL FACTORY WIRING THAT WILL NEED TO BE CONNECTED IN THE FIELD BY OTHERS WHEN THE DRIVE IS SHIPPED SEPARATE FROM THE UNIT. IN THE EVENT THAT A FACTORY MOUNTED DRIVE NEEDS TO BE REMOVED IN THE FIELD TO AID UNIT INSTALLATION, LABEL AND REMOVE INDICATED WIRING. DISCONNECT CONDUITS FROM THE DRIVE PANEL AND ROUTE THEM UP TO THE UNIT TO ALLOW CLEARANCE. REMOVE DRIVE PANEL ENCLOSURE AND ASSOCIATED BRACKETS.



WIRE NUMBER OR DEVICE	FIELD WIRING CIRCUIT SELECTION INFORMATION
INCOMING SUPPLY LEADS	SEE UNIT NAMEPLATE MINIMUM CIRCUIT AMPACITY.
5K1 AND 5K2	CONTACT RATING: 2.88A INDUCTIVE, 1/3 HP, 0.25kW AT 110-120VAC. 14 AWG MAX WIRE SIZE.
5S3, 5S4, 5S5, 5S6 AND 5S7	24VDC, 12mA RESISTIVE LOAD, 14 AWG MAX WIRE SIZE.
5S11, 5S12, 5S17 AND 5S18	CIRCUIT PROTECTED AT 20A, 110-120VAC 1PH, 14 AWG MAX WIRE SIZE.
ALL REMAINING LLD TERMINALS	CONTACT RATING: 2.88A INDUCTIVE, 1/3 HP, 0.25kW AT 110-120VAC. 14 AWG MAX WIRE SIZE.



SHIPPED WITH THE UNIT FOR FIELD INSTALLATION TO THE WB2 COMMUNICATION LINE CABLE IN THE MAIN UNIT CONTROL PANEL. REFER TO THE UNIT INSTALLATION LITERATURE FOR INSTALLATION OPTIONS AT THE JOB SITE.

ANY 1A8 OR 1A9 DEFAULT OUTPUT MAY BE REPROGRAMMED TO THE ALTERNATE STATUS OUTPUT SHOWN BELOW.

OPTIONAL SH15 CHILLER LIMIT MODE INDICATOR

DEVICE PREFIX CODE

- 1 = MAIN UNIT CONTROL PANEL DEVICE
- 2 = DRIVEN PANEL DEVICE
- 3 = PURGE DEVICE
- 4 = UNIT MOUNTED DEVICE
- 5 = CUSTOMER PROVIDED DEVICE

## System Control Circuit Wiring (Field Wiring)

**Table 11. Unit control panel wiring 120 Vac**

Standard Control Circuits: Unit Control Panel Control Wiring (120 Vac)	Unit Control Terminations	Input or Output Type	Contacts
Chilled Water Flow Proving Input <sup>(a)</sup>	1X1-5 to 1A6-J3-2	Binary Input	Normally Open, Closure with Flow
Condenser Water Flow Proving Input <sup>(b)</sup>	1X1-6 to 1A6-J2-2	Binary Input	Normally Open, Closure with Flow
Chilled Water Pump Relay Output	1A5-J2-4 to 6	Binary Output	Normally Open
Condenser Water Pump Relay Output	1A5-J2-1 to 3	Binary Output	Normally Open
<b>Optional Control Circuits (120 Vac)</b>	<b>Note:</b> Defaults are factory programmed; alternates can be selected at start-up using the service tool.		
Alarm Relay MAR (Non-Latching) Output	1A8-J2-1 to 3	Binary Output	Normally Open
Limit Warning Relay Output	1A8-J2-4 to 6	Binary Output	Normally Open
Alarm Relay MMR (Latching) Output	1A8-J2-7 to 9	Binary Output	Normally Open
Compressor Running Relay Output	1A8-J2-10 to 12	Binary Output	Normally Open
Maximum Capacity Relay Output	1A9-J2-1 to 3	Binary Output	Normally Open
Head Relief Request Relay Output	1A9-J2-4 to 6	Binary Output	Normally Open
Purge Alarm Relay Output	1A9-J2-7 to 9	Binary Output	Normally Open
Ice Making Relay Output	1A5-J2-10 to 12	Binary Output	Normally Open
<b>Standard Low Voltage Circuits (Less than 30 Vac)<sup>(c)</sup></b>	<b>Unit Control Panel Terminations</b>	<b>Input or Output Type</b>	<b>Contacts</b>
External Auto Stop Input	1A13-J2-1 to 2	Binary Input	Closure Required for Normal Operation
Emergency Stop Input	1A13-J2-3 to 4	Binary Input	Closure Required for Normal Operation
<b>Optional Low Voltage Circuits</b>			
External Base Loading Enable Input	1A18-J2-1 to 2	Binary Input	Normally Open
External Hot Water Control Enable Input	1A18-J2-3 to 4	Binary Input	Normally Open
External Ice Machine Control Enable Input	1A19-J2-1 to 2	Binary Input	Normally Open
% RLA Compressor Output	1A15-J2-1 to 3	Analog Output	2–10 Vdc
External Condenser Pressure Output	1A15-J2-4 to 6	Analog Output	2–10 Vdc
Evaporator/Condenser Differential Pressure Output	1A15-J2-4 to 6	Analog Output	2–10 Vdc
Condenser Head Pressure Control	1A15-J2-4 to 6	Analog Output	2–10 Vdc
External Current Limit Setpoint Input	1A16-J2-2 to 3	Analog Input	2–10 Vdc, or 4–20 mA
External Chilled Water Setpoint Input	1A16-J2-5 to 6	Analog Input	2–10 Vdc, or 4–20 mA
External Base Loading Setpoint Input	1A17-J2-2 to 3	Analog Input	2–10 Vdc, or 4–20 mA
Generic Refrigerant Monitor Input	1A17-J2-5 to 6	Analog Input	2–10 Vdc, or 4–20 mA
Outdoor Air Temperature Sensor	Inter-processor Communication (IPC) Bus Connection and Sensor	Communication and Sensor	
Trace Comm Interface or LonTalk	1A14-J2-1(+) to 2(-) 1A14-J2-3(+) to 4(-)	Communication to Tracer or LonTalk	(As Ordered; See Sales Order)
BACnet or MODBUS	1A22, 5(+) to 6(-)	Communication to BACnet or MODBUS	(As Ordered; See Sales Order)
Tracer SC Module	1A10	Communication to Tracer SC Module	

**Note:** All wiring to be in accordance with National Electrical Code (NEC) and any local codes.

- (a) If the Chilled Water Flow Proving Input is a factory-installed ifm efector flow-sensing device, the secondary field device (recommended with 38°F [3.3°C] and lower leaving chilled water temperatures) for proof of flow connects from 1X1-5 to 1K26-4 (binary input; normally open, closure with flow). Remove factory jumper when used.
- (b) If the Condenser Water Flow Proving Input is a factory-installed ifm efector flow-sensing device, the secondary (optional) field device for proof of flow connects from 1X1-6 to 1K27-4 (binary input; normally open, closure with flow). Remove factory jumper when used.
- (c) Standard low-voltage circuits (less than 30 Vac) must be separated from 120 Vac or higher wiring.



## System Control Circuit Wiring (Field Wiring)

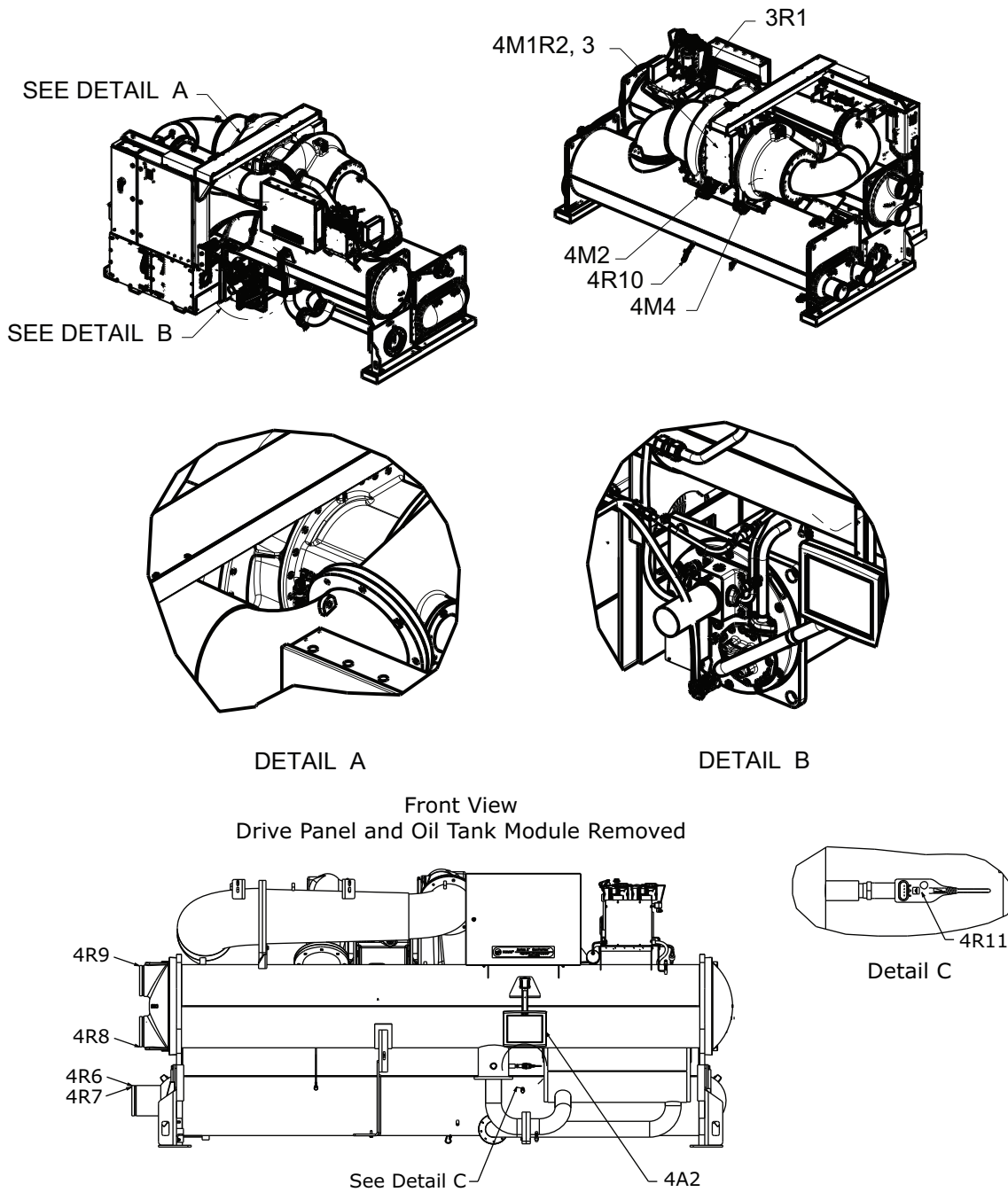
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### Sensor Circuits

All sensors are factory-installed except the optional outdoor air temperature sensor (refer to the following figure for sensor locations). This sensor is required for the outdoor air temperature type of chilled water reset.

Use the following guidelines to locate and mount the outdoor air temperature sensor. Mount the sensor probe where needed; however, mount the sensor module in the control panel.

Figure 39. CVHM sensor locations



- **3R1**, Purge compressor suction temperature, sensor—temp
- **4A2**, Tracer® AdaptiView™ display, monitor display
- **4M2**, Inlet guide vane first-stage actuator, actuator
- **4M4**, Inlet guide vane second-stage actuator, actuator
- **4M1R2,3**, Motor winding temperature 1, 2, sensor—temp
- **4R2**, Outboard bearing temperature, sensor—temp
- **4R3**, Oil pump discharge pressure transducer, sensor—press transducer
- **4R4**, Oil pump tank pressure transducer, sensor—press transducer



## System Control Circuit Wiring (Field Wiring)

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- **4R5**, Oil pump temperature sensor, sensor—temp
- **4R6**, Evaporator, entering water temperature, sensor—temp
- **4R7**, Evaporator leaving water temperature, sensor—temp
- **4R8**, Condenser entering water temperature, sensor—temp
- **4R9**, Condenser leaving water temperature, sensor—temp
- **4R10**, Evaporator saturated refrigerant temperature, sensor—temp
- **4R11**, Condenser saturated refrigerant temperature, sensor—temp

### CWR—Outdoor Option

The outdoor temperature sensor is similar to the unit-mounted temperature sensors in that it consists of the sensor probe and the module. A four-wire inter-processor communication (IPC) bus is connected to the module for 24 Vdc power and the communications link. Trane recommends mounting the sensor module within the control panel and the sensor two wire leads be extended and routed to the outdoor temperature sensor probe sensing location. This ensures the four-wire inter-processor control (IPC) bus protection and provides access to the module for configuration at start-up.

The sensor probe lead wire between the sensor probe and the module can be separated by cutting the two-wire probe lead leaving equal lengths of wire on each device: the sensor probe and the sensor module.

**Note:** *This sensor and module are matched and must remain together or inaccuracy may occur.*

These wires can then be spliced with two 14 to 18 AWG 600V wires of sufficient length to reach the desired outdoor location with a maximum length 1000 ft (304.8 m). The module four-wire bus must be connected to the control panel four-wire bus using the Trane-approved connectors provided.

The sensor will be configured (given its identity and become functional) at start-up when the Trane service technician performs the start-up configuration. It will NOT be operational until that time.

**Note:** *If shielded cable is used to extend the sensor leads, be sure to cover the shield wire with tape at the junction box and ground it at the control panel. If the added length is run in conduit, do NOT run them in the same conduit with other circuits carrying 30 or more volts.*

**Important:** *Maintain at least 6 in. (15.24 cm) between low-voltage (less than 30V) and high voltage circuits. Failure to do so could result in electrical noise that may distort the signals carried by the low-voltage wiring, including the IPC.*

### Optional Control and Output Circuits

Install various optional wiring as required by the owner's specifications (refer to "System Control Circuit Wiring (Field Wiring)," p. 51).

### Optional Tracer Communication Interface

This control option allows the control panel to exchange information—such as chiller status and operating set points—with a Tracer® system.

**Note:** *The circuit must be run in separate conduit to prevent electrical noise interference.*

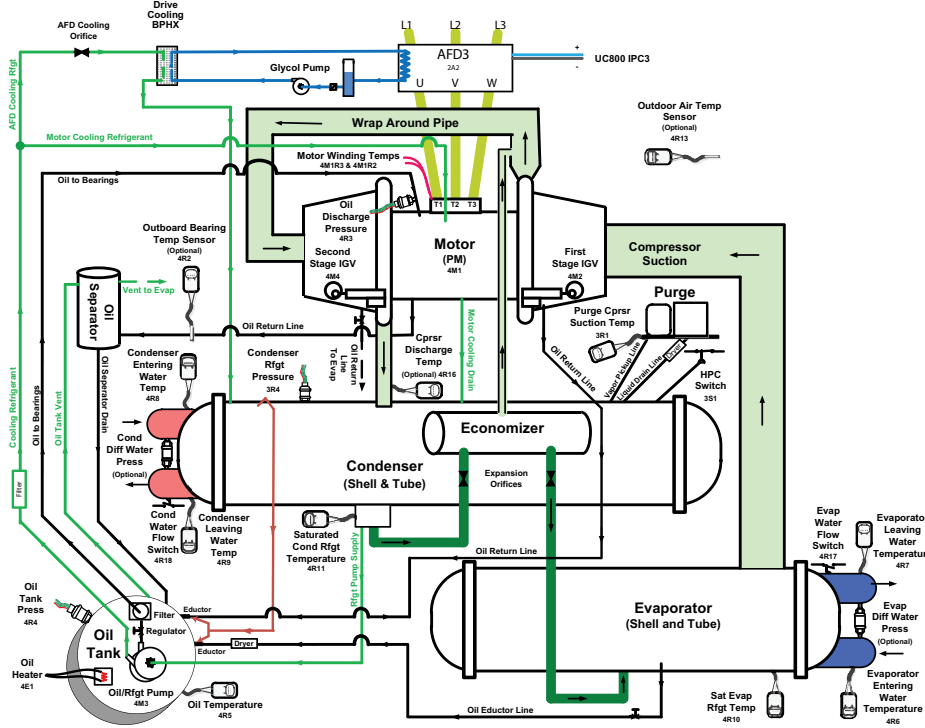
Additional information about the Tracer® communication interface option is published in the *Installation and Operation* manual that ships with the Tracer® communication interface.



# Controls System

Figure 40. Controls system configuration diagram

Revision: D  
Date: 7/12/2016  
Author: Ryan Doud



**Control Panel**

- Control Panel (Standard):**
- Power Supply 1 - 1A1
  - Power Supply 2 - 1A2
  - Motor Winding Temperatures 1 and 2 - 1A26 (TWT)
  - External Auto/Stop and Emergency Stop - 1A13 (DB)
  - Cond and Evap Water Pumps, Oil Tank Heater, and Ice Building Relays - 1A5 (QR)
  - Cond and Evap Water Flow Switch - 1A6 (DHVB)
  - Oil Pump Motor Relay - 1A7 (HPR)
  - UC800 - 1A22
  - TD12 - 4A2
- Control Panel (Optional):**
- External Current Limit and Chilled Water Setpoints - 1A16 (DA)
  - External Ice Building Command - 1A19 (DB)
  - Programmable Relays Module 1 - 1A8 (QR)
  - Programmable Relays Module 2 - 1A9 (QR)
  - % RLA and Cond Refrigerant Pressure Outputs - 1A15 (DA)
  - Evaporator and Condenser Differential Water Pressure Inputs (DA)
  - External Base Loading and Hot Water Control - 1A18 (DB)
  - External Base Loading Setpoint and Refrigerant Monitor Input - 1A17 (DA)
  - Vibration Input - 1A29 (DA)
  - Comm 4 - 1A14
  - Comm 5 LCI-C - 1A14
  - Tracer SC Module - 1A10

**Purge Panel**

- Purge Liquid Level Switch - 3A4 (DB)
- Purge Pumpout, and Alarm Relay - 3A3 (QR)
- Purge Pumpout and Exhaust Solenoids - 3A1 (DT)
- Purge Condensing Unit Relay - 3A2 (HPR)

## Schematic Wiring Drawings

Please refer to the submittals and drawings that shipped with the unit. Additional wiring drawings for

CentraVac™ chillers are available from your local Trane office.

# Operating Principles

## General Requirements

Operation and maintenance information for CVHM CenTraVac™ chillers are covered in this section. By carefully reviewing this information and following the instructions given, the owner or operator can successfully operate and maintain a CenTraVac™ chiller. If mechanical problems do occur, however, contact a Trane service technician to ensure proper diagnosis and repair of the unit.

**Important:** Although CenTraVac™ chillers can operate through surge, it is NOT recommended to operate them through repeated surges over long durations. If repeated surges of long durations occur, contact your Trane Service Agency to resolve the issue.

## Cooling Cycle

When in the cooling mode, liquid refrigerant is distributed along the length of the evaporator and sprayed through small holes in a distributor (i.e., running the entire length of the shell) to uniformly coat each evaporator tube. Here, the liquid refrigerant absorbs enough heat from the system water circulating through the evaporator tubes to vaporize. The gaseous refrigerant is then drawn through the eliminators (which remove droplets of liquid refrigerant from the gas) and the first-stage variable inlet guide vanes, and into the impeller.

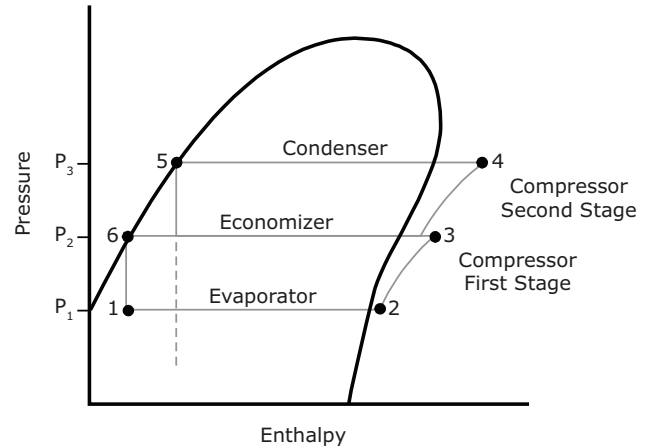
## CVHM Compressor

Compressed gas from the first-stage impeller is discharged through the wrap-around pipe to the second-stage variable guide vanes and into the second-stage impeller. Here, the refrigerant gas is again compressed, and then discharged into the condenser. Baffles within the condenser shell distribute the compressed refrigerant gas evenly across the condenser tube bundle. Cooling tower water circulated through the condenser tubes absorbs heat from the refrigerant, causing it to condense. The liquid refrigerant then flows out of the bottom of the condenser, passing through an orifice plate and into the economizer.

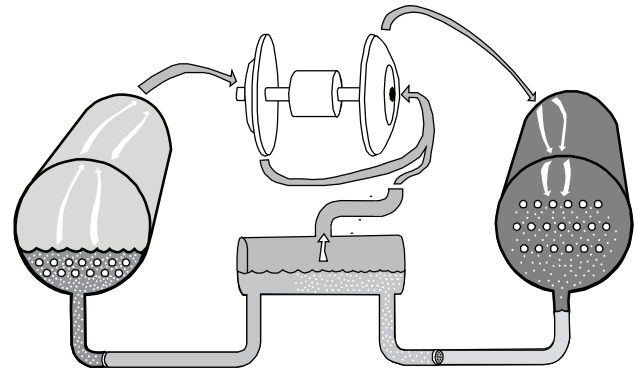
The economizer reduces the energy requirements of the refrigerant cycle by eliminating the need to pass all gaseous refrigerant through both stages of compression (refer to the following figure). Notice that some of the liquid refrigerant flashes to a gas because of the pressure drop created by the orifice plate, thus further cooling the liquid refrigerant. This flash gas is then drawn directly from the economizer into the

second-stage impellers of the compressor. All remaining liquid refrigerant flows out of the economizer, passing through another orifice plate and into the evaporator.

**Figure 41. Pressure enthalpy curve**



**Figure 42. Refrigerant flow**

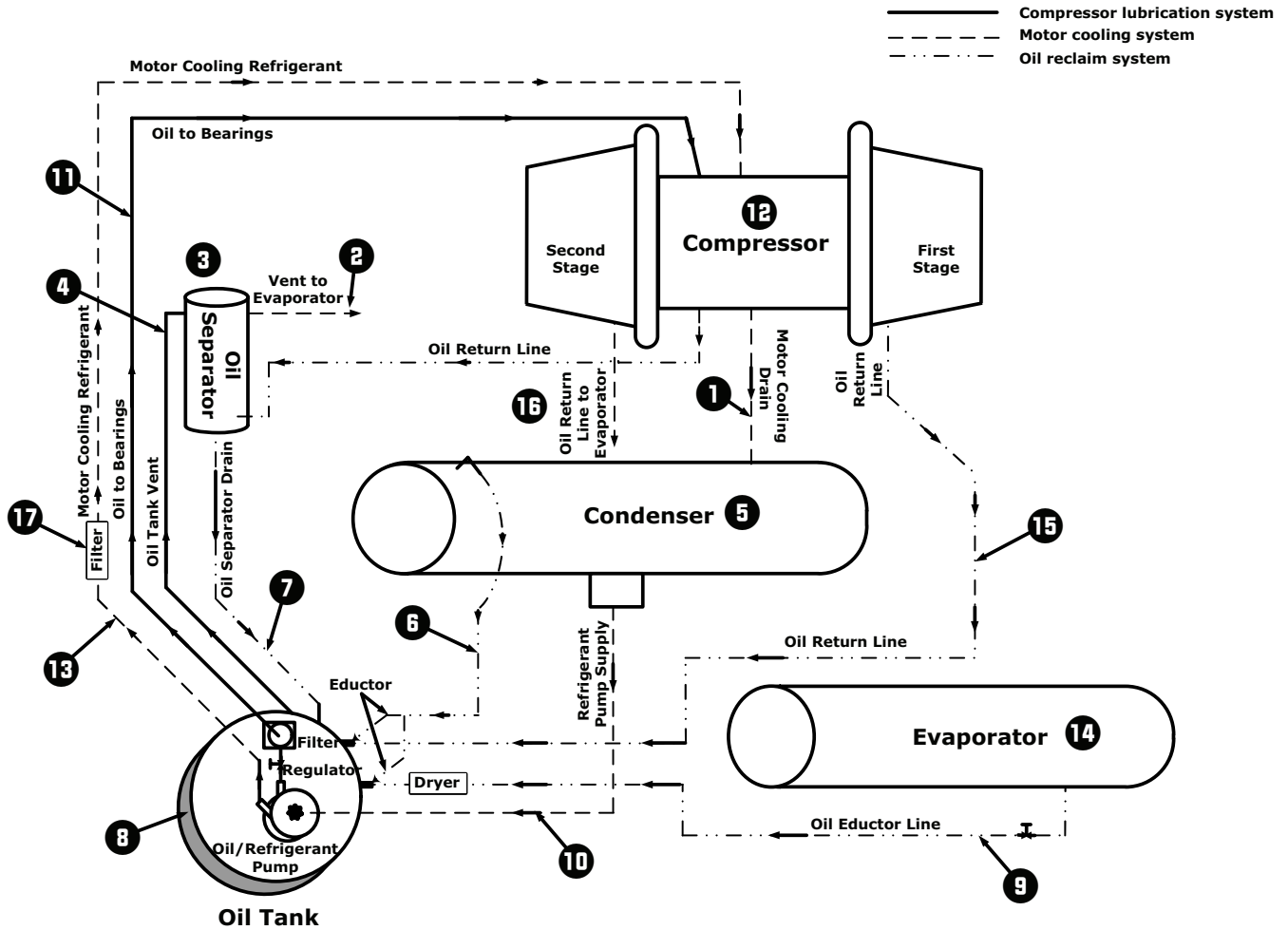


## Oil and Refrigerant Pump

### Compressor Lubrication System

A schematic diagram of the compressor lubrication system is illustrated in the following figure. Oil is pumped from the oil tank (by a pump and motor located within the tank) through an oil pressure regulating valve designed to maintain a net oil pressure of 22 to 26 psid (151.7 to 179.3 kPaD). It is then filtered and sent to the compressor motor bearings. From the bearings, the oil drains back to the manifold and separator under the motor and then on to the oil tank.

Figure 43. Oil refrigerant pump



1. Motor coolant return to condenser
2. Oil tank vent to evaporator
3. Oil separator and tank vent manifold
4. Tank vent line
5. Condenser
6. High pressure condenser gas to drive oil reclaim eductors
7. Oil return to tank
8. Oil tank
9. Oil reclaim from evaporator (second eductor)
10. Liquid refrigerant to pump
11. Oil supply to bearings
12. Compressor
13. Liquid refrigerant motor coolant supply
14. Evaporator
15. Oil reclaim from first stage suction cover (first eductor)
16. Oil reclaim from second stage suction cover to evaporator
17. Motor coolant filter

**⚠ CAUTION****Hot Surface!**

Failure to follow instructions below could result in moderate injury.

Surface temperatures can reach 150°F (66°C). To avoid possible skin burns, stay clear of these surfaces. If possible, allow surfaces to cool before servicing. If servicing is necessary while surface temperatures are still elevated, you **MUST** put on all Personal Protective Equipment (PPE).

To ensure proper lubrication and prevent refrigerant from condensing in the oil tank, a 750-watt heater is in a well in the oil tank. The heater is used to warm the oil while the unit is off. With the default settings, Running Oil Temperature Control is enabled, and the Running Oil Temperature Setpoint is factory-programmed at 110°F (43.3°C). The heater energizes as needed to maintain 140°F to 145°F (60.0°C to 62.8°C) when the chiller is not running.

When the chiller is operating, the temperature of the oil tank is typically 100°F to 160°F (37.8°C to 71.1°C). The oil return lines from the bearings transport oil and some seal leakage refrigerant. The oil return lines are routed into a manifold and separator under the motor. Gas flow exits the top of the manifold and is vented to the evaporator. Oil exits the bottom of the manifold and returns to the tank. Separation of the seal leakage gas in the separator keeps this gas out of the tank.

An eductor system is used to reclaim oil from both suction covers and the evaporator, and deposit it back into the oil tank. The first stage suction cover and evaporator eductor return to the oil tank; the second stage suction cover eductor drains to the evaporator. The evaporator eductor line has a shut-off valve mounted by the evaporator. The shut-off valve will be set during commissioning, but may be adjusted later by a qualified technician as necessary for oil return. A normal operating setting for the valve may range from full closed to one turn open.

**Note:** Depending on operating conditions, the oil sump's normal operating oil level may vary from just below the bottom sight glass to near the top of the upper sight glass.

## Tracer AdaptiView Display

Information is tailored to operators, service technicians, and owners.

When operating a chiller, there is specific information you need on a day-to-day basis—setpoints, limits, diagnostic information, and reports.

Day-to-day operational information is presented at the display. Logically organized groups of information—chiller modes of operation, active diagnostics, settings, graphs, and reports put information conveniently at your fingertips. For more information, refer to *Tracer*

*AdaptiView Display for Water-cooled CenTraVac Chillers Operations Guide (CTV-SVU01\*-EN).*

## Adaptive Frequency Drive

### Introduction

The refrigerant-cooled Adaptive Frequency™ drive (AFD) used with the CVHM CenTraVac™ chiller is a pulse width modulated (PWM) design incorporating an Insulated Gate Bipolar Transistor (IGBT) inverter. This drive converts AC power to DC power and back to AC power. The incoming line volts are converted to about 700 Vdc and are stored in a section of capacitors. The DC output feeds the inverter IGBTs that switch at predetermined time to change the DC input voltage to a symmetrical AC output voltage of desired magnitude and frequency. The output frequency range is 0 to 500 hertz.

A typical bus voltage for the AFD is 700 Vdc, which can run in a dynamic range of 350 to 900 Vdc with a steady state range of 480 to 780 Vdc.

A combination of two distinct operating modes make up the AFD control within the chiller's UC800 control: first, by controlling the inlet vanes, and second, by modulating impeller speed. The IGBTs control the speed in response to the UC800 compressor control signal. Circuit breakers, surge protectors, and ground faults are standard on all AFD units.

Some of the basic principles of the drive are:

- *Optional:* Passive harmonic filtering to meet IEEE-519 recommended limits.
- Unit displacement power factor of 0.98 or better at full load and a value of 0.96 at part load with total harmonic distortion (THD) filter.
- Low inrush current.
- The current never exceeds the full load amps.
- The AFD varies the motor speed in response to the speed command from the UC800 control.

The CenTraVac™ chiller control panel has full control of the unit operation, including the start/stop functions. If you encounter a fault condition or an alarm on the drive, the Tracer® AdaptiView™ display will indicate "alarm" and an "alarm message."

## UC800 Adaptive Frequency Drive Control

### Achieving Efficiency

Adjustable speed impeller control is used to improve CenTraVac™ chiller efficiency at part-load while tower relief is available. This occurs because the addition of the variable frequency drive gives the chiller control an extra degree of control freedom. The combination of inlet guide vane position and variable speed creates the possibility to control both chiller capacity and compressor efficiency. By manipulating speed and inlet guide vane position, it is possible to adjust the

aerodynamic loading on the compressor to operate in a region of higher efficiency.

**Challenges.** There are challenges associated with achieving high efficiency. The region of higher efficiency is near the compressor surge boundary. Surge occurs when the compressor can no longer support the differential pressure required between the evaporator and condenser. Reducing compressor speed can improve efficiency; however, at some point, the reduced impeller speed does not add enough dynamic pressure to the discharged refrigerant. When the total pressure (static + dynamic) leaving the compressor is less than the condenser pressure, refrigerant will start to flow backwards from the condenser. The flow reversal from the condenser to the compressor discharge creates a sudden loss of the dynamic pressure contribution from the compressor. Refrigerant flows backwards through the compressor, creating an unpleasant audible noise. Surge is avoided when possible because it causes a loss of efficiency and cooling capacity if the compressor is allowed to cycle in and out of surge for an extended period.

**Solutions.** The adjustable speed control algorithm of the Tracer® UC800 control was developed to operate near the surge boundary by periodically testing to find the surge boundary and then holding conditions at an optimal distance from surge. Once the optimal operating condition is found, the algorithm can avoid the surge in the future. When surge is detected, a surge recovery routine makes adjustments to move out of surge, reestablish stable operating conditions, and adjust the control boundary to avoid surge in the future.

### Chiller and Adaptive Frequency Drive Sequence of Operation

In the UC800, the chiller and Adaptive Frequency™ drive (AFD) sequence of operation is identical to a standard fixed speed chiller. Chiller capacity control, safeties, and limits work in the same manner regardless of whether an AFD is present.

The UC800's AFD speed control algorithm will simultaneously set inlet guide vane (IGV) position and compressor speed to achieve a desired compressor loading command while holding a fixed margin of safety between the compressor operating point and compressor surge. In order to quantify nearness to surge, a non-dimensional parameter called "compressor pressure coefficient" is used as a measure of surge potential. Decreasing motor speed increases the compressor pressure coefficient. The goal of the AFD control algorithm is to reduce speed enough to increase the pressure coefficient to the surge boundary.

### Compressor Pressure Coefficient

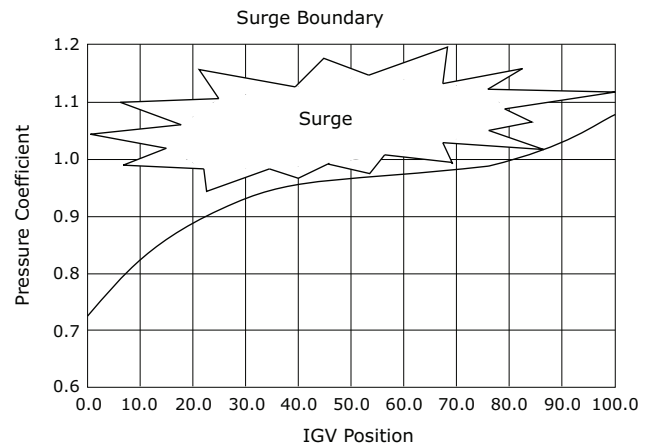
The non-dimensional pressure coefficient is derived based on turbo machinery principles. The kinetic energy can be reduced by reducing the condenser

pressure. To achieve condenser pressure reduction, reduce the temperature of the entering tower water. To obtain the best efficiency, follow a tower relief schedule at part loads.

### Surge Boundary

Surge boundary is a non-linear, empirically derived function of the compressor load. For the UC800, the compressor pressure coefficient boundary is defined as a function of inlet guide vane (IGV) position, as shown in the following figure.

**Figure 44. Pressure coefficient surge boundary**



### Adaptive Frequency Drive Speed Control

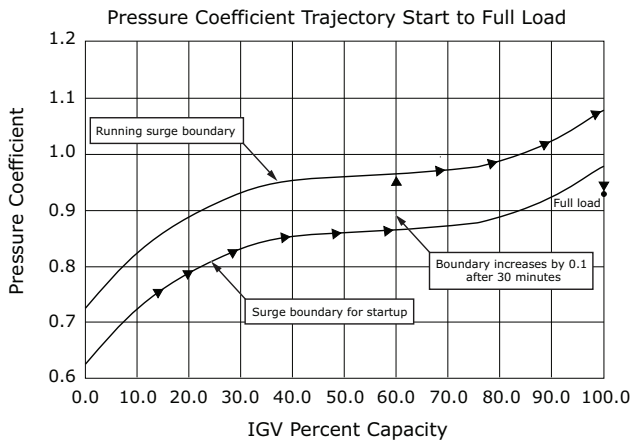
UC800 control utilizes an enhanced control method capable of simultaneously adjusting compressor speed and inlet guide vane position to achieve the desired chiller capacity and pressure coefficient.

### Startup

The starting speed for Adaptive Frequency™ drive (AFD) under UC800 control will vary depending upon the pressure ratio across the compressor. For most starts, the pressure ratio will be small and the AFD will start at its minimum speed. The speed will be adjusted every five seconds in response to changing pressure ratio and load requirements.

On startup, shell pressures and temperatures may not correspond to saturated conditions. To avoid potential surge on start, the boundary pressure coefficient will be reduced by 0.2 below the last running condition, and over 40 minutes adjusts itself towards the last running condition. This allows for the stabilization of pressures and water loop conditions. After reaching this condition the control will do a re-optimization.

**Figure 45. Startup surge boundary**



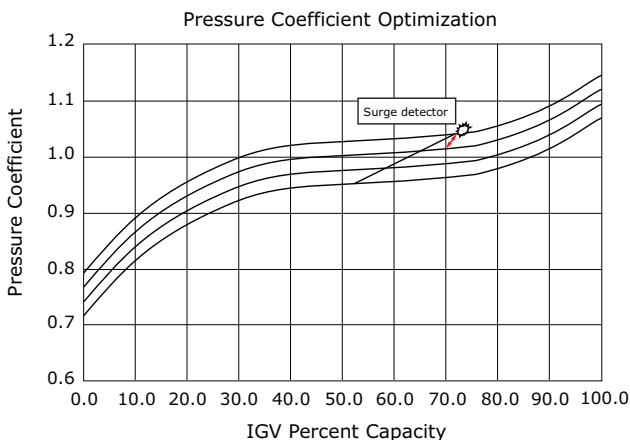
## Re-optimization

The AF Surge Boundary Offset Coefficient is a user-settable parameter to be used for adjusting the surge boundary either higher or lower. In addition to being user-settable, the surge control algorithm will periodically readjust this boundary. This re-optimization will occur when any of three different criteria are met:

1. After startup stabilization, the control will re-optimize unless the surge is detected in that time period.
2. Every 30 minutes, the control will compare the current inlet guide van (IGV) position with the IGV position at the end of the last re-optimization time and, if greater than the user adjustable sensitivity, will re-optimize.
3. When the re-optimization timer expires.

The control is re-optimized by increasing the AF Surge Boundary Offset Coefficient every minute until surge occurs. When surge occurs, the control will go into surge recovery until the surge flag is removed and all of the re-optimization timers will reset.

**Figure 46. Boundary re-optimization**



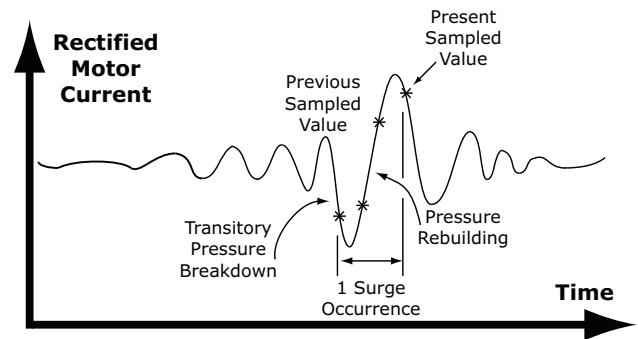
## Surge Recovery

When surge occurs, the pressures in the evaporator and condenser shells can become erratic. Surge recovery is needed to force conditions out of this unstable operating point. This is accomplished by reducing the pressure coefficient every 90 seconds of continuous surge. In addition, when the surge flag is set, the compressor speed command is increased by 60 rpm every five seconds until the surge condition clears. When the surge flag is removed, the speed command will relax back to the speed needed to raise the pressure coefficient to the new surge boundary.

## Surge Detection

Surge detection control logic monitors changes in compressor motor current. A surge occurrence leaves a characteristic motor current signature as shown in the following figure. This signature is formed because the transitory pressure breakdown between the condenser and evaporator causes a sudden reduction in compressor motor load. As the pressures equalize, the compressor begins to quickly load, increasing the motor current.

**Figure 47. Motor current signature representing surge**



## UC800 Interface to Adaptive Frequency Drive

At the start of the compressor motor, a signal corresponding to the starting frequency is sent to the drive.

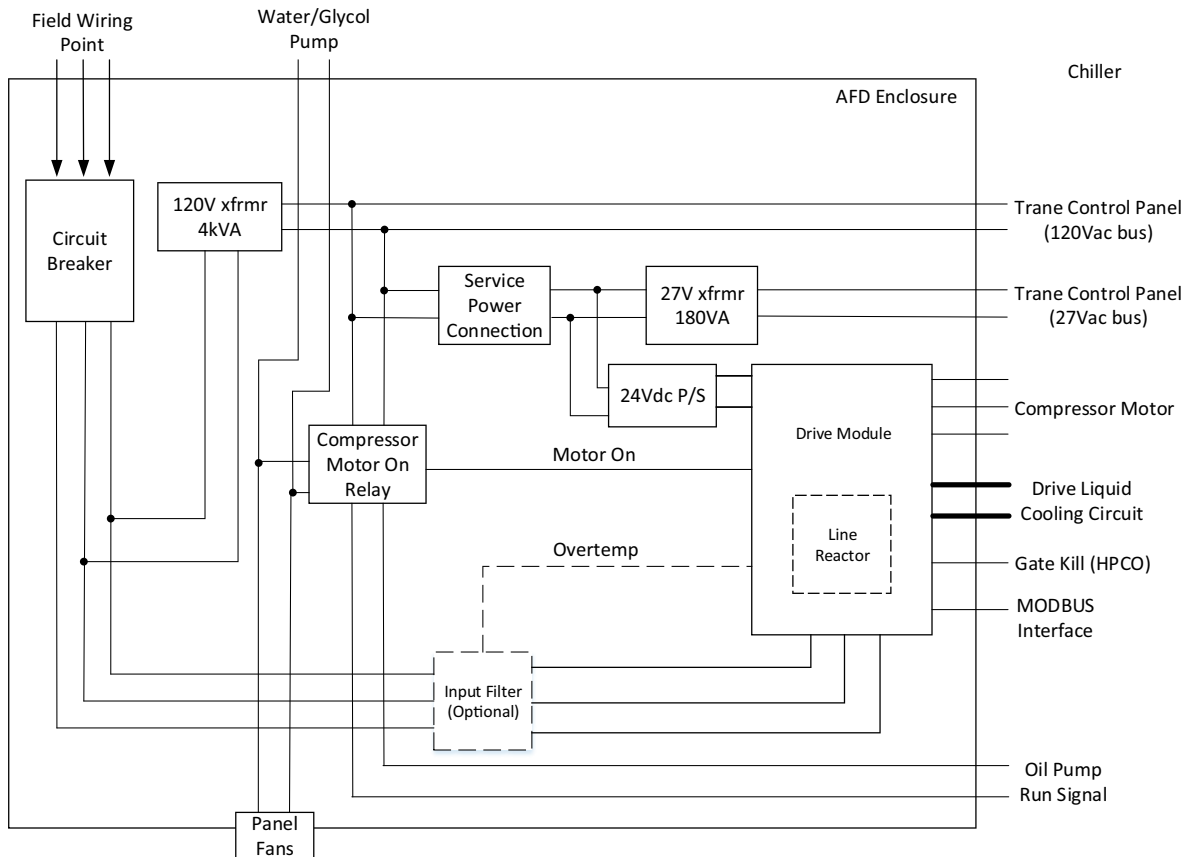
**High Pressure Cutout**—The inverter accepts a normally-closed (NC) HPC switch (at terminals 2X6-4 and 2X6-5). In the event of a chiller high pressure condition, the HPC switch opens, the drive shall shut down and de-energize the motor.

Output contacts are required to control the load of the refrigerant pump motor. The contacts are Normally Open, and closed when the Adaptive Frequency™ drive (AFD) energizes the motor.

**Note:** Unlike locked rotor amps associated with electromechanical starters, the phase currents are not expected to rise above RLA.

The following block diagram shows the communication of the UC800 to the AFD.

**Figure 48. UC800 to unit mounted inverter interface block diagram**



### AFD Cooling Circuit

The Adaptive Frequency™ drive (AFD) is cooled with an intermediate 50/50 propylene glycol mixture. This cooling loop transfers heat through a brazed plate heat exchanger to refrigerant. The refrigerant pump takes refrigerant from the chiller and pushes it upwards to the motor to provide motor cooling. The brazed plate heat exchanger line taps into this refrigerant flow and diverts a portion of the refrigerant to the heat exchanger.

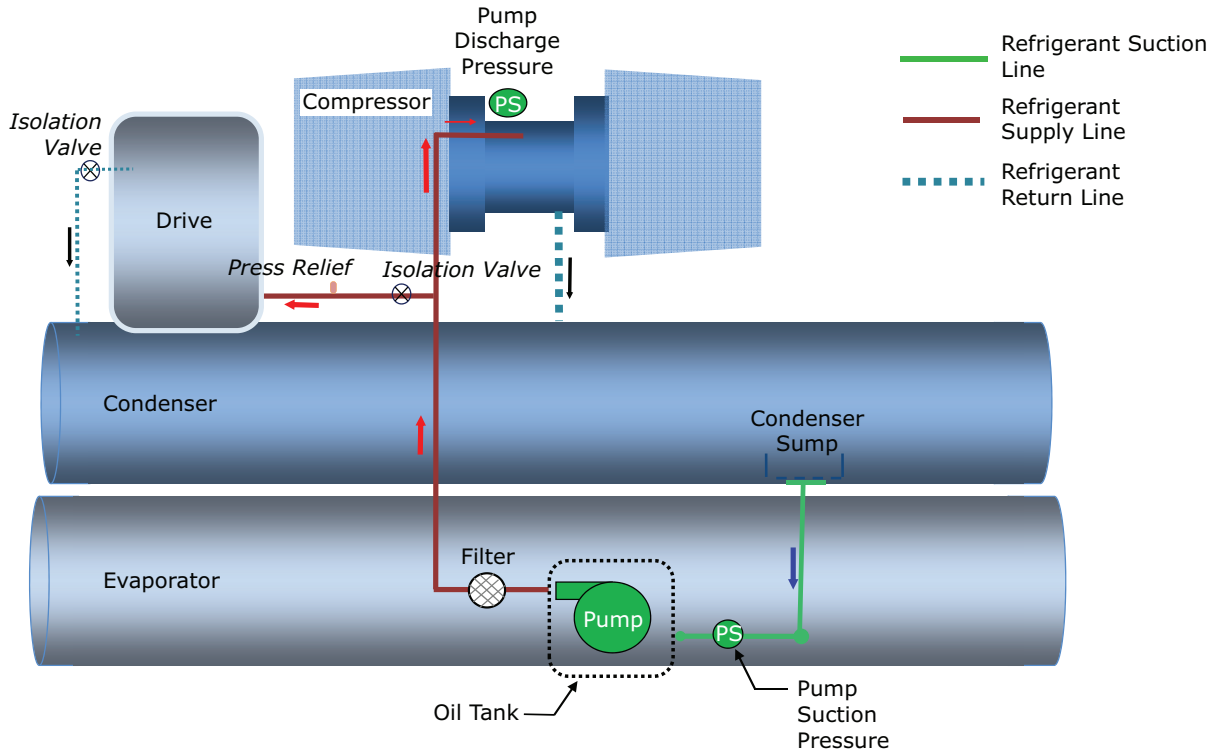
The refrigerant enters the brazed plate heat exchanger through a brazed connection (the heat exchanger is mounted to the side of the starter panel). Refrigerant removes heat from the glycol loop and exits the heat exchanger through a braze connection and flows to join the refrigerant return from the motor.

The differential pressure across the refrigerant pump is normally 10 to 15 psid (68.9 to 103.4 kPaD).

The glycol loop is a closed loop system consisting of a pump, strainer, expansion tank, AFD chill plate, and the braze plate heat exchanger. Glycol is circulated to the AFD chill plate (connection is made with SAE to hose bard fittings) removed heat from the AFD and discharges this heat through the brazed plate heat exchanger into refrigerant.

The temperature within the drive is monitored by the drive controls and is displayed on the chiller's Tracer® AdaptiView™ display. The UC800 shuts the chiller down if the displayed drive temperature exceeds 320°F (160.0°C).

**Figure 49. Schematic of the cooling circuit**





# Start-up and Shut-down

This section provides basic information on chiller operation for common events.

## Sequence of Operation

Adaptive control algorithms are used on CenTraVac™ chillers. This section illustrates common control sequences.

### Software Operation Overview Diagram

The following figure is a diagram of the five possible software states. This diagram can be thought of as a state chart, with the arrows and arrow text, depicting the transitions between states:

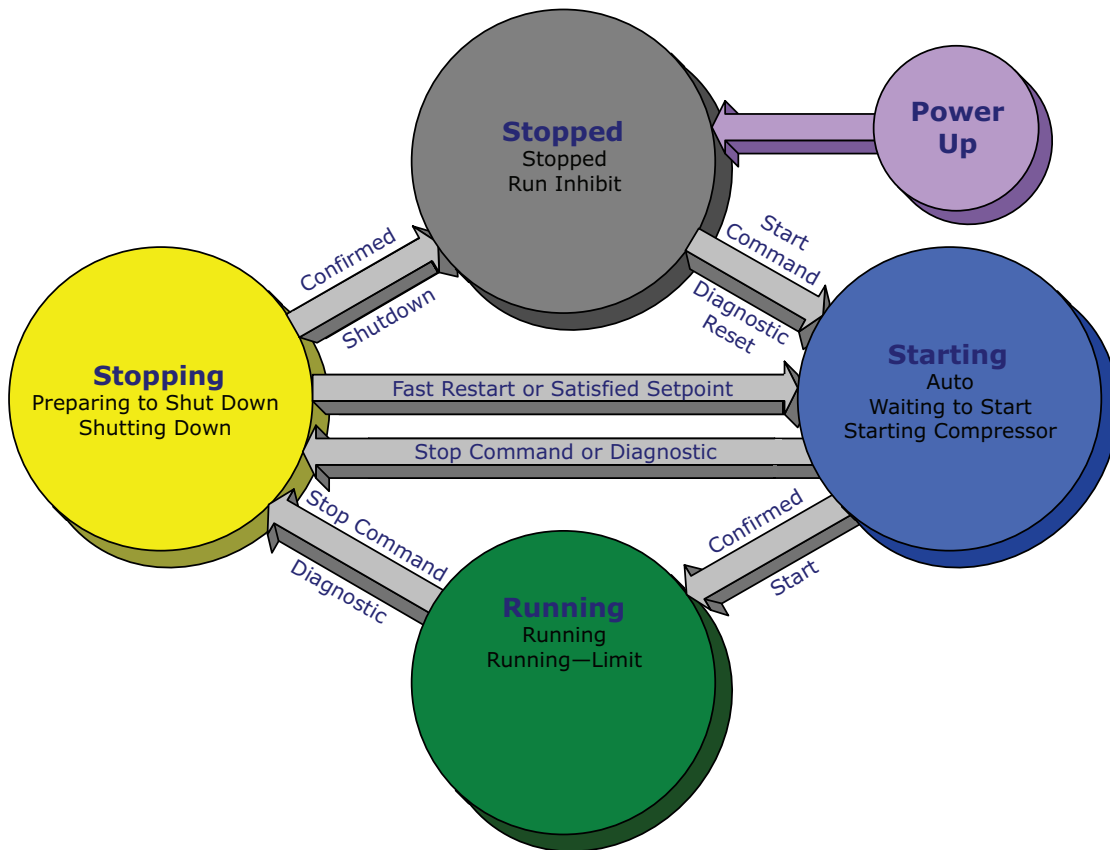
- The text in the circles is the internal software designations for each state.

- The first line of text in the circles is the visible top level operating modes that can be displayed in Tracer® AdaptiView™.
- The shading of each software state circle corresponds to the shading on the time lines that show the chiller's state.

There are five generic states that the software can be in:

- Power Up
- Stopped
- Starting
- Running
- Stopping

**Figure 50. Software operation overview**



In the following diagrams:

- The time line indicates the upper level operating mode, as it would be viewed in the Tracer® AdaptiView™.
- The shading color of the cylinder indicates the software state.

- Text in parentheses indicates sub-mode text as viewed in the Tracer® AdaptiView™.
- Text above the time line cylinder is used to illustrate inputs to the UC800. This may include user input to the Tracer® AdaptiView™ touch screen, control inputs from sensors, or control inputs from a generic BAS.

## Start-up and Shut-down

- Boxes indicate control actions such as turning on relays, or moving the inlet guide vanes.
- Smaller cylinders under the main cylinder indicate diagnostic checks.
- Text outside a box or cylinder indicates time-based functions.
- Solid double arrows indicate fixed timers.
- Dashed double arrows indicate variable timers.

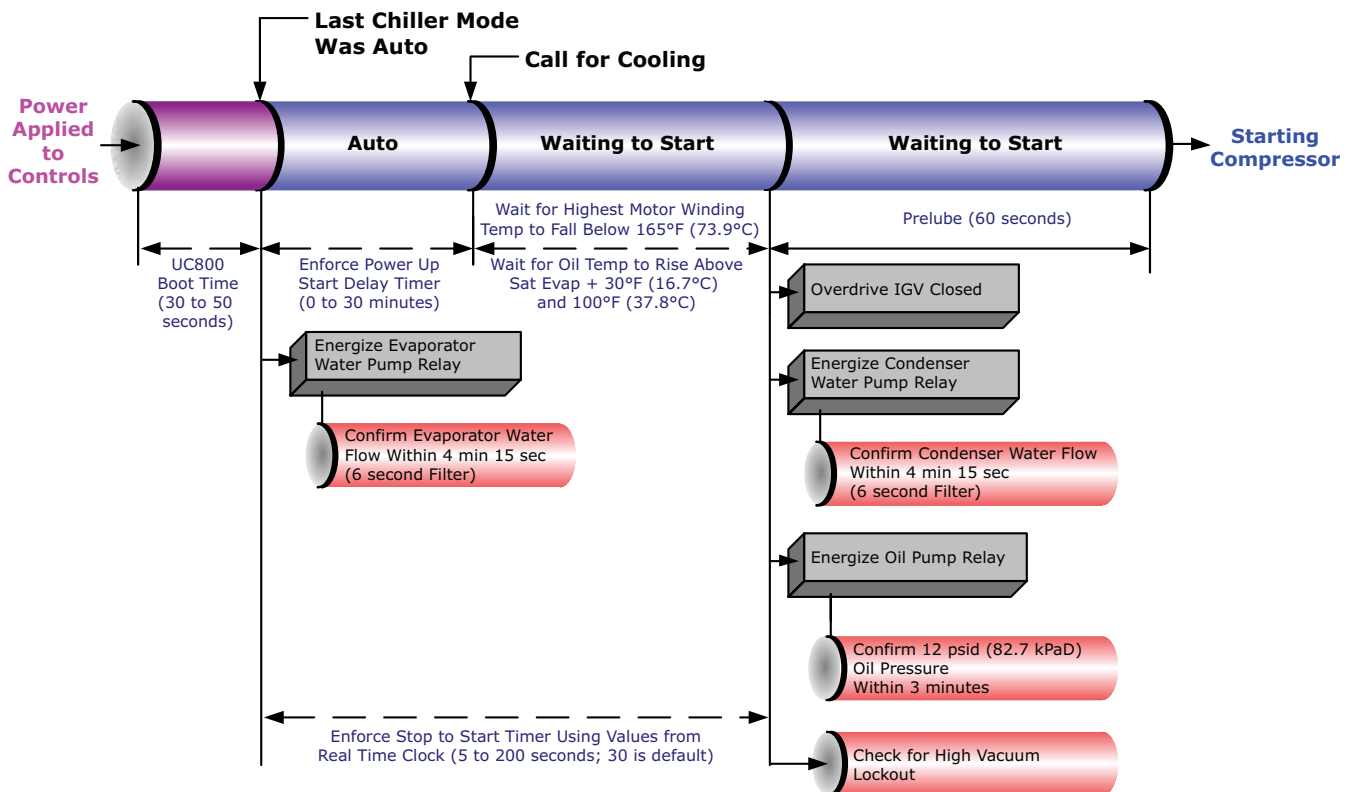
### Start-up Sequence of Operation

Logic circuits within the various modules will determine the starting, running, and stopping operation of the chiller. When operation of the chiller is required, the chiller mode is set at "Auto." Using

customer-supplied power, the chilled water pump relay is energized and chilled water flow must be verified within 4 minutes and 15 seconds. The UC800 decides to start the chiller based on the differential to start setpoint. With the differential to start criteria met, the UC800 then energizes condenser water pump relay with customer-supplied power (refer to the following figure).

Based on the Restart Inhibit function and the Differential to Start setpoint, the oil pump is energized. The oil pressure must be at least 12 psid (82.7 kPaD) for 60 continuous seconds and condenser water flow verified within 4 minutes and 15 seconds for the compressor start sequence to be initiated.

Figure 51. Sequence of operation: power up to starting



Now that the compressor motor is running, the inlet guide vanes and Adaptive Frequency™ Drive (AFD) will modulate to the chiller load variation to satisfy chilled water setpoint. The chiller continues to run in its appropriate mode of operation: Normal, Softload, Limit Mode, and so on (refer to the following figure [running]).

If the chilled water temperature drops below the chilled water setpoint by an amount set as the differential to stop setpoint, a normal chiller stop sequence is initiated as follows:

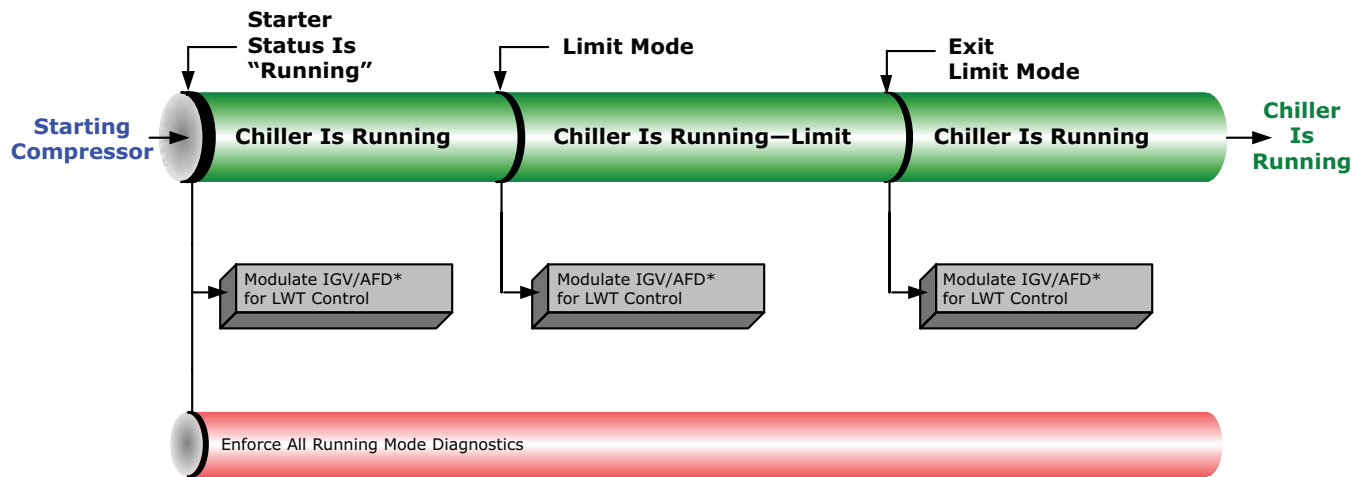
1. The inlet guide vanes are driven closed (up to

50 seconds).

2. After the inlet guide vanes are closed, the stop relay and the condenser water pump relays open to turn off. The oil pump motor will continue to run for 30 seconds post-lube while the compressor coasts to a stop. The chilled water pump will continue to run while the UC800 monitors leaving chilled water temperature, preparing for the next compressor motor start based on the differential to start setpoint.

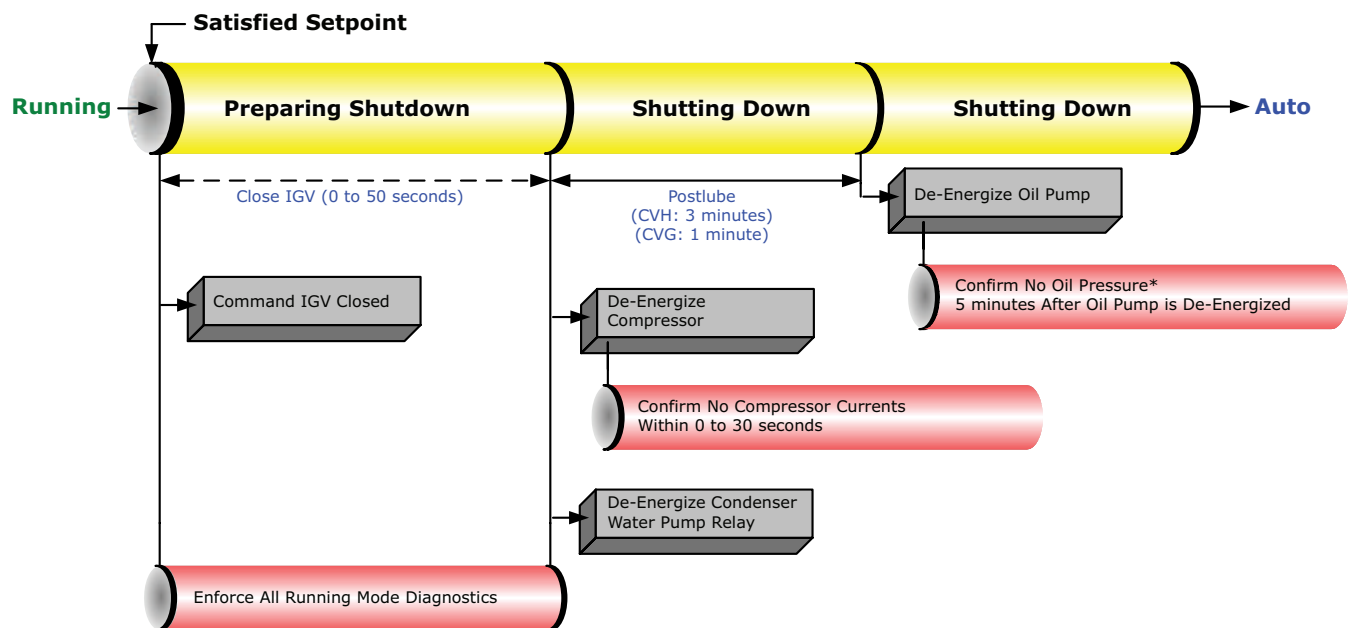
The following figure (satisfied setpoint) illustrates this sequence.

**Figure 52. Sequence of operation: running**



\*Note: AFD applies to CVH only.

**Figure 53. Sequence of operation: satisfied setpoint**



\*Note: CVH: No oil pressure is less than 3 psid (20.7 kPaD)  
 CVG: No oil pressure is opened Oil Differential Pressure Switch

If the STOP key is pressed on the operator interface, the chiller will follow the same stop sequence as described earlier except the chilled water pump will also open and stop the chilled water pump after the chilled water pump delay timer has timed out after compressor shut down (refer to the following figure [normal shut-down to stopped and run inhibit]).

If the immediate stop is initiated, a panic stop occurs which follows the same stop sequence as pressing the STOP key once, except the inlet guide vanes are not sequence-closed and the compressor motor is immediately turned off.

# Start-up and Shut-down

Figure 54. Sequence of operation: Fast restart within postlube

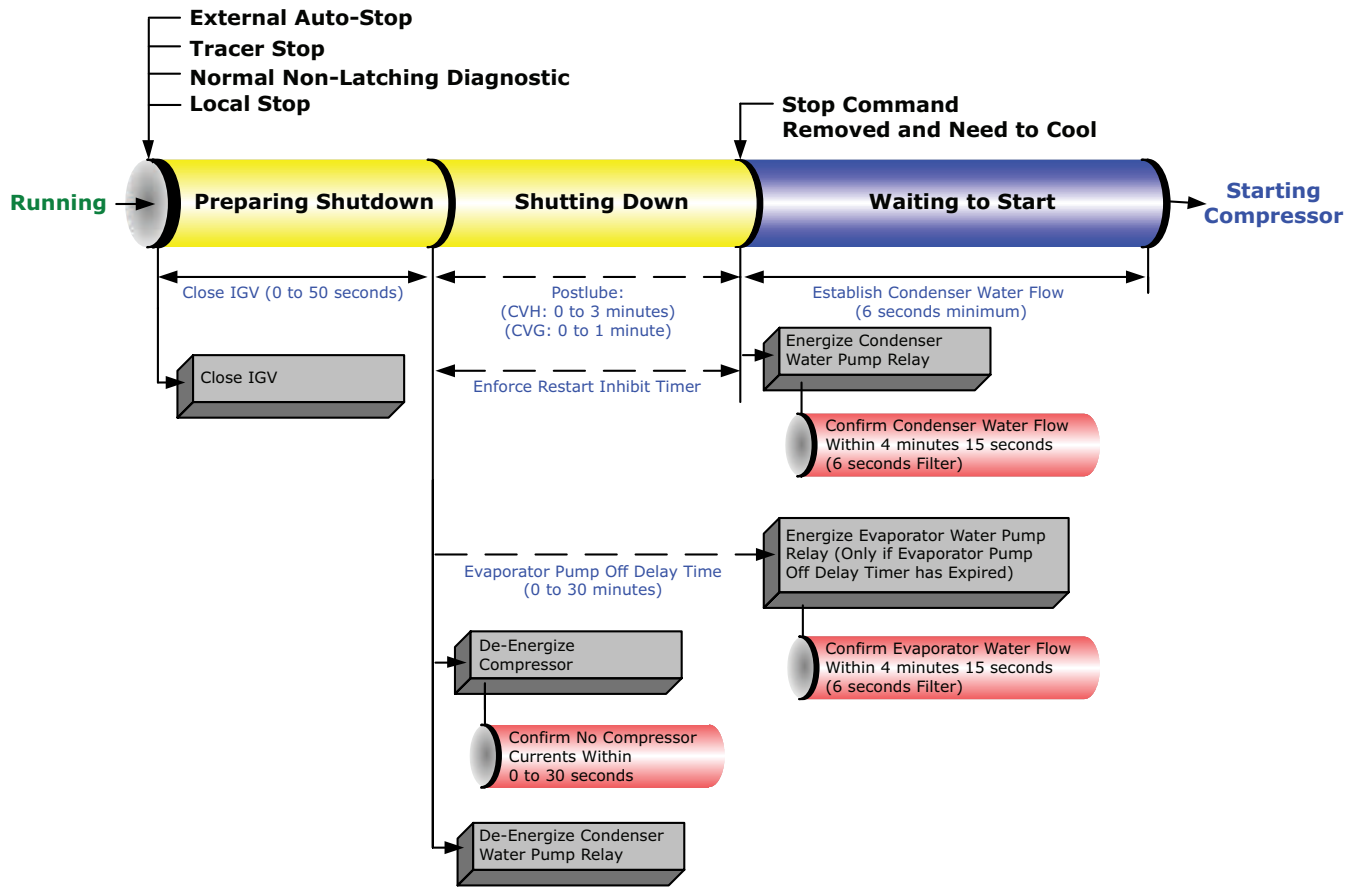
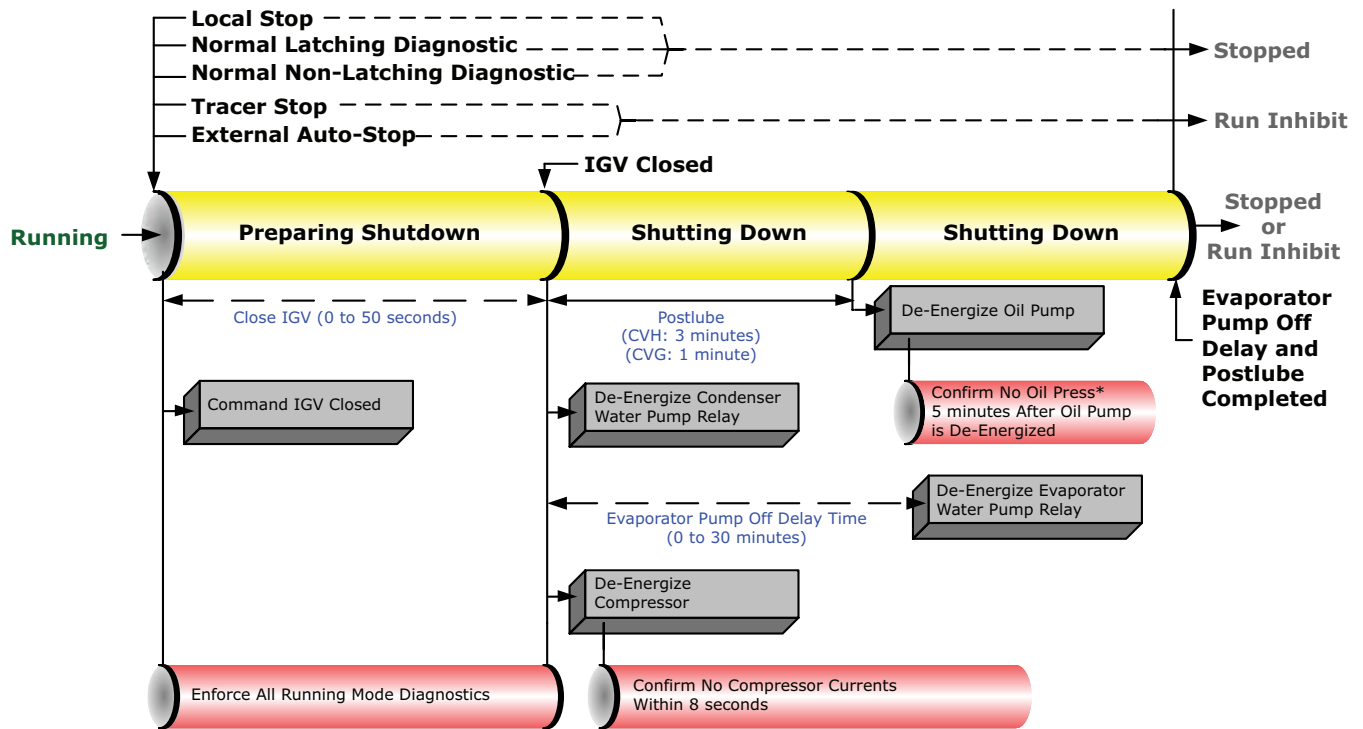


Figure 55. Sequence of operation: normal shut-down to stopped and run inhibit



\*Note: CVH: No oil pressure is less than 3 psid (20.7 kPaD)  
CVG: No oil pressure is opened Oil Differential Pressure Switch

## Power Up

"Software Operation Overview Diagram," p. 65 includes an illustration of Tracer® AdaptiView™ during a power up of the UC800. This process takes from 30 to 50 seconds depending on the number of installed options.

## Hot Water Control

Occasionally, CenTraVac™ chillers are selected to provide heating as a primary mission. With hot water temperature control, the chiller can be used as a heating source or cooling source. This feature provides greater application flexibility. In this case, the operator selects a hot water temperature and the chiller capacity is modulated to maintain the hot water setpoint. Heating is the primary mission and cooling is a waste product or is a secondary mission. This type of operation requires an endless source of evaporator load (heat), such as well or lake water. The chiller has only one condenser.

**Note:** Hot Water Temperature Control mode does NOT convert the chiller to a heat pump. Heat pump refers to the capability to change from a cooling-driven application to a heating-driven application by changing the refrigerant path on the chiller. This is impractical for centrifugal chillers as it would be much easier to switch over the water side.

This is NOT heat recovery. Although this feature could be used to recover heat in some form, a heat recovery unit has a second heat exchanger on the condenser side.

The Tracer® AdaptiView™ provides the Hot Water Temperature Control mode as standard. The leaving condenser water temperature is controlled to a hot water setpoint between 80°F and 140°F (26.7°C and 60.0°C). The leaving evaporator water temperature is left to drift to satisfy the heating load of the condenser. In this application, the evaporator is normally piped into a lake, well, or other source of constant temperature water for the purpose of extracting heat. In Hot Water Temperature Control mode, all the limit modes and diagnostics operate as in normal cooling with one exception: the leaving condenser water temperature sensor is an MMR diagnostic when in Hot Water Temperature Control mode. (It is an informational warning in the Normal Cooling mode.)

In the Hot Water Temperature Control mode, the differential-to-start and differential-to-stop setpoints are used with respect to the hot water setpoint instead of with the chilled water setpoint. The control panel provides a separate entry at the Tracer® AdaptiView™ to set the hot water setpoint; Tracer® AdaptiView™ is also able to set the hot water setpoint. In the Hot Water mode, the external chilled water setpoint is the external hot water setpoint; that is, a single analog input is shared at the 1A16-J2-5 to 6 (ground).



## Start-up and Shut-down

An external binary input to select external Hot Water Control mode is on the EXOP OPTIONAL module 1A18 terminals J2-3 to J2-4 (ground). Tracer® AdaptiView™ also has a binary input to select chilled water control or hot water temperature control. There is no additional leaving hot water temperature cutout; the HPC and condenser limit provide for high temperature and pressure protection.

In Hot Water Temperature Control, the softloading pulldown rate limit operates as a softloading pullup rate limit. The setpoint for setting the temperature rate limit is the same setpoint for normal cooling as it is for hot water temperature control. The hot water temperature control feature is not designed to run with ice-making.

The factory set PID tuning values for the leaving water temperature control are the same settings for both normal cooling and hot water temperature control.

## Control Panel Devices and Unit-Mounted Devices

### Unit Control Panel

Safety and operating controls are housed in the unit control panel, the starter panel, and the purge control panel. The control panel operator interface is called Tracer® AdaptiView™ and is located on an adjustable arm connected to the base of the control panel or alternate location. For more information about operating Tracer® AdaptiView™, refer to *Tracer AdaptiView Display for Water-cooled CenTraVac Chillers Operations Guide* (CTV-SVU01\*-EN).

The control panel houses several other controls modules called panel-mounted Low Level Intelligent Devices (LLIDs), power supply, terminal block, fuse, circuit breakers, and transformer. The inter-processor communication (IPC) bus allows the communications between LLIDs and the UC800. Unit-mounted devices are called frame-mounted LLIDs and can be temperature sensors or pressure transducers. These and other functional switches provide analog and binary inputs to the control system.

### User-defined Language Support

Tracer® AdaptiView™ is capable of displaying English text or any of 26 other languages (27 total languages). Switching languages is simply accomplished from a Language Settings menu. The following languages are available:

- Arabic (Gulf Regions)
- Chinese—China
- Chinese—Taiwan
- Czech
- Dutch
- English

- French
- French (Canada)
- German
- Greek
- Hebrew
- Hungarian
- Indonesian
- Italian
- Japanese
- Korean
- Norwegian
- Polish
- Portuguese (Portugal)
- Portuguese (Brazil)
- Russian
- Romanian
- Spanish (Europe)
- Spanish (Latin America)
- Swedish
- Thai
- Turkish

## Unit Start-up and Shut-down Procedures

### ⚠ WARNING

#### Live Electrical Components!

Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

When it is necessary to work with live electrical components, have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks.

## ⚠ WARNING

### Toxic Hazards!

A significant release of refrigerant into a confined space due to a rupture disk failure could displace available oxygen to breathe and cause possible asphyxiation. Failure to follow instructions below could result in death or serious injury.

Should a rupture disk fail, evacuate the area immediately and contact the appropriate rescue or response authority.

While the unit is off, do not allow the chiller to exceed 110°F (43.3°C) for models CDHF, CDHG, CVHE, CVHF, CVHG, CVHL, CVHM, and CVHS or above 130°F (54.4°C) for models CDHH and CVHH. Failure to prevent high chiller temperature will cause the inside pressure to rise:

- Do not run evaporator water pump longer than 30 minutes after the chiller is shut down.
- Ensure that the evaporator is isolated from the hot water loop before changeover to heating mode.

The rupture disk is designed to relieve and discharge the refrigerant from the unit if the pressure in the evaporator exceeds 15 psig (103.4 kPaG) for models CDHF, CDHG, CVHE, CVHF, CVHG, CVHL, CVHM, and CVHS or 50 psig (344.7 kPaG) for models CDHH and CVHH.

## Daily Unit Start-up

1. Verify the chilled water pump and condenser water pump starter are in ON or AUTO.
2. Verify the cooling tower is in ON or AUTO.
3. Check the oil tank oil level; the level must be visible in or above the lower sight glass. Also, check the oil tank temperature; normal oil tank temperature before start-up is 140°F to 145°F (60.0°C to 62.8°C).

**Note:** The oil heater is energized during the compressor off cycle. During unit operation, the oil tank heater may be de-energized.

4. Check the chilled water setpoint and readjust it, if necessary, in the Chiller Settings menu.
5. If necessary, readjust the current limit setpoint in the Chiller Setpoints menu.
6. Press AUTO.

The control panel also checks compressor motor winding temperature and a start is initiated after a minimum restart inhibit time if the winding temperature is less than 265°F (129.4°C). The chilled water pump relay is energized and evaporator water flow is proven. Next, the control panel checks the leaving evaporator water temperature and compares it to the chilled water setpoint. If the difference between these values is less than the start differential setpoint, cooling is not needed.

If the control panel determines that the difference

between the evaporator leaving water temperature and chilled water setpoint exceeds the start differential setpoint, the unit enters the initiate Start Mode and the oil pump and the condenser water pump are started. If flow is not initially established within 4 minutes 15 seconds of the condenser pump relay energization, an automatically resetting diagnostic "Condenser Water Flow Overdue" shall be generated, which terminates the prestart mode and de-energizes the condenser water pump relay. This diagnostic is automatically reset if flow is established at any later time.

**Note:** This diagnostic does NOT automatically reset if Tracer® AdaptiView™ is in control of the condenser pump through its condenser pump relay, since it is commanded off at the time of the diagnostic. It may reset and allow normal chiller operation if the pump was controlled from some external source.

When less than 5 seconds remain on the restart inhibit, the pre-start starter test is conducted on wye-delta starters. If the compressor motor starts and accelerates successfully, Running appears on the display. If the purge is set to AUTO, the purge will start running and will run as long as the chiller is running.

**Note:** If a manual reset diagnostic condition is detected during start-up, unit operation will be locked out and a manual reset is required before the start-up sequence can begin again. If the fault condition has not cleared, the control panel will not permit restart.

When the cooling requirement is satisfied, the control panel originates a Shutting down signal. The inlet guide vanes are driven closed for 50 seconds, the compressor stops, and the unit enters a 180-second post-lube period. The evaporator pump may continue to run for the amount of time set using Tracer® AdaptiView™.

After the post-lube cycle is done, the unit returns to auto mode.

## Seasonal Unit Start-up

1. Close all drain valves and reinstall the drain plugs in the evaporator and condenser headers.
2. Service the auxiliary equipment according to the start-up and maintenance instructions provided by the respective equipment manufacturers.
3. Fill and vent the cooling tower, if used, as well as the condenser and piping. At this point, all air must be removed from the system (including each pass). Then, close the vents in the condenser waterboxes.
4. Open all of the valves in the evaporator chilled water circuit.
5. If the evaporator was previously drained, fill and vent the evaporator and chilled water circuit. After all air is removed from the system (including each



## Start-up and Shut-down

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pass), close the vent valves in the evaporator waterboxes.

6. Lubricate the external vane control linkage as needed.
7. Check the adjustment and operation of each safety and operating control.
8. Close all disconnect switches.
9. Perform instructions listed in "Daily Unit Start-up," p. 71.

### Daily Unit Shut-down

**Note:** Also refer to the figure (satisfied setpoint) in "Start-up Sequence of Operation," p. 66.

1. Press STOP.
2. After compressor and water pumps shut down, the operator may turn Pump Contactors to OFF or open pump disconnects.

### Seasonal Unit Shut-down

**Important:** Control power disconnect switch must remain closed to allow oil sump heater operation. Failure to do this will allow refrigerant to condense in the oil pump.

1. Open all disconnect switches except the control power disconnect switch.
2. Drain the condenser piping and cooling tower, if used. Rinse with clean water.
3. Remove the drain and vent plugs from the condenser headers to drain the condenser. Air-dry bundle of residual water.
4. Once the unit is secured for the season, the maintenance procedures described in "Normal Operation," p. 73 (tables for recommended maintenance of standard and optional features) should be performed by qualified Trane service technicians.

**Note:** During extended shut-down periods, be sure to operate the purge unit for a two-hour period every two weeks. This will prevent the accumulation of air and non-condensables in the machine. To start the purge, change the purge mode to ON in the unit control "Settings Purge" menu. Remember to turn the purge mode to "Adaptive" after the two-hour run time.





# Recommended Maintenance

## ⚠ WARNING

### Hazardous Voltage w/Capacitors!

Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.

Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. For variable frequency drives or other energy storing components provided by Trane or others, refer to the appropriate manufacturer's literature for allowable waiting periods for discharge of capacitors. Verify with a CAT III or IV voltmeter rated per NFPA 70E that all capacitors have discharged.

For additional information regarding the safe discharge of capacitors, see *PROD-SVB06\*-EN*.

## NOTICE

### Check Purge Run-Time for Unit Hermetic Integrity!

Failure to follow instructions below could result in chiller damage.

If frequent purging is required, monitor purge pumpout rate, and identify and correct source of air or water leak as soon as possible to prevent moisture contamination caused by leakage.

## NOTICE

### Do Not Use Non-Compatible Parts or Materials!

Use of non-compatible parts or materials could result in equipment damage.

Only genuine Trane® replacement components with identical Trane part numbers should be used in Trane CenTraVac chillers. Trane assumes no responsibility for damages resulting from the use of non-compatible parts or materials.

This section describes the basic chiller preventive maintenance procedures, and recommends the intervals at which these procedures should be performed. Use of a periodic maintenance program is important to ensure the best possible performance and efficiency from a CenTraVac™ chiller.

Recommended purge maintenance procedures are detailed in *Operation and Maintenance Guide: Purge System with Tracer AdaptiView Control for Water-Cooled CenTraVac Chillers with R-514A Refrigerant* (PRGG-SVX001\*-EN).

## Record Keeping Forms

An important aspect of the chiller maintenance program is the regular completion of records. Refer to "Appendix A: Forms and Check Sheets," p. 88 for copies of the recommended forms. When filled out accurately by the machine operator, the completed logs can be reviewed to identify any developing trends in the chiller's operating conditions. For example, if the machine operator notices a gradual increase in condensing pressure during a month's time, she can systematically check and then correct the possible cause of this condition.

## Normal Operation

Table 12. Normal operation

Operating Characteristic	Normal Reading
Approximate Evaporator Pressure	6 to 9 psia (41.4 to 62.1 kPaA) / -9 to -6 psig (-62.1 to -41.4 kPaG)
Approximate Condenser Pressure <sup>(a)</sup> , <sup>(b)</sup>	17 to 27 psia (117.2 to 182.2 kPaA) / 2 to 12 psig (13.8 to 82.7 kPaG) (standard condenser)
Oil Sump Temperature Unit not running	140°F to 176°F (60.0°C to 80.0°C)
Oil Sump Temperature Unit running	95°F to 162°F (35.0°C to 72.2°C)
Oil Sump Differential Oil Pressure <sup>(c)</sup>	22 to 26 psid (151.7 to 179.3 kPaD)

<sup>(a)</sup> Condenser pressure is dependent on condenser water temperature, and should equal the saturation pressure of the refrigerant at a temperature above that of leaving condenser water at full load.

<sup>(b)</sup> Normal pressure readings for ASME condenser exceed 12 psig (82.7 kPaG).

Table 12. Normal operation (continued)

<sup>(c)</sup> Oil tank pressure: -9 to -6 psig (-62.1 to -41.4 kPaG). Discharge oil pressure: 7 to 15 psig (48.3 to 103.4 kPaG).

## NOTICE

### Equipment Damage!

Failure to remove the strain relief with the sensor could result in equipment damage.

Do NOT attempt to pull sensor bulb through the strain relief; always remove the entire strain relief with the sensor.



## Recommended Maintenance

**Table 13. Recommended maintenance**

Daily	Every 3 months	Every 6 months	Annually <sup>(a)</sup> , <sup>(b)</sup>
Check the chiller's evaporator and condenser pressures, oil tank pressure, differential oil pressure, and discharge oil pressure. Compare the readings with the values provided in the preceding table.			
Check the oil level in the chiller oil sump using the two sight glasses provided in the oil sump head. When the unit is operating, the oil level should be visible in the lower sight glass.			
Complete logs on a daily basis.			
	Clean all water strainers in the water piping system.		
		Lubricate vane operator tang O-rings.	
		Operate the tang operators manually and check for any abnormalities.	
		Lubricate the oil filter shutoff valve O-rings.	
		Drain contents of the rupture disk and purge discharge vent-line drip-leg into an evacuated waste container. Do this more often if the purge is operated excessively. Apply oil to any exposed metal parts to prevent rust.	
			Shut down the chiller once each year to check the items listed on the "Appendix D: CVHM CenTraVac™ Chiller Annual Inspection List," p. 93 (refer to "Appendix A: Forms and Check Sheets," p. 88).
			Perform the annual maintenance procedures referred to in <i>Operation and Maintenance Guide: Purge System with Tracer AdaptiView Control for Water-Cooled CenTraVac Chillers with R-514A Refrigerant</i> (PRGG-SVX001*-EN).
			Verify the accuracy of the evaporator refrigerant temperature sensor (4R10). If the sensor is exposed to temperature extremes outside its normal operating range (0°F to 90°F [-17.8°C to 32.2°C]), check its accuracy at six-month intervals.
			Inspect the condenser tubes for fouling; clean if necessary.
			Inspect and clean the ifm efector® flow detection sensors. Use Scotch-Brite® or other non-abrasive material to clean scale; do NOT use steel wool, which could cause the probe to rust.
			Submit a sample of the compressor oil to a Trane-qualified laboratory for comprehensive analysis.

- <sup>(a)</sup> Every three years, use a non-destructive tube test to inspect the condenser and evaporator tubes. It may be desirable to perform tube tests on these components at more frequent intervals depending upon chiller application. This is especially true of critical process equipment. Ask your Sales account manager for a copy of engineering bulletin (CTV-PRB024\*-EN) for clarification of the role of eddy current testing in chiller maintenance by providing information about eddy current technology and heat exchanger tubing.
- <sup>(b)</sup> Contact a qualified service organization to determine when to conduct a complete examination of the unit to discern the condition of the compressor and internal components. Check the following: chronic air leaks (which can cause acidic conditions in the compressor oil and result in premature bearing wear) and evaporator or condenser water tube leaks (water mixed with the compressor oil can result in bearing pitting, corrosion, or excessive wear).

**Table 14. Recommended maintenance of optional features**

Feature	Every 3 months	Every 6 months	Annually
Waterbox Coatings	Inspect waterbox coatings within the first 1–3 months to determine a required maintenance schedule for your job site. Refer to “Waterbox and Tubesheet Protective Coatings,” p. 78 for more information.		
Waterbox Anodes	Inspect waterbox anodes within the first 1–3 months to determine a required maintenance schedule for your job site. Refer to “Sacrificial Anodes,” p. 78 for more information.		
Gantries			Lubricate the gantries annually. Use ConocoPhillips MegaPlex® XD3 (gray in color), LPS® MultiPlex Multi-Purpose (blue in color), or equivalent.

## Recommended Compressor Oil Change

### NOTICE

#### Equipment Damage!

Mixing refrigerants or oils could result in equipment damage including bearing damage, introduction of acids into the chiller, or continuous purge pump-out in high-head/high ambient applications.

CenTraVac chillers are manufactured with different refrigerant/oil systems: 1) chillers using R-123 refrigerant and OIL00022 compressor oil, and 2) chillers using R-514A refrigerant and OIL00334/OIL00335 compressor oil.

**Verify proper refrigerant and oil for your chiller and do NOT mix refrigerants or oils!**

This *Installation, Operation, and Maintenance* manual applies to CenTraVac™ chillers with R-514A refrigerant and OIL00334/OIL00335 compressor oil.

**Important:** *Verify proper refrigerant and compressor oil for your chiller before proceeding!*

After the first six months of accumulated operation or after 1000 hours operation—whichever comes first—it is recommended to change the oil and filter. After this oil change, it is recommended to subscribe to the Trane annual oil analysis program rather than automatically change the oil as part of scheduled maintenance. Change the oil only if indicated by the oil analysis. Using an oil analysis program will reduce the chiller’s overall lifetime waste oil generation and minimize refrigerant emissions. The analysis determines system moisture content, acid level, and wear metal content of the oil, and can be used as a diagnostic tool. The oil analysis should be performed by a qualified laboratory that is experienced in refrigerant and oil chemistry and in the servicing of Trane® centrifugal chillers.

In conjunction with other diagnostics performed by a qualified service technician, oil analyses can provide valuable information on the performance of the chiller to help minimize operating and maintenance costs and

maximize its operating life. A valve is installed next to the oil filter for the purpose of obtaining oil samples.

#### Notes:

- Use only Trane compressor oil and verify proper refrigerant and compressor oil for your chiller before proceeding!
- A full compressor oil change is 9 gallons (34.1 L) of oil. Use OIL00334 (1 gallon [3.8 L] containers)/OIL00335 (5 gallon [18.9 L] containers) compressor oil.
- One spare compressor oil filter is provided with each new chiller. If not used earlier, use at first recommended compressor oil and filter change.
- This recommended compressor oil change is NOT covered by factory warranty.

## Purge System

The use of low-pressure refrigerant in CenTraVac™ chillers permits any section of the unit to be below atmospheric pressure, regardless of whether the unit is running. This creates an environment in which air or moisture could enter the unit. If these non-condensables are allowed to accumulate while the chiller is running, they become trapped in the condenser; this situation increases condensing pressure and compressor power requirements, and reduces the chiller’s efficiency and cooling capacity. Therefore, proper maintenance of the purge system is required.

The purge is designed to remove non-condensable gases and water from the refrigeration system. Purge operation, maintenance, and troubleshooting procedures are detailed in *Operation and Maintenance Guide: Purge System with Tracer AdaptiView Control for Water-Cooled CenTraVac Chillers with R-514A Refrigerant* (PRGG-SVX001\*-EN).



## Recommended Maintenance

### Leak Checking Based on Purge Pump Out Time

Use the following formula to calculate the annual refrigerant leakage rate based on the daily purge pump-out time and the unit refrigerant charge.

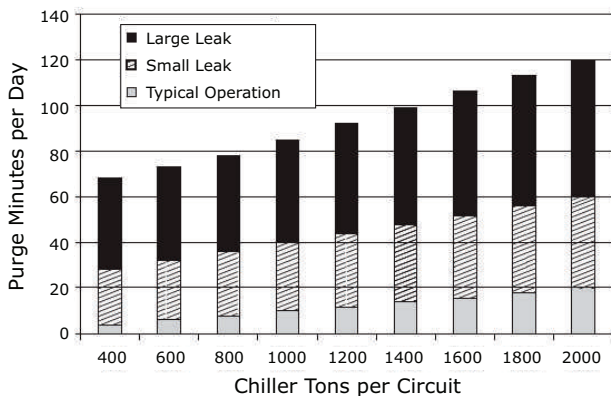
Formula: % annual leakage rate = [(X min/day) \* (0.0001 lb of refrigerant/min)/(Y lb)] \* 100

- X = minutes/day of purge pump out operation
- Y = initial refrigerant charge

The following figure has been developed to aid in determining when to do a leak check of a chiller based on the purge pump-out time and unit size. This figure depicts normal purge pump-out times, small leaks, and large leaks based on chiller tonnage.

If the purge pump-out time is in the small leak region, then a leak check should be performed and all leaks repaired at the earliest convenience. If the purge pump-out time is in the large leak region, a thorough leak check of the unit should be performed immediately to find and fix the leaks.

**Figure 56. Purge operation under typical and leak conditions**



### Long Term Unit Storage

Contact your local Trane Service Agency for recommendations for storage requirements for chillers to be removed from service in excess of a normal seasonal shut-down.

#### ⚠ WARNING

##### Refrigerant May Be Under Positive Pressure!

Failure to follow instructions below could result in an explosion which could result in death or serious injury or equipment damage.

System contains refrigerant and may be under positive pressure; system may also contain oil. Recover refrigerant to relieve pressure before opening the system. See unit nameplate for refrigerant type. Do not use non-approved refrigerants, refrigerant substitutes, or non-approved refrigerant additives.

#### NOTICE

##### Equipment Damage!

Failure to protect the unit from freezing could result in equipment damage.

If fluid has been added to the piping, the unit must be protected from freezing. Freeze damage from an unheated equipment room is not the Trane company's responsibility. These are indoor units.

#### NOTICE

##### Chiller Damage!

Failure to ensure that water is not present in tubes during evacuation could result in freezing tubes, damaging the chiller.

### Refrigerant Charge

#### ⚠ WARNING

##### Refrigerant May Be Under Positive Pressure!

Failure to follow instructions below could result in an explosion which could result in death or serious injury or equipment damage.

System contains refrigerant and may be under positive pressure; system may also contain oil. Recover refrigerant to relieve pressure before opening the system. See unit nameplate for refrigerant type. Do not use non-approved refrigerants, refrigerant substitutes, or non-approved refrigerant additives.

**NOTICE**

**Equipment Damage!**

Mixing refrigerants or oils could result in equipment damage including bearing damage, introduction of acids into the chiller, or continuous purge pump-out in high-head/high ambient applications.

CenTraVac chillers are manufactured with different refrigerant/oil systems: 1) chillers using R-123 refrigerant and OIL00022 compressor oil, and 2) chillers using R-514A refrigerant and OIL00334/OIL00335 compressor oil.

Verify proper refrigerant and oil for your chiller and do NOT mix refrigerants or oils!

This *Installation, Operation, and Maintenance* manual applies to CenTraVac™ chillers with R-514A refrigerant and OIL00334/OIL00335 compressor oil.

**Important:** Verify proper refrigerant and compressor oil for your chiller before proceeding!

Refer to *Installation, Operation, and Maintenance: R-514A Low-Pressure Refrigerant Handling Guidelines Conservation and Safe Handling of R-514A Refrigerant in Trane Chillers for Service Technicians* (CTV-SVX008\*-EN)

**Leak Testing**

**⚠ WARNING**

**Explosion Hazard!**

Failure to follow safe leak test procedures below could result in death or serious injury or equipment or property-only-damage. Never use an open flame to detect gas leaks. Use a leak test solution for leak testing.

**⚠ WARNING**

**Hazardous Pressures!**

Failure to follow instructions below could result in a violent explosion, which could result in death or serious injury. If a heat source is required to raise the tank pressure during removal of refrigerant from cylinders, use only warm water or heat blankets to raise the tank temperature. Do not exceed a temperature of 150°F. Do not under any circumstances apply direct flame to any portion of the cylinder.

**Important:** If leak testing is required, contact a Trane Service Agency.

**Recommended System Maintenance**

**NOTICE**

**Proper Water Treatment Required!**

The use of untreated or improperly treated water could result in scaling, erosion, corrosion, algae or slime.

Use the services of a qualified water treatment specialist to determine what water treatment, if any, is required. Trane assumes no responsibility for equipment failures which result from untreated or improperly treated water, or saline or brackish water.

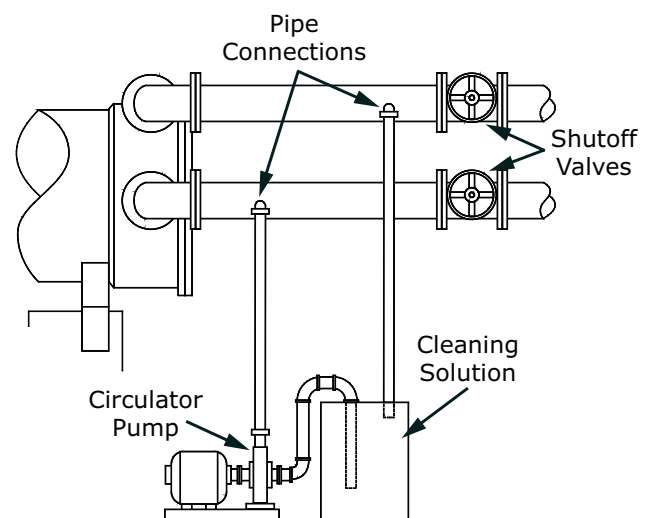
**Condenser**

Condenser tube fouling is indicated when the approach temperature (the difference between the condensing refrigerant temperature and the leaving condenser water temperature) is higher than predicted.

If the annual condenser tube inspection indicates that the tubes are fouled, two cleaning methods—mechanical and chemical—can be used to rid the tubes of contaminants. Use the mechanical cleaning method to remove sludge and loose material from smooth-bore tubes.

To clean other types of tubes including internally-enhanced types, consult a qualified service organization for recommendations.

**Figure 57. Typical chemical cleaning setup**



1. Follow all instructions in [“Waterbox Removal and Installation,” p. 81](#) to remove waterbox covers.
2. Work a round nylon or brass bristled brush (attached to a rod) in and out of each of the condenser water tubes to loosen the sludge.
3. Thoroughly flush the condenser water tubes with clean water.



## Recommended Maintenance

- Scale deposits are best removed by chemical means. Be sure to consult any qualified chemical house in the area (one familiar with the local water supply's chemical mineral content) for a recommended cleaning solution suitable for the job.

**Note:** A standard condenser water circuit is composed solely of copper, cast iron, and steel.

### NOTICE

#### Unit Corrosion Damage!

Failure to follow instructions below could result in corrosion damage to the unit and tubes.

Follow proper procedures when using corrosive chemicals to clean water side of unit. If unsure, it is recommended that the services of a qualified chemical cleaning firm be used.

**Important:** All of the materials used in the external circulation system, the quantity of the solution, the duration of the cleaning period, and any required safety precautions should be approved by the company furnishing the materials or performing the cleaning. Remember, however, that whenever the chemical tube cleaning method is used, it must be followed up with mechanical tube cleaning, flushing, and inspection.

## Evaporator

Since the evaporator is typically part of a closed circuit, it may not accumulate appreciable amounts of scale or sludge. Normally, cleaning every three years is sufficient. However, periodic inspection and cleaning is recommended on open evaporator systems, such as air washers.

## Waterbox and Tubesheet Protective Coatings

Trane recommends that coated waterboxes/tubesheets — regardless of the type of protective coating included — be taken out of service within the first one to three months of operation for inspection. Any voids or defects identified upon inspection must be repaired. If the water quality is known to be highly supportive of corrosion (i.e., sea water, etc.), inspect the coating system at one month; if the water quality is known to be relatively benign (i.e., normal treated and clean condenser water), inspect the coating system within three months. Only when initial inspections show no problems are present should subsequent maintenance intervals be increased.

## Sacrificial Anodes

The replacement schedule for the optional zinc or magnesium anodes can vary greatly with the

aggressiveness of the water that is in the system. Some sites could require anode replacement every two to three months while other sites may require anode replacement every two to three years. Trane recommends inspection of anodes for wear sometime within the first several months of the anodes being placed into service. If the observed loss of anode material is small, then the interval between subsequent inspections can be lengthened. Replace the anode and/or shorten the inspection interval if the anode has lost 50 percent or more of its original mass. If anode depletion occurs very quickly, consult a water treatment specialist to determine if the anode material selected is correct for the application.

### NOTICE

#### Equipment Damage!

Failure to follow instructions could result in equipment damage.

Do NOT use Teflon-based tape or paste on anode; a small amount of liquid sealant (Loctite® 242 or equivalent) may be applied to prevent leakage when installing an anode, but do not apply so much sealant that it prevents the necessary electrical connection between the anode and the waterbox.

As needed after draining the waterbox, use a 2-1/2 in. (63.5 mm) wrench to remove/install Trane-supplied waterbox anodes.

## Adaptive Frequency Drive

### Visual Inspection—Power Removed

### ⚠ WARNING

#### Hazardous Voltage w/Capacitors!

Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.

Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. For variable frequency drives or other energy storing components provided by Trane or others, refer to the appropriate manufacturer's literature for allowable waiting periods for discharge of capacitors. Verify with a CAT III or IV voltmeter rated per NFPA 70E that all capacitors have discharged.

For additional information regarding the safe discharge of capacitors, see PROD-SVB06\*-EN.

- Check the water/glycol coolant lines and SAE fitting connections to ensure they are tight and do not leak.

## Recommended Maintenance

2. Ensure the door interlocks are present and working.
3. Verify the safety ground connections to the door panels are securely connected.
4. Inspect power wire cables and devices to assure no abrasion is occurring from vibrations against chassis of cabinets, or other edges.
5. Ensure the drive interior and exterior is clear of any dust or debris. Fans, circuit boards, vents etc. must be clean. Only use a vacuum for cleaning. Do NOT use compressed air.
6. Inspect the interior of the drive for any signs of moisture entry or leakage.
7. Visually inspect all drive components and wiring. Look for signs of heat or failure (look for swelled or leaking capacitors, discolored reactors or inductors, broken pre-charge resistors, smoke, or arc trails on MOVs and capacitors, etc.).
8. Closely inspect the motor terminal board for any signs of leakage, arcing, etc.
9. Check ALL cable/lug/terminal connections inside the drive enclosure. Ensure all are clean and tight, and not rubbing against each other anywhere.
10. Re-seat all ribbon cable or control wire plugs to ensure all are snug and tight.

### Drive Cooling Fluid Service Intervals

#### NOTICE

##### Equipment Damage!

Failure to follow instructions could result in equipment damage.

Drive cooling fluid and strainer must be serviced every five (5) years.

- Every (5) years, contact your local Trane Service Agency to service the drive fluid and strainer.
- On a yearly basis, perform a fluid pH test.

### Operational Inspection—Power Applied

#### ⚠ WARNING

##### Live Electrical Components!

Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

When it is necessary to work with live electrical components, have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks.

1. Verify the drive cabinet cooling fans are operating. This should be done from outside the enclosure, by looking into the cabinet at door and cabinet vents, to avoid electrical hazards.

*Note: The power module fan comes on with power. Other fans cycle with drive operation.*

2. Check historic fault codes using Tracer® TU.
3. Check configuration settings and confirm all proper settings are still present in the controls.
4. Review the diagnostic history.
5. Create a *Chiller Service Report* to document all setpoints.
6. Check the UC800 alarm histories for any indications of operational problems.

### Routine Maintenance

The Adaptive Frequency™ Drive (AFD) requires minimal routine maintenance. A routine visual inspection every one to two years is adequate.

#### ⚠ WARNING

##### Hazardous Voltage w/Capacitors!

Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.

Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. For variable frequency drives or other energy storing components provided by Trane or others, refer to the appropriate manufacturer's literature for allowable waiting periods for discharge of capacitors. Verify with a CAT III or IV voltmeter rated per NFPA 70E that all capacitors have discharged.

*For additional information regarding the safe discharge of capacitors, see PROD-SVB06\*-EN.*

#### ⚠ WARNING

##### Hazardous Voltage w/Capacitors!

Failure to follow instructions below could result in death or serious injury.

Disconnect all electric power, including remote disconnects and wait for DC capacitors to discharge before servicing. Refer to the manufacturer's recommendations for proper discharge time as DC bus capacitors retain hazardous voltages after input power has been disconnected. Follow proper lockout/ tagout procedures to ensure the power cannot be inadvertently energized. Verify with a CAT III or IV voltmeter rated per NFPA 70E that all capacitors have discharged before touching any internal components.

*For additional information regarding the safe discharge of capacitors, see PROD-SVB06\*-EN.*

Perform a visual inspection including the following:



## Recommended Maintenance

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- Inspection for contamination
  - Remove any animals, nests, etc. If possible, seal openings through which entry was made.
  - Remove any excessive dust and debris which is on the power wiring, power components, or power terminals. Use a vacuum utilizing a soft bristle brush to remove dust and debris.
  - Remove excess dust and debris from PCBAs by using a low pressure air flow, such as a vacuum or low pressure forced air. Do NOT use compressed air from a nozzle—the exit velocity of the air can damage components. Do NOT put any device in direct contact with the PCBA surface or components.
  - Inspect for signs of moisture ingress. Seal appropriate openings if moisture appears to be encroaching upon electrical circuitry.
- Inspection for damage
  - Inspect PCBAs for damage such as overheated components or broken connections.
  - Inspect wires for signs of damage such as cracking, heat damage, and compromised insulation.
- Inspection for loose components
  - Remove foreign loose components.
  - Inspect torqued connections using a torque wrench only. Should any torque controlled electrical connection need to be tightened, do not exceed the value stated in the following table. Failure to do so may result in a broken connection.

**Table 15. Torque by connector type**

Connector Type	Torque		
	N·m	ft·lb	in·lb
M8 power terminals	11.3	8.3	100
M10	36.6	27.0	324





# Waterbox Removal and Installation

**Important:** Only qualified technicians should perform the installation and servicing of this equipment.

## Discussion

This section will discuss recommended hoist ring/clevises and lifting. Proper lifting technique will vary based on mechanical room layout.

- It is the responsibility of the person(s) performing the work to be properly trained in the safe practice of rigging, lifting, securing, and fastening of the waterbox.
- It is the responsibility of the person(s) providing and using the rigging and lifting devices to inspect these devices to ensure they are free from defect and are rated to meet or exceed the published weight of the waterbox.
- Always use rigging and lifting devices in accordance with the applicable instructions for such device.

## Procedure

### ⚠ WARNING

#### Heavy Objects!

Failure to properly lift waterbox could result in death or serious injury. Each of the individual cables (chains or slings) used to lift the waterbox must be capable of supporting the entire weight of the waterbox. The cables (chains or slings) must be rated for overhead lifting applications with an acceptable working load limit. Refer to the table for waterbox weights.

**Note:** Refer to "Torque Requirements and Waterbox Weights," p. 82 for waterbox weights.

### ⚠ WARNING

#### Straight Vertical Lift Required!

Failure to properly lift waterbox in straight vertical lift could cause the eyebolts to break which could result in death or serious injury from object dropping.

The proper use and ratings for eyebolts can be found in ANSI/ASME standard B18.15. Maximum load rating for eyebolts are based on a straight vertical lift in a gradually increasing manner. Angular lifts will significantly lower maximum loads and should be avoided whenever possible. Loads should always be applied to eyebolts in the plane of the eye, not at some angle to this plane.

Review mechanical room limitations and determine the

safest method or methods of rigging and lifting the waterboxes.

1. Determine the type and size of chiller being serviced. Refer to Trane® nameplate located on chiller control panel.

**Important:** This section contains rigging and lifting information only for Trane CenTraVac™ chillers built in La Crosse. For Trane CenTraVac™ chillers built outside the United States, refer to literature provided by the applicable manufacturing location.

2. Select the proper lift connection device from the table in "Connection Devices Information," p. 82. The rated lifting capacity of the selected lift connection device must meet or exceed the published weight of the waterbox. Verify the waterbox weight from the latest published literature.
3. Ensure that the lift connection device has the correct connection for the waterbox (e.g., thread type [course/fine, English/metric] and screw diameter [English/metric]).
4. Properly connect the lift connection device to the waterbox. Refer to the following figure and ensure that the lift connection device is securely fastened.
5. Disconnect water pipes, if connected.
6. Remove hex head bolts.
7. Lift the waterbox away from the shell.

### ⚠ WARNING

#### Overhead Hazard!

Failure to follow instructions could result in death or serious injuries.

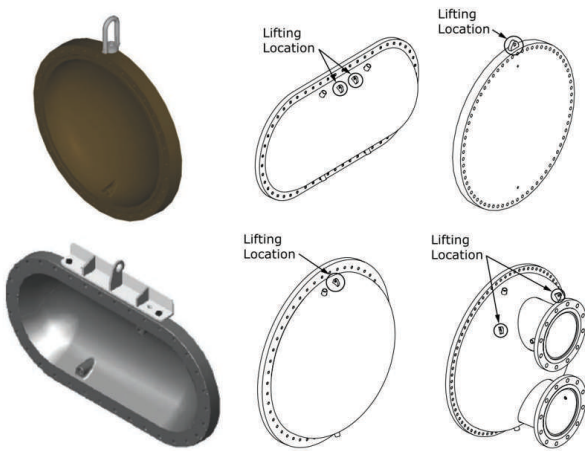
Never stand below or in close proximity to heavy objects while they are suspended from, or being lifted by, a lifting device in case the object drops.

8. Store waterbox in a safe and secure location and position.

**Note:** Do NOT leave waterbox suspended from lifting device.

## Waterbox Removal and Installation

**Figure 58. Waterbox rigging and lifting—condenser and evaporator connections**



### Reassembly

Once service is complete, the waterbox should be reinstalled on the shell following all previous procedures in reverse. Use new O-rings or gaskets on all joints after thoroughly cleaning each joint.

**Important:** Torque waterbox screws as specified in “Torque Requirements and Waterbox Weights,” p. 82.

### Torque Requirements and Waterbox Weights

**Note:** These chillers are assembled with SAE fasteners.

**Table 16. CenTraVac chiller screw torques – SAE**

Screw Size in	Torque – Gasket type O-ring		Torque – Flat	
	ft·lb	N·m	ft·lb	N·m
3/8	25	33.9	12–18	16.3–24.4
1/2	70	94.9	33–50	44.7–67.8
5/8	150	203.4	70–90	94.9–122.0
3/4	250	339.0	105–155	142.4–210.2

**Table 17. Waterbox weights**

Shell Size	Description	Fabricated Non-Marine Waterbox, Welded Flat Plate		Non-Marine Cast Waterbox		Fabricated Non-Marine Waterbox Welded Dome		Marine Style Waterbox Cover				
		Weight		Lifting Connection	Weight		Lifting Connection	Weight		Lifting Connection	Weight	
		lb	kg		lb	kg		lb	kg		lb	kg
	Evaporator, 150 psig (1034.2 kPaG)	—	—	397	180	Lifting Fixture	171	77	0.469	265	120	1/2 - 13
	Evaporator, 300 psig (2068.4 kPaG)	—	—	—	—	—	167	76	0.469	265	120	1/2 - 13
	Condenser, 150 psig (1034.2 kPaG)	—	—	265	120	1/2 - 13	210	95	0.469	265	120	1/2 - 13
	Condenser, 300 psig (2068.4 kPaG)	—	—	—	—	—	248	113	0.469	441	200	1/2 - 13

**Note:** Refer to product block identifier on the model number plate which identifies the evaporator and condenser shell sizes and the rated pressure. The designators are as follows:

Weights shown are maximum for waterbox size. Verify the waterbox from the latest published literature.

## Connection Devices Information

**Table 18. Connection devices**

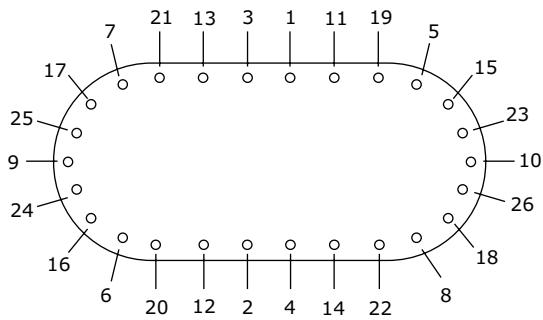
Unit	Product	Part Number	Order Information
CTV	Safety Hoist Ring 3/4-10	RNG01884	Contact Trane Parts Department
CTV	Safety Hoist Ring 1/2-13	RNG01885	Contact Trane Parts Department
CTV	Evap Lifting Fixture	BAR00400	Contact Trane Parts Department

## Screw-Tightening Sequence for Waterboxes

### Evaporator Waterbox Covers

Ensure that the waterbox head rests tightly against the tube sheet, and then snugly tighten the screws in sequential order as shown in the following figure. If excessive tube sheet crown prevents the head from contacting the tube sheet, tighten the screws located where the greatest gaps occur. Be sure to use an equal number of screw turns from side to side. Then, apply final torque to each screw in sequential order.

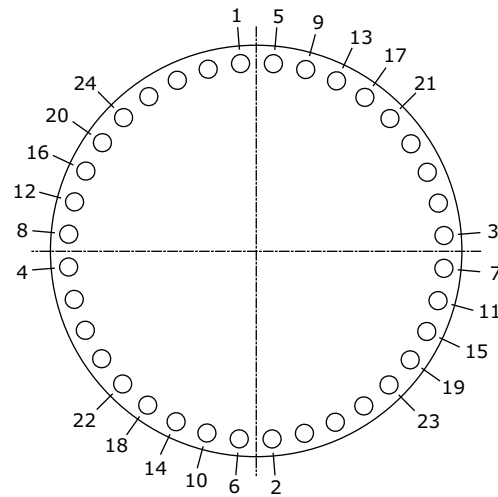
**Figure 59. Evaporator waterbox cover screw tightening sequence**



## Condenser Waterbox Covers

Condenser waterbox covers use a similar procedure to that which is used for the evaporator waterbox covers. Use a crossing pattern as shown in the following figure.

**Figure 60. Condenser waterbox cover screw tightening sequence**





# Adaptive Frequency Drive Removal and Installation

## Factory Warranty Information

Compliance with the following is required to preserve the factory warranty:

### *All Unit Installations*

Startup **MUST** be performed by Trane, or an authorized agent of Trane, to **VALIDATE** this WARRANTY.

Contractor must provide a two-week startup notification to Trane (or an agent of Trane specifically authorized to perform startup).

### *Additional Requirements for Units Requiring Disassembly and Reassembly*

When a new chiller is shipped and received from our Trane manufacturing location and, for any reason, it requires disassembly or partial disassembly, and reassembly— which could include but is not limited to the evaporator, condenser, control panel, compressor/ motor, economizer, purge, factory-mounted starter or any other components originally attached to the fully assembled unit— compliance with the following is required to preserve the factory warranty:

- Trane, or an agent of Trane specifically authorized to perform start-up and warranty of Trane® products, will perform or have direct on-site

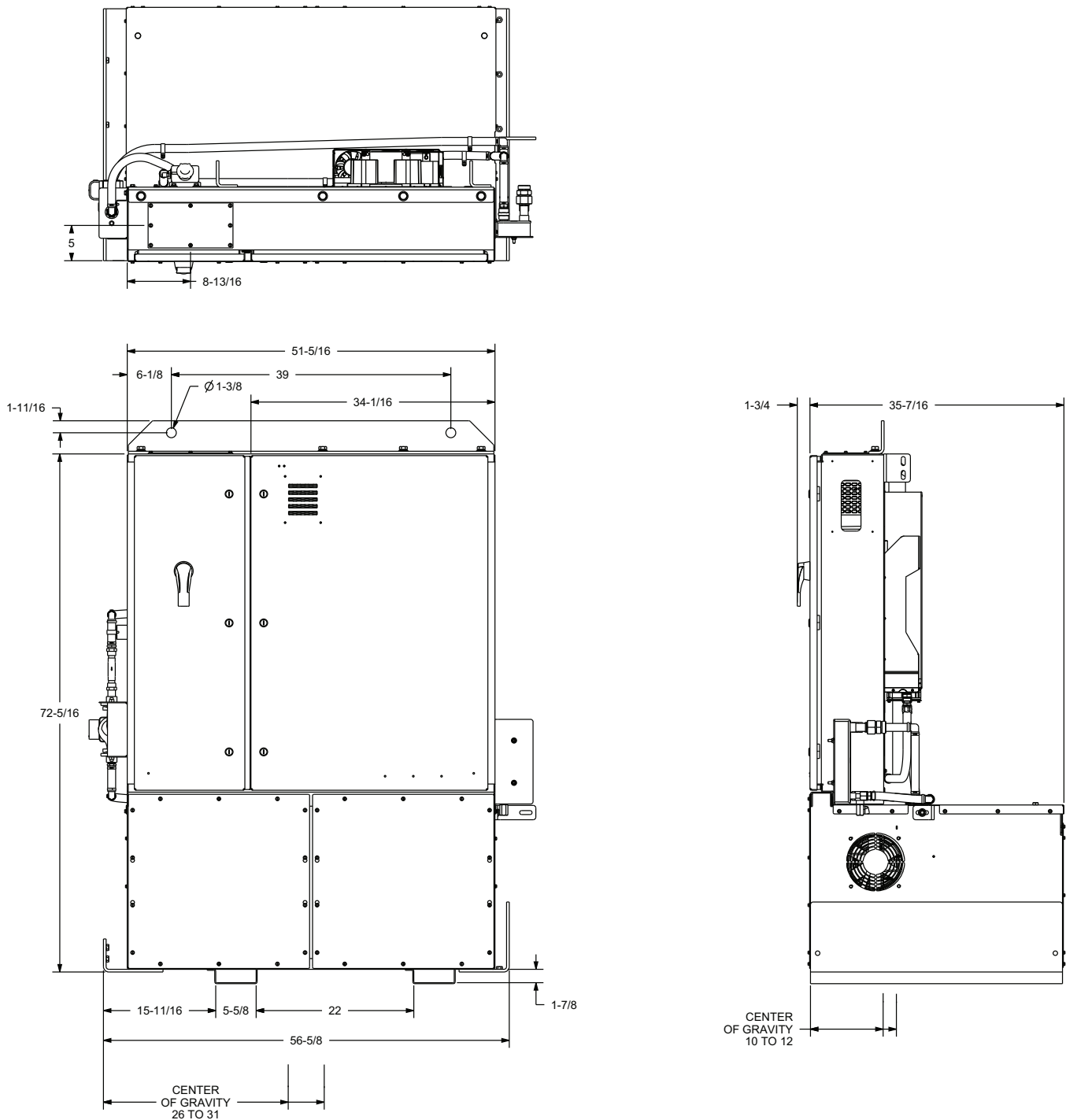
technical supervision of the disassembly and reassembly work.

- The installing contractor must notify Trane—or an agent of Trane specifically authorized to perform startup and warranty of Trane® products—two weeks in advance of the scheduled disassembly work to coordinate the disassembly and reassembly work.
- Start-up must be performed by Trane or an agent of Trane specifically authorized to perform startup and warranty of Trane® products.

Trane, or an agent of Trane specifically authorized to perform start-up and warranty of Trane® products, will provide qualified personnel and standard hand tools to perform the disassembly and reassembly work at a location specified by the contractor. The contractor shall provide the rigging equipment such as chain falls, gantries, cranes, forklifts, etc. necessary for the disassembly and reassembly work and the required qualified personnel to operate the necessary rigging equipment.

## Cabinet Dimensions

Figure 61.



## Cabinet Removal

If you need to temporarily remove the entire Adaptive Frequency™ drive (AFD) cabinet from the chiller to allow unit installation through restricted spaces or the AFD cabinet shipped disassembled from the chiller, use the following general information and instructions. The

maximum weight of the drive is 1900 lb (862 kg).

**Note:** For specific weights of the AFD cabinet, refer to submittal package.

### ⚠ WARNING

#### Heavy Object!

Failure to follow instructions below could result in unit dropping which could result in death or serious injury, and equipment or property-only damage.

Ensure that all the lifting equipment used is properly rated for the weight of the unit being lifted. Each of the cables (chains or slings), hooks, and shackles used to lift the unit must be capable of supporting the entire weight of the unit. Lifting cables (chains or slings) may not be of the same length. Adjust as necessary for even unit lift.

### ⚠ WARNING

#### Improper Unit Lift!

Failure to properly lift unit in a LEVEL position could result in unit dropping and possibly crushing operator/technician which could result in death or serious injury, and equipment or property-only damage.

Test lift unit approximately 24 inches (61 cm) to verify proper center of gravity lift point. To avoid dropping of unit, reposition lifting point if unit is not level.

1. Remove the AFD upper support bracket hex head screws at the wrap-around pipe side. There are two screws in each bracket.
2. Close the isolation valves for the refrigerant lines to the brze plate heat exchanger (both feed and return).

### ⚠ WARNING

#### Explosion Hazard and Deadly Gases!

Failure to follow all proper safe refrigerant handling practices could result in death or serious injury.

Never solder, braze or weld on refrigerant lines or any unit components that are above atmospheric pressure or where refrigerant may be present. Always remove refrigerant by following the guidelines established by the EPA Federal Clean Air Act or other state or local codes as appropriate. After refrigerant removal, use dry nitrogen to bring system back to atmospheric pressure before opening system for repairs. Mixtures of refrigerants and air under pressure may become combustible in the presence of an ignition source leading to an explosion. Excessive heat from soldering, brazing or welding with refrigerant vapors present can form highly toxic gases and extremely corrosive acids.

### ⚠ WARNING

#### Refrigerant May Be Under Positive Pressure!

Failure to follow instructions below could result in an explosion which could result in death or serious injury or equipment damage. System contains refrigerant and may be under positive pressure; system may also contain oil. Recover refrigerant to relieve pressure before opening the system. See unit nameplate for refrigerant type. Do not use non-approved refrigerants, refrigerant substitutes, or non-approved refrigerant additives.

*Important: Any unit pressure must be relieved before disconnecting refrigerant lines. The units ship from the factory with a 5 psi (34.5 kPa) dry nitrogen holding charge.*

3. Disconnect the refrigerant lines (SAE connections) closest to the braze plate heat exchanger (going into the out of the braze plate heat exchanger. Cap the refrigerant lines going into the BPHX as well as the refrigeration line going to the chiller to prevent debris from entering the system.
4. Mark and disconnect the motor power wires at the drive output terminals and inside motor junction box. There will be six power wires and two ground wires.

*Note: Always compare the wire connections to the as-built wiring diagrams to assure the schematics match the actual connections. Make notes as necessary to assure the wires are reconnected to the same locations.*

5. Remove wire tray covers and completely remove wires from wire tray. Disassemble and remove the wire tray by unscrewing the tray at the compressor junction box and then removing the screws from support bracket on the AFD cabinet.
6. Mark and disconnect the high pressure cutout switch wires at the terminal block and pull the cable out of the AFD cabinet.
7. Mark and disconnect the wires that run between the drive and the control panel at the drive and pull the conduit out of the AFD cabinet.
8. Mark and disconnect the drive communication cable wires at the terminal block and pull the cable out of the AFD cabinet.
9. Support the weight of the AFD cabinet with a fork truck or another suitable lifting device (minimum 1900 lb [862 kg] rated capacity).
10. Loosen and remove the hex head screws that secure the AFD cabinet to the lower mounting brackets. Unhook the right side at the L-bracket welded to the condenser (four screws total). Unhook the left side at the condenser support leg

## Adaptive Frequency Drive Removal and Installation

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(four screws and nuts total).

11. Carefully lift the AFD cabinet away from the chiller. Do NOT bump or jolt the AFD while lifting.

**Important:** *In cases where the unit is being installed through restricted spaces, the oil tank filter may need to be temporarily removed. Prior to removal of the filter, switch the regulator to the "change filter" setting. After the filter has been removed from the regulator block, the opening must be sealed to ensure no contaminants are allowed into the system. Due to the hygroscopic nature of the oil, install a new filter after the chiller has passed through the restricted space.*

Installation of the AFD cabinet is essentially the reverse of the removal procedure. All mounting screws should be torqued to ANSI standards based on the screw diameter. The motor power wires connecting to the drive output terminals should be torqued according to the label inside the AFD cabinet. Tighten the control wires that connect to the AFD terminal block between 7.1 and 8.9 in·lb (0.8 N·m to 1.0 N·m). The motor powers wires connecting to the motor terminals inside the compressor motor junction box shall be torqued between to 8.33 ft·lb (11.3 N·m). Torque the corresponding ground cables inside the compressor motor junction box to 38 ft·lb (51.5 N·m). Refer to the as-built wiring diagrams for connection locations.



## Appendix A: Forms and Check Sheets

The following forms and check sheets are included for use with Trane start-up of CVHM CenTraVac™ chillers. Forms and check sheets are used, as appropriate, for installation completion verification before Trane start-up is scheduled, and for reference during the Trane start-up.

Where the form or check sheet also exists outside of this publication as standalone literature, the literature order number is also listed.

- “Appendix B: CenTraVac™ Chiller Installation Completion and Request for Trane Service,” p. 89 (CTV-ADF001\*-EN)
- “Appendix C: CVHM CenTraVac™ Chiller Start-up Tasks to be Performed by Trane,” p. 91

- “Appendix D: CVHM CenTraVac™ Chiller Annual Inspection List,” p. 93
- “Appendix E: CVHM CenTraVac™ Chiller Operator Log,” p. 94

### Unit Start-up/Commissioning

**Important:** *Start-up must be performed by Trane or an agent of Trane specifically authorized to perform start-up and warranty of Trane® products. Contractor shall provide Trane (or an agent of Trane specifically authorized to perform start-up) with notice of the scheduled start-up at least two weeks prior to the scheduled start-up.*





# Appendix B: CenTraVac™ Chiller Installation Completion and Request for Trane Service

**Important:** A copy of this completed form must be submitted to the Trane Service Agency that will be responsible for the start-up of the chiller. Start-up will NOT proceed unless applicable items listed in this form have been satisfactorily completed.

TO: \_\_\_\_\_  
 TRANE SERVICE OFFICE: \_\_\_\_\_  
 S.O. NUMBER: \_\_\_\_\_  
 SERIAL NUMBERS: \_\_\_\_\_  
 JOB/PROJECT NAME: \_\_\_\_\_  
 ADDRESS: \_\_\_\_\_

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The following items are being installed and will be completed by:

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**Important:** Start-up must be performed by Trane or an agent of Trane specifically authorized to perform start-up and warranty of Trane® products. Contractor shall provide Trane (or an agent of Trane specifically authorized to perform start-up) with notice of the scheduled start-up at least two weeks prior to the scheduled start-up. **Equipment not started by Trane is not warranted by Trane.**

**Notes:** Improper installation of CenTraVac™ chillers, including optional components, can result in start-up delay and required rework. Follow all provided instructions and in use particular care with optional devices:

- Follow installation procedures for RuptureGuard™; refer to CTV-SVX06\*-EN for CDHF, CDHG, CVHE, CVHF, CVHG, CVHL, CVHM, and CVHS models, refer to CDHH-SVX001\*-EN for CDHH models, and refer to CVHH-SVX001\*-EN for CVHH CenTraVac™ chiller models.
  - Do NOT over-insert or over-torque the probe of the ifm efector™ flow detection controller and sensor; refer to PART-SVN223\*-EN or the CenTraVac™ chiller Installation, Operation, and Maintenance manual.
  - Do NOT block serviceable parts when installing isolation springs.
- Expenses that result in improper installation of CenTraVac™ chillers, including optional components, will NOT be paid by Trane.

Check box if the task is complete or if the answer is "yes".

## 1. CenTraVac™ Chiller

In place and piped.

**Note:** Do not insulate the CenTraVac™ chiller or adjacent piping prior to the chiller commissioning by Trane service personnel. The contractor is responsible for any foreign material left in the unit.

## 2. Piping

Chilled water piping connected to:

- CenTraVac™ chiller
- Air handling units
- Pumps
- Optional ifm efector® flow detection controller and sensor properly installed

Condenser and heat recovery condenser (as applicable) piping connected to:

- CenTraVac™ chiller
- Pumps
- Cooling tower
- Heating loop (as applicable)

Additional piping:

- Make-up water connected to cooling tower
- Water supply connected to filling system
- Systems filled
- Pumps run, air bled from system
- Strainers cleaned
- Rupture disk or RuptureGuard™ ventilation piping properly installed
- Optional RuptureGuard™ properly installed

## 3. Flow balancing valves installed

- Leaving chilled water
- Leaving condenser water
- Optional heat recovery or auxiliary condenser water

## 4. Gauges, thermometers, and air vents

- Installed on both sides of evaporator
- Installed on both sides of condenser and heat recovery condenser (as applicable)

## 5. Wiring

- Compressor motor starter has been furnished by Trane, or has been configured and installed in compliance with the appropriate Trane Engineering Specification for Starter by Others (available from your local Trane Sales Office)
- Full power available



## Appendix B: CenTraVac™ Chiller Installation Completion and Request for Trane Service

- Interconnecting wiring, starter to panel (as required)
- External interlocks (flow switch, pumps auxiliary, etc.)
- Chiller motor connection (remote starters)

**Note:** Do not make final remote starter-to compressor motor connections until requested to do so by the Trane service representative!

- Chilled water pump (connected and tested)
- Condenser water pump (connected and tested)
- Optional ifm efector® flow detection controller and sensor cable properly installed and secured for non-stress at probe connector
- Cooling tower fan rotation checked
- Heat recovery condenser water pump (as applicable)
- 115 Vac power available for service tools
- All controls installed and connected
- All magnetic starters installed and connected
- For CVHS and CVHM chillers, indicate type of power distribution grounding:
  - Solidly Grounded (Center Ground Wye)
  - or-
  - Non-Solidly Grounded (Any Delta, High Impedance Ground, or Ungrounded Wye)

### 6. Testing

- Dry nitrogen available for pressure testing (for disassembled units)
- Material and equipment available for leak testing (if necessary)

### 7. Refrigerant

- For CDHH and CVHH chillers: Verify supplied refrigerant is "Solstice ZD" Refrigeration Grade by checking certificates provided with tanks.
- Refrigerant on job site and in close proximity to chiller

Total amount in cylinders/drums: \_\_\_\_\_ (specify lb or kg) and fill in specifics below:

Number of cylinders/drums \_\_\_\_ of size \_\_\_\_ (specify lb or kg)

Number of cylinders/drums \_\_\_\_ of size \_\_\_\_ (specify lb or kg)

**Note:** After commissioning is complete, it is the installer's responsibility to transport empty refrigerant containers to an easily accessible point of loading to facilitate container return or recycling.

### 8. System

- Systems can be operated under load conditions.

### 9. Availability

- Electrical, control personnel, and contractor's representative are available to evacuate, charge, and test the CenTraVac™ chiller under serviceman's supervision.

### 10. Equipment room

- Does the equipment room have a refrigerant monitor/sensor capable of monitoring and alarming within the allowable exposure level of the refrigerant?
- Does the installation have properly placed and operating audible and visual refrigerant alarms?
- Does the equipment room have proper mechanical ventilation?
- If it is required by local code, is a self-contained breathing apparatus available?

### 11. Owner awareness

- Has the owner been fully instructed on the proper use and handling of refrigerant?
- Does the owner have a copy of the MSDS for refrigerant?

**Note:** Additional time required to properly complete the start-up and commissioning, due to any incompleteness of the installation, will be invoiced at prevailing rates.

This is to certify that the Trane equipment has been properly and completely installed, and that the applicable items listed above have been satisfactorily completed.

**Checklist Completed by**  
**(Print Name):** \_\_\_\_\_

**SIGNATURE:** \_\_\_\_\_

**DATE:** \_\_\_\_\_

In accordance with your quotation and our purchase order number \_\_\_\_\_, we therefore require the presence of Trane service on this site, for the purpose of start-up and commissioning, by \_\_\_\_\_ (date).

**Note:** Minimum of two week advance notification is required to allow for scheduling of the chiller start-up.

ADDITIONAL COMMENTS/INSTRUCTIONS



# Appendix C: CVHM CenTraVac™ Chiller Start-up Tasks to be Performed by Trane

## ⚠ WARNING

### Safety Alert!

Failure to follow instructions below could result in death or serious injury.

In addition to the following tasks, you **MUST**:

- Follow all instructions in the unit's *Installation, Operation, and Maintenance* manual, including warnings, cautions, and notices.
- Perform all required tasks in any applicable Service Alerts and Service Bulletins.
- Review and understand all information provided in Submittals and Design Specifications.

### 1. General

- Inspect chiller for damage (shipping or rigging).
- Verify and record unit nitrogen holding charge pressure.
- Inspect water piping for proper installation.
  - Inspect strainers, flow sensing devices, isolation valves, pressure gauges, thermometer wells, flow balancing valves, vent cocks, and drains.
  - Inspect cooling tower piping.
- Verify proper clearances.
- Power wiring meets size requirement.
  - Verify proper voltage and amperage rating.
- Verify proper foundation installation.
- Verify unit isolator pads/springs have been installed.
- Verify low voltage circuits are isolated from high voltage circuits.
- Check equipment room for ventilation, refrigerant monitor, rupture disk piping, and Personal Protective Equipment (PPE).

**Note:** All conditions which do not conform to the established requirements for unit installation **MUST** be corrected prior to start-up. Any non-conforming condition which is not corrected prior to start-up must be noted in the Non-Compliance Form (PROD-ADF001\*-EN) by the start-up technician; this information must also be signed by responsible site personnel before start-up and the completed Non-Compliance Form will become part of the start-up record, submitted with a Start-up Check Sheet and a Chiller Service Report.

### 2. Pre-Start Operations

- Verify nitrogen holding charge.
- Calibrate the high pressure cutout control (HPC).
- Confirm proper oil pump operation.
- Evacuate unit.
- Check condenser installation.
- Check evaporator installation.

## NOTICE

### Do Not Apply Electrical Power to a Unit in a Vacuum!

Failure to follow instructions below could result in motor and compressor damage. Do not apply electrical power to a motor in a vacuum.

- Check electrical and controls.
  - Inspect Adaptive Frequency™ drive (AFD) and control panel.
  - Confirm all wiring connections are tight, free of abrasion and have no sharp bends in panel and on compressors.
  - Inspect contactors and relays.
  - Verify unit wiring (low and high voltage) is correctly isolated, phased, and properly grounded.
  - Connect external 120 Vac power to power up the control panel.
  - Run the oil pump to verify pump can provide 22 to 26 psid (151.7 to 179.3 kPaD) net pressure.
  - Verify and record control parameters.
  - Verify all control interlocks are installed and properly functioning.
  - Set AFD grounding jumpers (PE-A for MOV



## Appendix C: CVHM CenTraVac™ Chiller Start-up Tasks to be Performed by Trane

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and PEB for Common Mode) for power distribution grounding:

- Both jumpers “Connected” for Solidly Grounded System (Center Ground Wye).
- Both jumpers “Disconnected” for Non Solidly Grounded System (Any Delta, High Impedance Ground, or Ungrounded Wye).

**Note:** Refer to AFD-SVG002\*-EN for more information.

- Measure condenser pressures and flow.
- Adjust condenser flow sensing device.
- Measure evaporator pressures and flow.
- Adjust evaporator flow sensing device.
- Inspect AFD panel and perform AFD panel checkout procedures.
- Confirm proper phase check incoming power.
- Inspect control panel.
- Confirm oil pump pressure—regulating valve setting.
- Verify vane operator is working properly and moves without binding.
- Remove separate source power and reconnect wiring.

### 3. Preparation for Start-up

- Relieve nitrogen holding charge.
- Evacuate and charge the system.
- Verify eductor valves have been set to 1/2-turn open from the closed position.

- Apply power to the AFD panel.
- Verify current to the oil sump heater.

### 4. Chiller Start-up

- Set Purge mode to “On.”
- Start the compressor and verify compressor motor operation.
- Verify no unusual noises or vibrations and observe operating conditions.
- If necessary, adjust oil pressure regulator between 22 to 26 psid (151.7 to 179.3 kPaD) net.
- When chiller is stable, take system log three times at 15-minute intervals.
- Set Purge mode to “Adaptive.”
- Reset the “Starter Energy Consumption” resettable.
- Record a *Chiller Service Report*.
- Review “AdaptiView Display Customer Training Checklist.”
  - Equipment Description
  - Stopping/Starting Chiller Operation
  - Alarms
  - Reports
  - Data Graphs
  - Equipment Settings
  - Display Settings
  - Security Settings
  - Basic Troubleshooting



# Appendix D: CVHM CenTraVac™ Chiller Annual Inspection List

Follow the annual maintenance instructions provided in the text of this manual, including but not limited to:

## 1. Compressor/Motor

- Check motor terminals.
- Inspect motor terminal board.
- Check inlet guide vanes (IGV) for abnormalities.

## 2. Adaptive Frequency™ Drive

- Inspect contacts.
- Check all connections per manufacturer specifications.
- Follow all manufacturer recommendations for Adaptive Frequency™ Drive (AFD) maintenance.
- Record all applicable AFD settings.

## 3. Oil System

- Annual oil analysis (follow recommendations).
- Clean and lubricate oil system as required.
- Electrical inspection.
- Pump motor continuity check.
- Run oil pump and check differential oil pressure.

## 4. Condenser

- Inspect for fouling and scaling in tubes.
- Check operation of condenser water flow sensing device.
- Factory recommendation to eddy current test tubes every three years.

## 5. Evaporator

- Inspect for fouling and scaling in tubes.
- Check operation of evaporator water flow sensing device.
- Factory recommendation to eddy current test tubes every three years.

## 6. Control Circuits

- Verify control parameters.
- Test appropriate sensors for accuracy.
- Ensure sensors are properly seated in wells with

thermopaste installed.

- Check evaporator leaving water temperature low temperature cutout setpoint.
- Condenser high pressure switch check-out.
- Check adjustment and operation of the inlet guide vane actuator.

## 7. Leak Test Chiller

- Check purge times and unit performance logs. If warranted, pressure leak test.
- Review oil analysis. If required, submit refrigerant sample for analysis.
- Inspect unit for any signs of refrigerant or oil leakage.
- Check unit for any loose screws on flange, volutes, or casing.

## 8. Purge Unit

- Review the purge *Installation, Operation, and Maintenance* manual and follow maintenance and/or inspection items identified.
- Review purge pump-out data.
- Review overall operation of purge and service as necessary.

## 9. Exterior

- Inlet guide vane linkage.
- Clean and touch-up painted surfaces as needed.
- Repair deteriorated, torn, or missing insulation.

## 10. Optional Accessories

- If applicable, lubricate factory-installed gantries.
- After the first month of operation, inspect Heresite® or Belzona® coated waterboxes; thereafter, inspect as needed.
- Inspect anodes.
- Inspect and lubricate hinged waterboxes.
- With water flow sensing option, bleed tubing from waterboxes to transformers.



# Appendix E: CVHM CenTraVac™ Chiller Operator Log

<b>Water-Cooled CVHM CenTraVac™ Chillers with UC800 Controller</b>			
<b>Tracer® AdaptiView™ Reports—Log Sheet</b>	<b>Log 1</b>	<b>Log 2</b>	<b>Log 3</b>
<b>Evaporator</b>			
Evaporator Entering Water Temperature			
Evaporator Leaving Water Temperature			
Evaporator Saturated Refrigerant Temperature			
Evaporator Refrigerant Pressure			
Evaporator Approach Temperature			
Evaporator Water Flow Status			
<b>Condenser</b>			
Condenser Entering Water Temperature			
Condenser Leaving Water Temperature			
Condenser Saturated Refrigerant Temperature			
Condenser Refrigerant Pressure			
Condenser Approach Temperature			
Condenser Water Flow Status			
<b>Compressor</b>			
Compressor Starts			
Compressor Running Time			
Oil Tank Press			
Oil Discharge Press			
Oil Diff Press			
Oil Tank Temp			
IGV1 Position			
IGV1 Position Steps			
IGV2 Position			
IGV2 Position Steps			
<b>Motor</b>			
Average Motor Current % RLA			
AFD Motor Current U, V, W %RLA			
AFD Motor Current U, V, W			
Starter Input Power Consumption			
Starter Power Demand			
Motor Winding Temperature # 1			
Motor Winding Temperature # 2			
Motor Frequency			
Speed Command			
Motor Speed			
AFD Transistor Temperature			
<b>Purge</b>			
Time Until Next Purge Run			
Daily Pumpout—24 hrs			
Average Daily Pumpout—7 days			
Daily Pumpout Limit			
Chiller On—7 days			
Pumpout Chiller On—7 days			
Pumpout Chiller Off—7 days			
Pumpout—Life			



## Appendix E: CVHM CenTraVac™ Chiller Operator Log

<b>Water-Cooled CVHM CenTraVac™ Chillers with UC800 Controller</b>			
<b>Tracer® AdaptiView™ Reports—Log Sheet</b>	<b>Log 1</b>	<b>Log 2</b>	<b>Log 3</b>
Purge Refrigerant Compressor Suction Temperature			
Purge Liquid Temperature			
<b>Date:</b>			
<b>Technician:</b>			
<b>Owner:</b>			

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