



Installation, Operation, and Maintenance

Series S™ Water-Cooled CenTraVac Chillers With Tracer AdaptiView Control



Model: CVHS

X39641230010

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.

February 2014

CVHS-SVX01A-EN





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:

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

⚠ CAUTION 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.

NOTICE: 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 such as HCFCs and HFCs.

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. 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 electrical codes.

⚠ WARNING

Personal Protective Equipment (PPE) Required!

Installing/servicing this unit could result in exposure to electrical, mechanical and chemical hazards.

- 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 Material Safety Data Sheets (MSDS)/Safety Data Sheets (SDS) and OSHA guidelines for proper PPE.
- When working with or around hazardous chemicals, **ALWAYS** refer to the appropriate MSDS/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.**

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

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

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

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

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

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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

When a new fully assembled chiller is shipped and received from our Trane manufacturing location and, for any reason, it requires disassembly or partial disassembly—which could include but is not limited to the evaporator, condenser, control panel, compressor/motor, purge, factory-mounted Adaptive Frequency™ drive (AFD) 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 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.



Table of Contents

Introduction	2	Waterbox Locations	22	
Warnings, Cautions, and Notices	2	Grooved Pipe Coupling	23	
Important Environmental Concerns	2	Flange-Connection Adapters	23	
Important Responsible Refrigerant Practices	2	Victaulic Gasket Installation	24	
Unit Model Number Description	6	Bolt-Tightening Sequence for Water Piping Connections	24	
Model Number Descriptions	7	Flanges with 8 or 12 Bolts	24	
Description	7	Flanges with 16 Bolts	24	
Pre-Installation	8	Pressure Testing Waterside Piping	25	
ASHRAE Standard 15 Compliance	8	Vent Piping	26	
Unit Shipment	8	Refrigerant Vent Line	26	
Installation Requirements and Contractor Responsibilities	8	General Requirements	26	
Storage Requirements	10	Purge Discharge	26	
Unit Components	11	Vent Line Materials	26	
Unit Clearances and Weights	12	Vent Line Sizing	26	
Recommended Unit Clearances	12	Vent Line Installation	27	
General Weights	13	Insulation	31	
Installation: Mechanical	14	Unit Insulation Requirements	31	
Operating Environment	14	Insulation Thickness Requirements	31	
AFD Enclosure Rating	14	Installation: Controls	33	
Environmental Conditions	14	UC800 Specifications	33	
Foundation Requirements	14	Wiring and Port Descriptions	33	
Rigging	14	Communication Interfaces	33	
Standard Chiller Lift	15	Rotary Switches	33	
Special Lift Requirements	15	LED Description and Operation	33	
Unit Isolation	15	Installing the Tracer AdaptiView Display ..	36	
Isolation Pads	16	Installing the Tracer AdaptiView Display—Al-	ternate Location	37
Spring Isolators	16	Adjusting the Tracer AdaptiView Display Arm	37	
Leveling the Unit	17	Electrical Requirements	38	
Installation: Water Piping	19	Installation Requirements	38	
Overview	19	Electrical Requirements	38	
Water Treatment	19	Power Supply Wiring	40	
Pressure Gauges	19	Three-Phase Power	40	
Valves—Drains and Vents	19	Circuit Breakers and Fused Disconnects ..	40	
Strainers	19	Installing AFD Input Power Wiring Standard Cabinet	40	
Required Flow-Sensing Devices	19	Torquing Electrical Power Connections ..	41	
Evaporator and Condenser Water Piping ..	21			
Water Piping Connections	22			

Cabinet Wire Routing	41	Recommended System Maintenance . . .	63
Grounding the Cabinet	41	AFD	64
System Control Circuit Wiring (Field Wiring)	42	Visual Inspection—Power Removed . . .	64
Temperature Sensor Circuits	44	Operational Inspection—Power Applied .	65
Optional Control and Output Circuits . .	46	Waterbox Removal and Installation	67
Optional Tracer Communication Interface	46	Discussion	67
Unit Start-up/Commissioning	46	Procedure	67
Schematic Wiring Drawings	46	Reassembly	68
Operating Principles	47	Torque Requirements	68
General Requirements	47	Connection Devices Information	68
Cooling Cycle	47	Bolt-Tightening Sequence for Waterboxes	69
Refrigerant Pump	47	Evaporator Waterbox Covers	69
Tracer AdaptiView Display	48	Condenser Waterbox Covers	69
AFD	48	AFD Removal and Installation	70
Introduction	48	Drive Cabinet Dimensions	71
UC800 Adaptive Frequency Drive Control	48	AFD Cabinet Removal	72
AFD Cooling Circuit	53	Forms and Check Sheets	74
Start-up and Shut-down	54		
Sequence of Operation	54		
Software Operation Overview Diagram .	54		
Start-up Sequence of Operation	54		
Power Up Diagram	56		
Hot Water Control	56		
Control Panel Devices and Unit-Mounted De-	57		
vices	57		
Unit Control Panel	57		
User-Defined Language Support	57		
Unit Start-up and Shut-down Procedures	57		
Daily Unit Start-up	58		
Seasonal Unit Start-up	58		
Daily Unit Shut-down	58		
Recommended Maintenance	60		
Record Keeping Forms	60		
Normal Operation	60		
Purge System	61		
Leak Checking Based on Purge Pump Out	62		
Time	62		
Long Term Unit Storage	62		
Refrigerant Charge	62		



Unit Model Number Description

The unit nameplate is located on the right side of the control panel. A typical unit nameplate is illustrated in Figure 1 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 AFDs are identified by a separate number found on the AFD.

Product Description Block. The CenTraVac™ 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 identifies all characteristics of a unit.

Figure 1. Typical unit nameplate



Model Number Descriptions

Description

Digit 1, 2 — Unit Function

CV = CenTraVac Hermetic

Digit 3 — Drive

H = Direct Drive

Digit 4 — Development Sequence

S

Digit 5, 6, 7 — Nominal Compressor Tonnage

300= 300 Nominal tons

SSS= Special

Digit 8 — Unit Motor Voltage

E = 440V-60Hz

F = 460V-60Hz

G = 480V-60Hz

S = Special

Digit 9 — Unit Type

A = Cooling Condenser

S = Special

Digit 10, 11 — Design Sequence

AA = Original Design

Digit 12 — Hot Gas By-Pass

0 = Without HGB

S = Special

Digit 13 — Control Enclosure

C = Standard Control Enclosure

S = Special

Digit 14, 15, 16, 17 —

Compressor Motor Power (kW)¹

0190= 190 CPKW

Digit 18, 19, 20, 21 —

Compressor Impeller Cutback² Stage 1

1520= 15.20-in. Diameter

SSSS = Special

Digit 22, 23, 24, 25 —

Compressor Impeller Cutback³ Stage 2

1510= 15.10-in. Diameter

SSSS= Special

Digit 26 — Evaporator Shell Size

C = 300-Ton Short Evap Shell (030A)

D = 300-Ton Long Evap 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 Cond Shell (030A)

D = 300-Ton Long Cond Shell (030B)

S = Special

Digit 29 — Condenser

Waterboxes

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 Waterboxes

0 = None

S = Special

Digit 31 — Auxiliary Condenser Size and Waterboxes

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

Digit 39 — Control: Chilled

Water Reset

0 = None

1 = Chilled Water Reset

Digit 40 — Control: Heat

Recovery Temperature Sensors

0 = No

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 Cond and Evap

A = Thermal Dispersion Water Flow Proving Selected for Cond and Evap

B = Thermal Dispersion Water Flow

Proving Selected for Cond Only

C = Thermal Dispersion Water Flow Proving Selected for Evap Only

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 0.10-inch dimensions; i.e., if digits 18–21 = 1520, the cutback diameter is 15.20.

³ Cutbacks are done in 0.10-inch dimensions; i.e., if digits 22–25 = 1510, the cutback diameter is 15.10.



Pre-Installation

ASHRAE Standard 15 Compliance

Trane recommends that indoor CenTraVac unit installations fully meet or exceed the guidelines of the current version of ASHRAE Standard 15, in addition to any applicable local, state, or national 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.

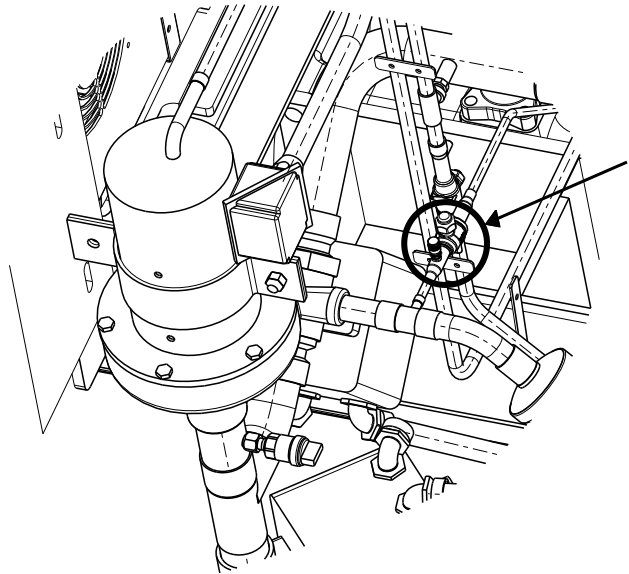
Refer to the latest copy of ASHRAE Standard 15 for specific guidelines. Trane assumes no responsibility for any economic, health, or environmental issues that may result from an equipment room's design or function.

Unit Shipment

Inspect unit while it is still on the truck for any shipping damage. The chiller ships shrink-wrapped in a 10-mil 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. [Figure 2, p. 11](#) 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 of dry nitrogen before shipment.



Note: The holding charge should register approximately 5 psig (34.5 kPa) at 72°F (22.2°C). Place a gauge on access valve provided (indicated by arrow and circle in the figure at left) 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.

Installation Requirements and Contractor Responsibilities

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

⚠ CAUTION

Combustible Material!

Shrink-wrap is a combustible material. Avoid open flames and hot sparks. Failure to follow this instruction could result in minor to moderate injury and equipment damage.

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"> • Meet foundation requirements
Rigging			<ul style="list-style-type: none"> • Safety chains • Clevis connectors • Lifting beam
Disassembly/Reassembly (as required) ^(a)	<ul style="list-style-type: none"> • Trane, or an agent of Trane specifically authorized to perform start-up of Trane® products (contact your local Trane office for pricing) 		
Isolation		<ul style="list-style-type: none"> • Isolation pads or spring isolators 	<ul style="list-style-type: none"> • Isolation pads or spring isolators
Electrical	<ul style="list-style-type: none"> • Circuit breakers • Unit mounted AFD • 24-pulse input or line reactor (optional) 	<ul style="list-style-type: none"> • Temperature sensor (optional outdoor air) • Flow switches (may be field supplied) • Tracer AdaptiView™ display and mounting arm • Field-installed AFD (optional) 	<ul style="list-style-type: none"> • Electrical connections to unit mounted AFD • Wiring sizes per submittal and NEC • Ground connection(s) • BAS wiring (optional) • Control voltage wiring (optional) • Chilled water pump contactor and wiring including interlock • Condenser water pump contactor and wiring including interlock • Option relays and wiring
Water piping		<ul style="list-style-type: none"> • Flow sensing devices (may be field supplied) 	<ul style="list-style-type: none"> • Taps for flow sensing devices • Taps for thermometers and gauges • Thermometers • Strainers (as required) • Water flow pressure gauges • Isolation and balancing valves in water piping • Vents and drain on waterbox valves (one each per pass) • Pressure relief valves (for waterboxes as required)
Relief	<ul style="list-style-type: none"> • Rupture disc assembly 	<ul style="list-style-type: none"> • RuptureGuard™ (optional) 	<ul style="list-style-type: none"> • Vent line and flexible connector and vent line from rupture disc to atmosphere
Insulation	<ul style="list-style-type: none"> • Insulation (optional) 		<ul style="list-style-type: none"> • Insulation • Chiller feet insulation
Water Piping Connection Components	<ul style="list-style-type: none"> • Flanged (optional) • Welded on flange for 300 psig waterboxes 	<ul style="list-style-type: none"> • Flanged (optional) • Victaulic® to flange adapter for 150 psig waterboxes 	<ul style="list-style-type: none"> • Victaulic • Victaulic coupling for 150 and 300 psig waterboxes
Other Materials			<ul style="list-style-type: none"> • HCFC-22 refrigerant (1 lb maximum per machine as needed) • Dry nitrogen (8 psig maximum per machine as needed)
"CenTraVac™ Installation Completion Check Sheet and Request for Trane Service" (CTV-ADF001-EN; refer to "Forms and Check Sheets," p. 74)			<ul style="list-style-type: none"> • To be completed by installing contractor prior to contacting Trane for start-up
Chiller start-up commissioning ^(b)	<ul style="list-style-type: none"> • Trane, or an agent of Trane specifically authorized to perform start-up of Trane® products 		

(a) Trane, or an agent of Trane specifically authorized to perform start-up and warranty of Trane® products, will perform or have direct on-site supervision of the disassembly and reassembly work.

(b) 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

NOTICE:

Insulation Damage!

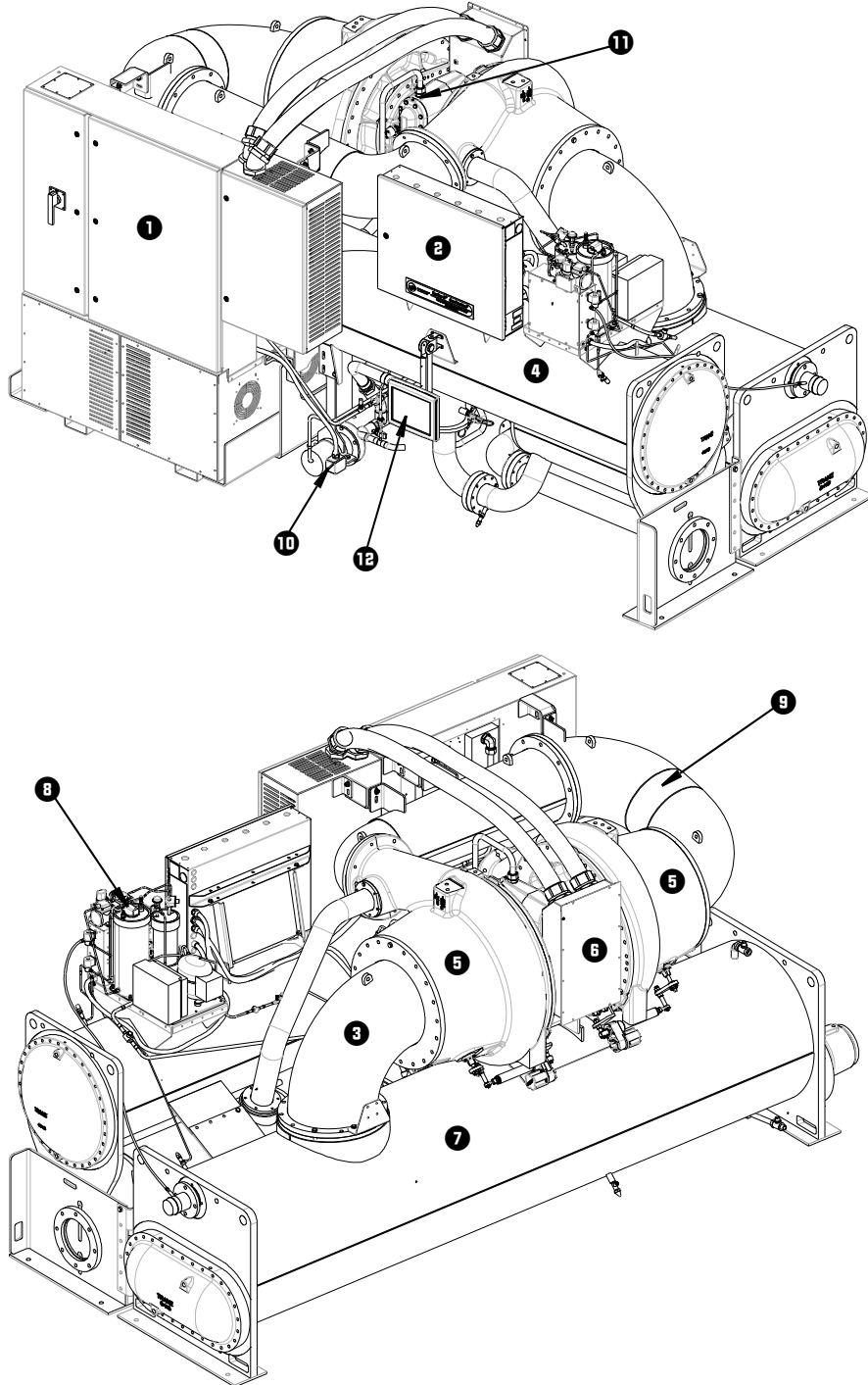
Do not expose unit to direct sunlight as it could result in damage to factory-installed insulation.

Less than 1 month	1–6 months	Greater than 6 months
Location requirements: <ul style="list-style-type: none">• solid foundation• vibration free• dry• temperature range -40°F to 158°F (-40°C to 70°C)	Location requirements: <ul style="list-style-type: none">• solid foundation• vibration free• dry• temperature range -40°F to 158°F (-40°C to 70°C)	Location requirements: <ul style="list-style-type: none">• solid foundation• vibration free• dry• temperature range -40°F to 158°F (-40°C to 70°C)
<ul style="list-style-type: none">• Do not remove any plastic coverings	<ul style="list-style-type: none">• Do not remove any plastic coverings	<ul style="list-style-type: none">• Do not remove any plastic coverings
<ul style="list-style-type: none">• Do not charge the chiller with refrigerant• If additional refrigerant is on site, follow manufactures storage requirements	<ul style="list-style-type: none">• Do not charge the chiller with refrigerant• If additional refrigerant is on site, follow manufactures storage requirements	<ul style="list-style-type: none">• Do not charge the chiller with refrigerant• If additional refrigerant is on site, follow manufactures storage requirements
<ul style="list-style-type: none">• Verify dry nitrogen pressure using gauge located on the evaporator shell reads 3 to 5 psig (21 to 34.5 kPa)• Notify the local Trane office if charge has escaped	<ul style="list-style-type: none">• Verify dry nitrogen pressure using gauge located on the evaporator shell reads 3 to 5 psig (21 to 34.5 kPa)• Notify the local Trane office if charge has escaped	<ul style="list-style-type: none">• Verify dry nitrogen pressure using gauge located on the evaporator shell reads 3 to 5 psig (21 to 34.5 kPa)• Notify the local Trane office if charge has escaped
<ul style="list-style-type: none">• Do not operate purge unit	<ul style="list-style-type: none">• Do not operate purge unit	<ul style="list-style-type: none">• Do not operate purge unit
	<ul style="list-style-type: none">• Verify waterbox and tube bundles are clean and dry	<ul style="list-style-type: none">• Verify waterbox and tube bundles are clean and dry
Note: Chillers stored 5 years or longer should be inspected every 5 years by a qualified service organization for leaks.		

Unit Components

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

Figure 2. Typical CVHS CentraVac chiller



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



Unit Clearances and Weights

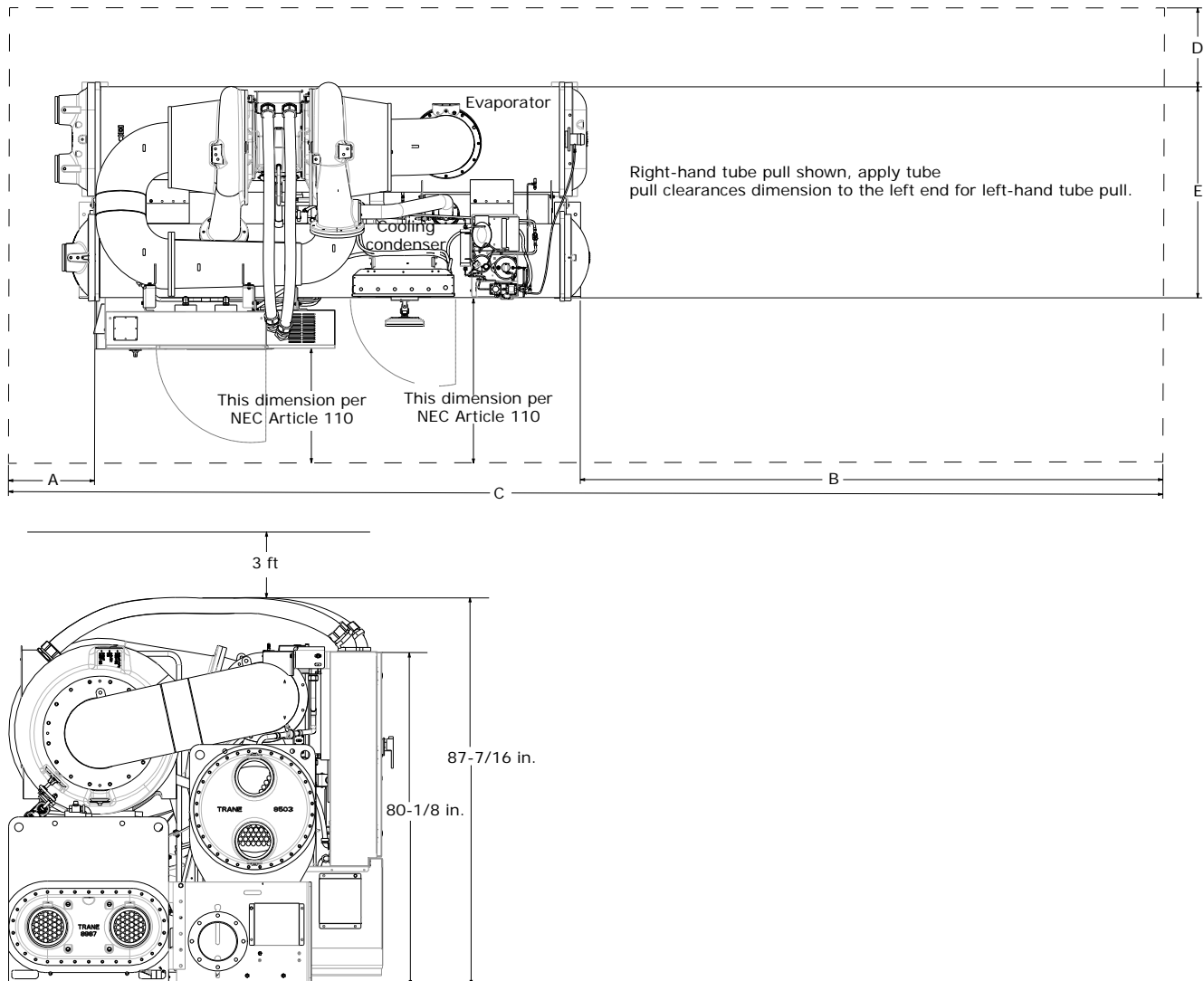
Recommended Unit Clearances

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 feet (91.44 cm).
- Use a housekeeping pad to provide better service clearances; refer to submittal for more information.

NEC Article 110 Refer to NEC and local electrical codes for starter and control panel clearance requirements.

Figure 3. Clearance requirements



Unit Clearances and Weights

Table 1. Clearance requirements^(a)

EVSZ	CDSZ	A		B		C		D ^(b)		E	
		inch	cm	inch	cm	inch	cm	inch	cm	inch	cm
030A	030A	47.75	121.29	156	396.24	353.75	898.53	20	50.8	70	177.8
030B	030B	47.75	121.29	186	472.44	413.75	1050.93	20	50.8	70	177.8

Note: Determine bundle size by looking at unit nameplate. EVSZ is evaporator size and CDSZ is condenser size; A is short and B is long.

(a) All dimensions are approximate; refer to the unit submittal package for exact dimensions for your unit.

(b) 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

The unit weight information provided in [Table 2](#) should be used for general information purposes only. Trane does not recommend using this weight information for considerations relative to chiller handling. The large number of variances between chiller selections drives variances in chiller weights that are not recognized in this table. For specific weights for your chiller, refer to your submittal package.

The values in [Table 2](#) representing chiller weights include the following:

- TECU 0.035-in. tube wall.
- 300 psig marine waterboxes.
- Operating weights include the heaviest possible refrigerant weight.
- Heaviest possible AFD.
- Heaviest possible bundle and heaviest possible motor voltage combination for the application family chiller.

Table 2. Unit weights

MODEL	EVSZ	CDSZ	Maximum AFD Weight		Shipping Weight without Drive		Shipping Weight with Drive		Operating Weight	
			lb	kg	lb	kg	lb	kg	lb	kg
CVHS	030A	030A	2787	1264	19503	3846	22290	10111	25254	11455
	030B	030B	2787	1264	20710	9394	23497	10658	26735	12127

Note: Determine bundle size by looking at unit nameplate. EVSZ is evaporator size and CDSZ is condenser size; A is short and B is long.



Installation: Mechanical

Operating Environment

Important:

- The standard chiller is design for indoor use only and as such has NEMA Type 1 enclosures.

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°C to + 40°C).

NOTICE:

Equipment Failure!

Unit operating at ambient temperatures exceeding 104°F (40°C) could fatigue the unit's rupture disc, causing it to break at a reduced refrigerant pressure (<15 psig). AFD component damage could also occur due to the panel's inability to dissipate heat adequately. If any of these adverse operating conditions are present, take necessary action to improve the equipment room environment.

AFD Enclosure Rating

The AFD cabinet has a NEMA 1 enclosure rating:

NEMA 1: Vented. Intended for general-purpose indoor applications.

Environmental Conditions

Important: Location of the AFD is important if proper performance and normal operating life is to be expected. Therefore, unless designed for special environments, the controller should be installed in an area where the following conditions exist

- Verify that NEMA 1 enclosure drives can be kept clean and dry.
- The area chosen should allow the space required for proper air flow. Adequate clearance for air circulation around the enclosure is a 6 inch (15.25 cm) minimum clearance required wherever vents are located in the cabinet.
- Be sure that the NEMA 1 enclosure is installed away from oil, coolants, or other airborne contaminants.
- Do not install the drive above 3300 feet (1000 meters) without derating output power. For every 300 feet (91.4 meters) above 3300 feet (1000 meters), derate the output current 1 percent.
- Line frequency is 50 or 60 Hz.
- Non-corrosive location.
- Verify that the drive location will meet the environmental conditions specified in [Table 3](#).

Table 3. Environmental conditions

Condition	Specification
Ambient Temperature (outside NEMA 1 enclosure)	32°F to 104°F (0°C to + 40°C)
Storage Temperature (Ambient)	-40°F to 158°F (-40°C to 70°C)
Humidity	5% to 95% (non-condensing)

Foundation Requirements

Chiller mounting surface must be:

- rigid non-warping mounting pads or a concrete foundation.
- able to support the chiller at its full operating weight (including completed piping, and full operating charges of refrigerant 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. [Table 2, p. 13](#) shows approximate weights for various chiller sizes and options.

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. 15](#).

Note: The lifting beam used for units must be at least 12.5 feet (3.81 meters) long.

⚠ WARNING

Heavy Objects!

Do not use cables (chains or slings) except as shown in [Figure 4, p. 15](#). Each of the cables (chains or slings) 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. Failure to properly lift unit could result in death or serious injury, or equipment or property-only damage.

⚠ WARNING

Improper Unit Lift!

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. Failure to properly lift unit could result in death or serious injury, or equipment or property-only damage.

NOTICE:

Wiring Damage!

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

Standard Chiller Lift

1. Insert clevis connections at the points indicated in [Figure 4, p. 15](#). A 2 inch (50.8 mm) diameter lifting hole is provided at each of these points.
2. Attach the lifting chains or cables.
3. Once 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.

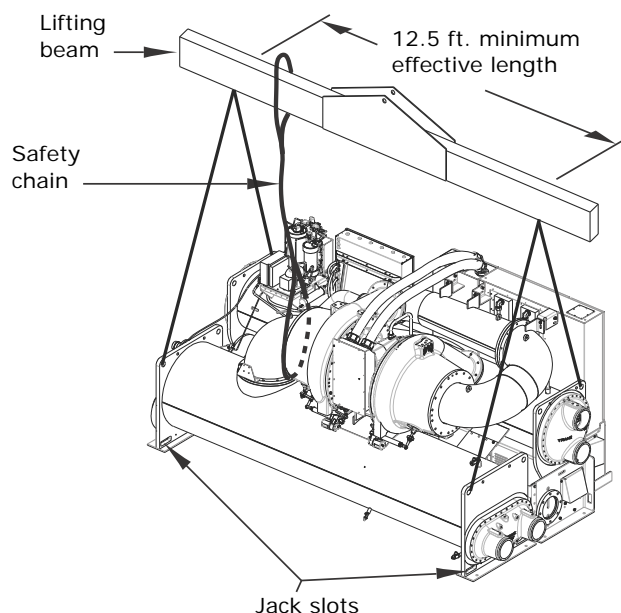
Important: There should not be tension on this safety cable; the cable is used only to prevent the unit from rolling during the lift.

4. Remove both skid boards from chiller feet.
5. Position isolator pads or spring isolators beneath the chiller feet (refer to ["Unit Isolation," p. 15](#) for instructions).

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

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 clevis connections and safety chain.

Figure 4. Typical rigging arrangements



Special Lift Requirements

NOTICE:

Equipment Damage!

Do not use a fork lift to move the chiller! Moving the chiller using a fork lift could result in equipment or property-only damage.

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 [Figure 4, p. 15](#); then push or pull the unit across a smooth surface. Should the chiller be on shipping blocks, it is not necessary to remove the shipping blocks from the chiller before moving it into place.
- Use care on uneven surfaces. The refrigerant pump and piping in the center of the unit is within 1/2 in. of the ground.
- If removal of the AFD is necessary to move the chiller to the operating location, refer to ["AFD Removal and Installation," p. 70](#). 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 (see [Figure 5](#)) 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.

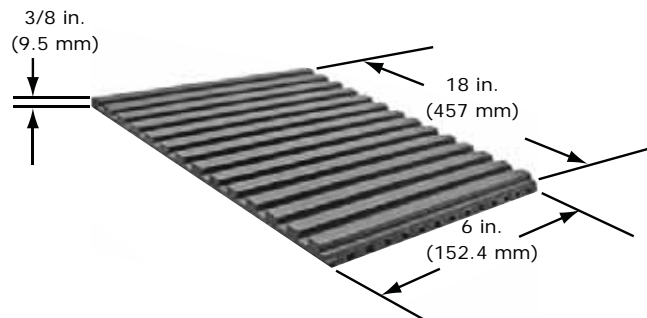
Important: When determining placement of isolation pads or spring isolators, remember that the

control panel side of the unit is always designated as the unit front.

Isolation Pads

When the unit is ready for final placement, position isolation pads (6-in. sides) end for end under the full length of the chiller leg. The pads measure 6 in. x 18 in. (152.4 mm x 457 mm) and on some units there may be small gaps between pads. Pads are provided to cover entire foot.

Figure 5. Isolation pad and dimensions

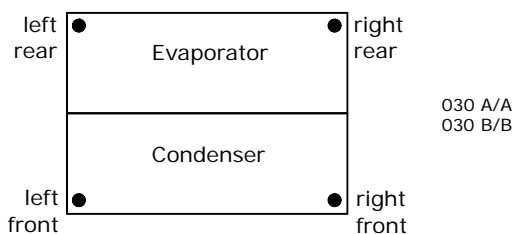


Remember that the chiller must be level within 1/16 in. (1.6 mm) over its length and width after it is lowered onto the isolation pads. In addition, all piping connected to the chiller must be properly isolated and supported so that it does not place any stress on the unit.

Spring Isolators

Spring isolators should be considered whenever chiller installation is planned for an upper story location. Base isolator placement is shown in [Figure 6](#).

Figure 6. Isolation spring placement by shell size, evaporator and condenser length



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

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

1. Position the spring isolators under the chiller as shown in [Figure 6](#). 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.

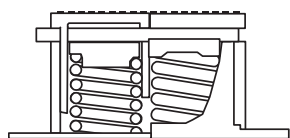
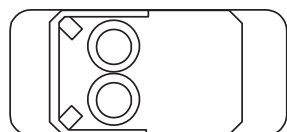
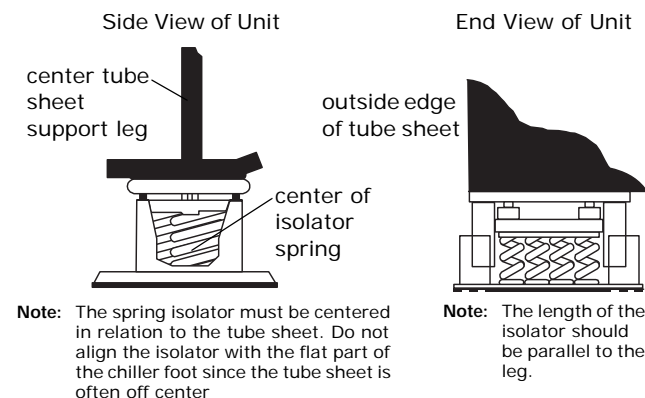
3. If required, bolt the isolators to the floor through the slots provided, or cement the pads.

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

4. If the chiller must be fastened to the isolators, insert capscrews 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 bolts. 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. 15](#). The weight of the chiller will force down the upper housing of each isolator, and could cause it to rest on the isolator's lower housing (refer to [Figure 7](#)).

Figure 7. Chiller foot and isolator orientation


6. 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 bolt one complete revolution upward.

Note: When the load is applied to the isolators (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 bolt (Step 7) will raise the chiller.

7. Turn the adjusting bolt on each of the remaining isolators to obtain the required minimum clearance of 1/4 in. (6.35 mm).
8. Once the minimum required clearance is obtained on each of the isolators, level the chiller by turning the adjusting bolt 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. (0.15875 cm) over its length and width, and the clearance of each isolator must be at least 1/4 in. (6.35 mm).

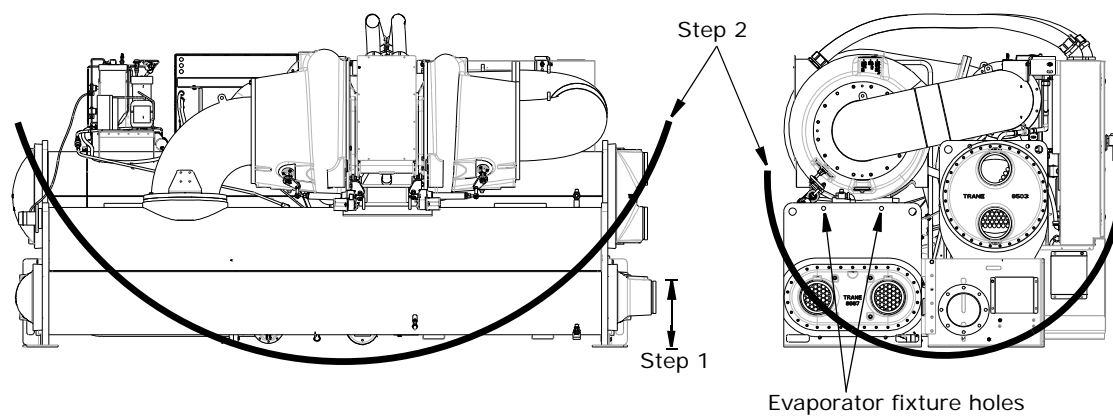
Leveling the Unit

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

1. Measure and make a punch mark an equal distance up from the bottom of each foot of the chiller.

2. Suspend a clear plastic tube along the length of the chiller as shown in the following figure.
3. Fill the tube with water until the level aligns with the punch mark at one end of the chiller.
4. 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.
5. Once the unit is level across its length, repeat Step 1 through Step 3 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 (see Figure 8, p. 18) can be used as reference points to level off.

Figure 8.

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 feet (0.91 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. 21](#). General recommendations for the installation of field supplied piping components (e.g., valves, flow switches, etc.) common to most chiller water circuits are listed below.

Water Treatment

The use of untreated or improperly treated water in a CenTraVac 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!

The use of untreated or improperly treated water in a CenTraVac could result in scaling, erosion, corrosion, algae or slime. It is recommended that the services of a qualified water treatment specialist be engaged 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.

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. (152 mm) pipe, the tap would be at least 6 in. (152 mm) from any elbow, orifice, etc.

Valves—Drains and Vents

NOTICE:

Waterbox Damage!

Do not over-tighten or use excessive Teflon® pipe tape when installing valves, drains, plugs and vents on cast iron water boxes. Failure to follow these instructions could result in damage to the waterbox.

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 mm), 1/2 in. (13 mm), or 3/4 in. (19 mm).

NOTICE:

Over-pressurization!

Failure to install pressure-relief valves in the condenser and evaporator water circuits could result in waterbox damage due to hydrostatic expansion.

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:

Tube Damage!

Failure to install strainers in all water piping entering the chiller could result in tube plugging conditions that damage unit components.

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

Use an ifm efector® flow detection controller and sensor (see [“ifm efector Water Flow Detection Controller and](#)

Installation: Water Piping

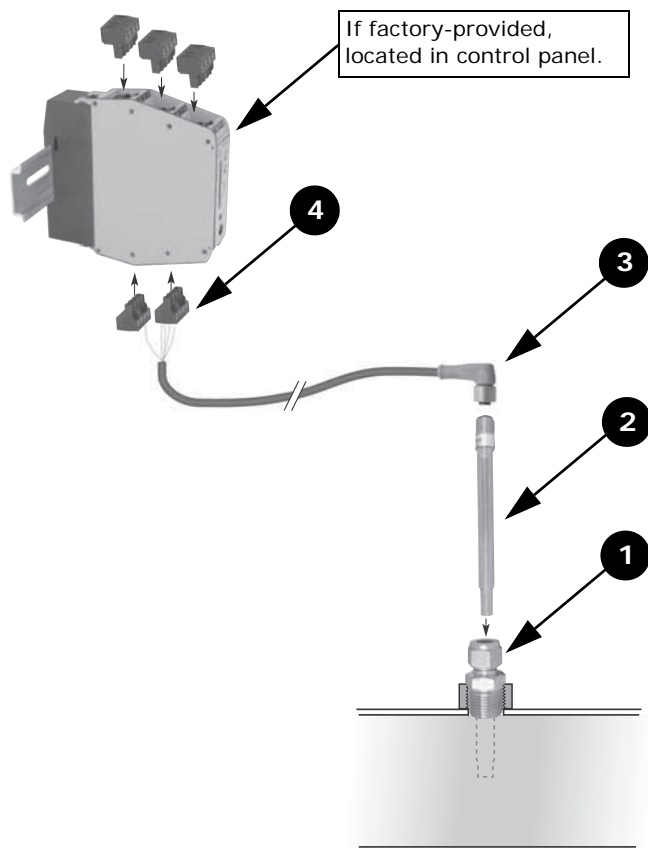
[Sensor,” p. 20](#)) to verify evaporator and condenser water flows.

If a customer-supplied flow sensing device is used to ensure adequate chiller 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.

ifm efector Water Flow Detection Controller and Sensor

Figure 9. 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 meters) (see item labeled “1” in [Figure 9, p. 20](#)). 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.

2. Insert the flow probe through the 1/2-in. NPT adapter as near the center of the pipe as possible (see item labeled “2” in [Figure 9, p. 20](#)). Finger-tighten the 1/2-in. NPT adapter; then, tighten with a wrench an additional 1-1/4 turns.

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. Placing the tip of the probe at the center of the pipe is preferred.

3. 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 [Figure 9, p. 20](#)). Install the supplied Micro DC Cable (9 meters [25 ft] in length) to the Flow Probe and hand-tighten the connector nut.
4. Plug the other end of the Micro DC Cable into the Flow Control Monitor with the Combicon connector (see item labeled “4” in [Figure 9, p. 20](#)). Refer to [Figure 10](#) for cable wiring.

NOTICE:

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

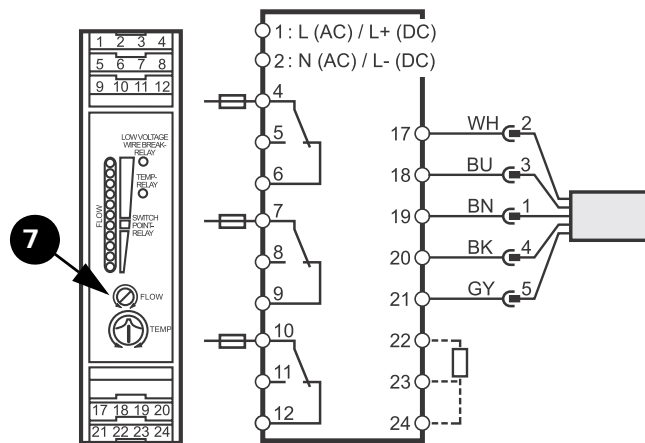
Applying electrical power to a motor in a vacuum could cause damage to the motor.

5. 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.
6. Remove all air from the piping circuit prior to adjusting the low water flow setpoint.
7. Reduce the water flow to the minimum allowable flow and adjust the Flow setting on the Flow Control Monitor (see item labeled “7” in [Figure 10](#)). 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.

8. Once 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 10. ifm efector flow sensing device terminal connection



NOTICE:

Proof of Flow Switch!

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.

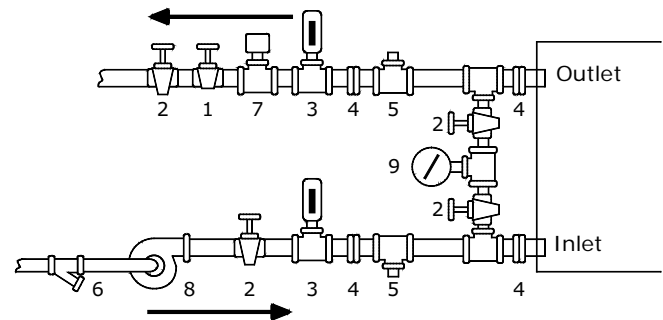
Failure to provide flow switches or jumping-out of switches could result in severe equipment damage.

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 trouble shooting, a viewable diagnostic is generated if a proof of flow switch does not close when flow is required.

Evaporator and Condenser Water Piping

Figure 11 and Figure 12, p. 21 illustrate the recommended (typical) water piping arrangements for the evaporator and condenser.

Figure 11. Typical evaporator water piping circuit

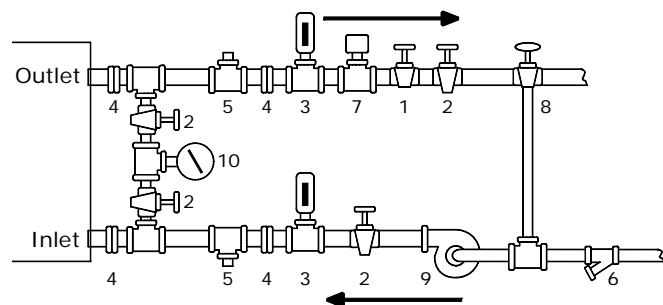


1. Balancing Valve
2. Gate (Isolation) Valve or Ball Valve
3. Thermometer (if field supplied)
4. Waterbox Nozzle Connection
5. Drain, Vent, Anode
6. Strainer
7. Chilled Water Flow Switch (5S1)^(a)
8. Pump
9. Pressure Gauge^(b)

(a) Flow switch 5S1 may be installed in either the entering or leaving leg of the chilled water circuit.

(b) 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 12. 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, Anode
6. Strainer
7. Condenser Water Flow Switch (5S2)^(a)
8. 3-Way Valve (Optional)
9. Condenser Water Pump
10. Pressure Gauge^(b)

Notes:

1. On multiple pass condensers, entering condenser water must enter at the lowest nozzle.

(a) The Flow Switch 5S2 may be installed in either the entering or leaving leg of the chilled water circuit.

(b) It is recommended to pipe a single gauge between entering and leaving pipes.

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 feet (0.91 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.

Installation: Water Piping

Water piping connection sizes and components are identified in [Table 4, p. 22](#) and [Table 5, p. 22](#). 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. 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 (21 kPa) 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: *Plug-type sensor extension cables are available for purchase from Trane Parts Service if needed. 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 ^(a)	Nominal Pipe Size			
	1 Pass		2 Pass	
	Inch	mm	Inch	mm
030	10	273.0	8	219.1

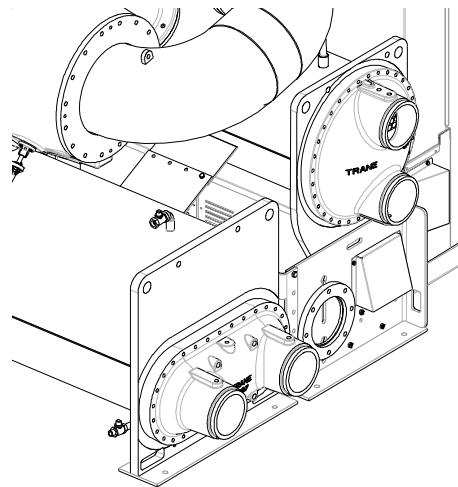
(a) EVSZ = Evaporator Shell Size; A = Short Shell, B = Long Shell

Table 5. Condenser water piping connection sizes

CDSZ ^(a)	Nominal Pipe Size	
	2 Pass	
	Inch	mm
030	8	219.1

(a) CDSZ = Condenser Shell Size; A = Short Shell, B = Long Shell

Figure 13. Typical grooved pipe connection



Waterbox Locations

If removal of waterboxes is necessary, refer to [“Waterbox Removal and Installation,” p. 67](#).

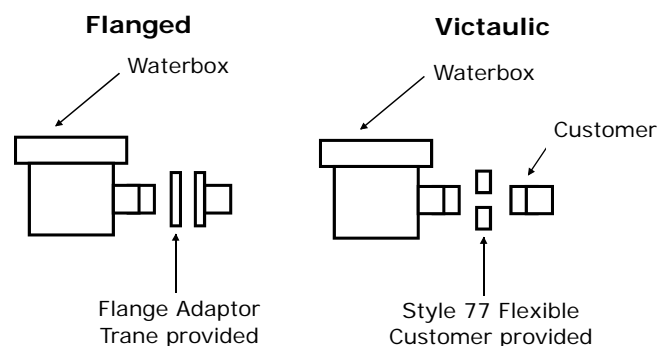
If the waterboxes on any of the shells are exchanged end-for-end, be sure to reinstall them right side up to maintain the correct baffle arrangements. Use a new gasket with each waterbox cover.

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 or 1035 kPa and 300 psig or 2068 kPa 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 usually not required to attenuate vibration and/or prevent stress on the connections.

Figure 14. Customer piping connection types



- 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

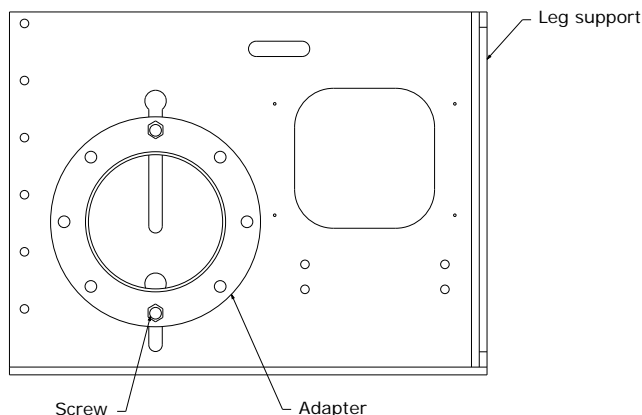
NOTICE:

Never Weld to Cast Boxes!

Adapters must be used to convert flanges. Welding to cast boxes will result in equipment damage.

When flat-face flange connections are specified, flange-to-groove adapters are provided (Victaulic Style 741 for 150 psig or 1035 kPa systems; Style 743 for 300 psig or 2068 kPa systems). The adapters are shipped bolted to one of the chiller end-supports. Adapter descriptions are given in [Table 6, p. 24](#) and [Table 7, p. 24](#). The flange adapters provide a direct, rigid connection of flanged components to the grooved-pipe chiller waterbox connections.

Figure 15. 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 bolts must be provided by the installer. Bolt sizes and number required are given in [Table 6, p. 24](#) and [Table 7, p. 24](#). The Style 741, 150 psig or 1035 kPa flange adapter requires a smooth, hard surface for a good seal.

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

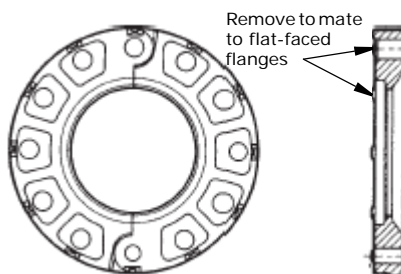
The Style 743 (300 psig or 2068 kPa) flange adapters are designed to mate with raised-face flanges. They can be used with flat-faced flanges; however, only if the raised projections on the outside face of the adapter are removed; see [Figure 16](#). The flange-adapter gasket must be placed with the color-coded lip on the pipe and the other lip facing the mating flange.

NOTICE:

Piping Connection Leaks!

To provide effective seal, gasket contact surfaces of adapter must be free of gouges, undulations or deformities. Failure to provide effective seal could result in equipment or property-only damage.

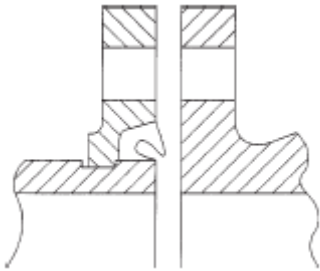
Figure 16. Modifying 300 psig flange adapters for flat-faced flange application



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 [Figure 17](#) for gasket configuration.

Figure 17. Typical Victaulic flange 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 bolt through the mating holes of the Victaulic flange to secure the flange firmly in the groove.
6. Tighten fasteners alternately and equally until housing bolt pads are firmly together (metal to metal); refer to ["Bolt-Tightening Sequence for Water Piping Connections," p. 24](#). Do not excessively tighten fasteners.

Note: Uneven tightening may cause gasket to pinch.

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

Nominal Pipe Size		Assembly Bolt Size ^(a)		Number of Assembly Bolts Required	Bolt Pattern Diameter		Weight	
Inch	mm	Inch	mm		Inch	mm	Pounds	kg
8	219.1	3/4 x 3-1/2	19 x 89	8	11.75	298	16.6	7.5
10	273.0	7/8 x 4	22 x 102	12	14.25	362	24.2	11.0

(a) Bolt size for conventional flange to flange connection. Longer bolts are required when flange washer must be used. Grade 5 bolts are recommended.

Table 7. Installation data for 350 psig flange adapters (Style 743)

Nominal Pipe Size		Assembly Bolt Size ^(a)		Number of Assembly Bolts Required	Bolt Pattern Diameter		Weight	
Inch	mm	Inch	mm		Inch	mm	Pounds	kg
8	219.1	7/8 x 4-3/4	22 x 121	12	13	330	34.3	15.6
10	273.0	1 x 5-1/4	25 x 133	16	15.25	387	48.3	21.9

(a) Bolt size for conventional flange to flange connection. Longer bolts are required when flange washer must be used. Grade 5 bolts are recommended.

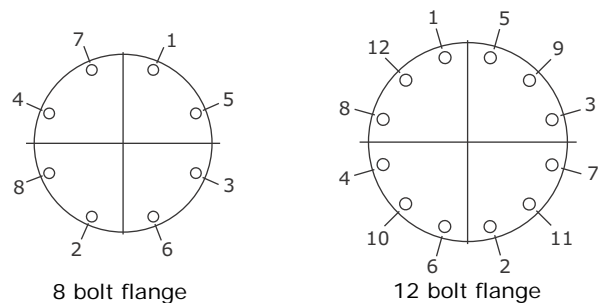
Bolt-Tightening Sequence for Water Piping Connections

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

Note: Before tightening any of the bolts, align the flanges.

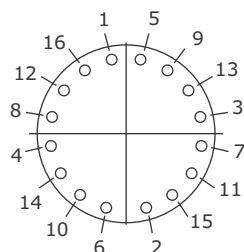
Flanges with 8 or 12 Bolts

Tighten all bolts to a snug tightness, following the numerical sequence for the appropriate bolt pattern as shown below. Repeat this sequence to apply the final torque to each bolt.



Flanges with 16 Bolts

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



Pressure Testing Waterside Piping

NOTICE:

Equipment Damage!

Do not over pressurize the system or exceed design pressure. Always perform as a hydro pressure test with water present in piping and waterboxes. Failure to follow these recommendations could result in equipment damage.

Waterside design pressure is either 150 or 300 psig; refer to unit nameplate or to submittal documentation.



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 noncondensable 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 DWV (drain/waste/vent) 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 R-123, 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 R-123:

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.

Section 9.7.8.5 of ASHRAE Standard 15-2007 provides guidance for determining the maximum vent line length. Appendix H of the standard provides the equation (shown in [Figure 21, p. 30](#)) and data necessary to properly size the vent line at the outlet of a pressure-relief device or fusible plug.

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.

[Table 8, p. 29](#) 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, with [Figure 21, p. 30](#). 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.

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: [Table 8, p. 29](#) and [Figure 21, p. 30](#) are applicable only for non-manifolded vent-line runs connected to a 15 psi rupture disc 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 disc vent line, consult local codes for applicable guidelines and constraints.

All CenTraVac centrifugal chillers are equipped with carbon rupture discs. If refrigerant pressure within the evaporator exceeds 15 psig the rupture disc breaks and shell pressure is relieved as refrigerant escapes from the chiller.

A cross-section of the rupture disc assembly appears in [Figure 18, p. 28](#) along with an illustration indicating the location of the rupture disc on the suction elbow.

Important: If a RuptureGuard is to be installed, remove and discard the factory-installed rupture disc; for more information, refer to Installation, Operation, and Maintenance: RuptureGuard Pressure Relief System Option (CTV-SVX06B-EN, or the most recent version).

Several general recommendations for rupture disc vent line installation are outlined below.

Note: If the rupture disc was removed for service or vent line piping installation, the rupture disc must be reinstalled (as shown in [Figure 18, p. 28](#)) using the following installation procedure:

- Verify that the vacuum support side of the rupture disc is positioned as shown in the cross-section view that appears in [Figure 18, p. 28](#).
 - Install the two bottom bolts through the pipe flanges.
 - Install the rupture disc with a gasket on each side between the pipe flanges. Orient the disc with the reference arrow or vacuum support bar facing the chiller side as shown in [Figure 18, p. 28](#).
 - Install the two top bolts.
 - Center the disc and gaskets to the flange bore.
 - Hand tighten all bolts assuring equal pressure.
 - Use a torque wrench set to 240 in·lb (27 N·m) with a 9/16-in. socket.
 - Tighten bolts in a star pattern, one half turn each, to maintain even pressure on the disc.
 - Final torque on all bolts should be 240 in·lb (27 N·m).
- When attaching the vent line to the chiller, do not apply threading torque to the outside pipe of the rupture disc assembly.

NOTICE:

Rupture Disc Damage!

Do not apply threading torque to the outside pipe. Failure to follow this instruction could result in damage to the rupture disc assembly.

- Provide support as needed for the vent line. Do not use the rupture disc assembly to support the vent line piping.
- Use a flexible connection between the vent-line and the rupture disc assembly to avoid placing stress on the rupture disc. (Stress can alter rupture pressure and cause the disc to break prematurely.) The flexible connector used to isolate the rupture disc 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 [Figure 19, p. 28](#) for a recommended relief piping arrangement.
- An individual vent line is normally installed for each relief device. It is permissible to manifold the rupture discs 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: [Figure 19, p. 28](#) does NOT apply for manifolded vent lines.

⚠ WARNING

Pressure-Relief Device Discharge Hazard!

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

NOTICE:

Proper Refrigerant Vent Line Termination!

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 disc, the rainwater pressure could cause the disc to rupture, allowing water to enter the chiller. Failure to properly terminate a refrigerant vent line could result in equipment damage.

- 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 (4.57 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.

Vent Piping

- Provide a drip leg on the vent-line (see Figure 19, p. 28). Provide a standard 1/4-in. FL x 1/4-in. NPT, capped refrigerant service valve to facilitate liquid removal.

NOTICE:

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 ensure 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 the drip leg.

- Consult local regulations and codes for any additional relief line requirements and refer to *Refrigerant Handling Guidelines* (CTV-SVX05B-EN, or the most recent version).

Figure 18. Illustrates rupture disc location, cross section of rupture disc

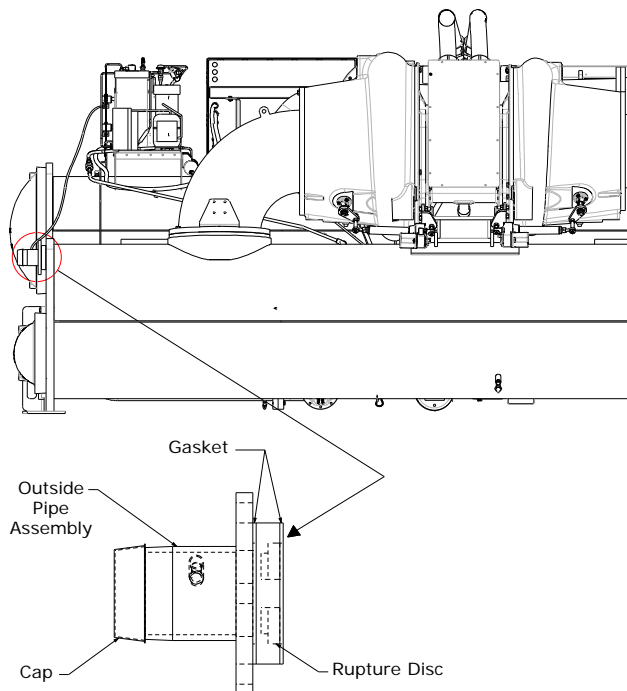
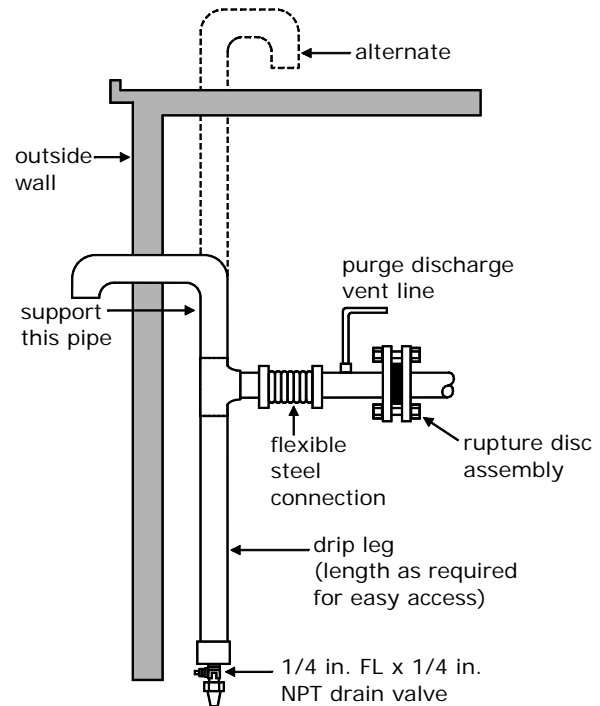


Figure 19. Arrangement for rupture disc relief piping

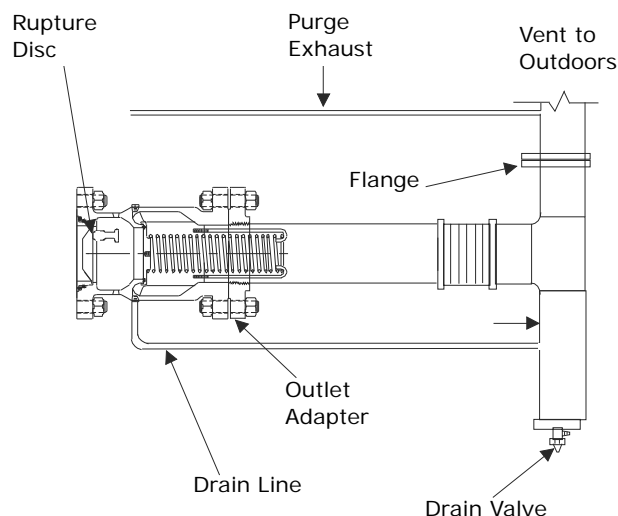


Notes:

- If a RuptureGuard is to be installed, remove and discard the factory-installed rupture disc; for more information, refer to Installation, Operation, and Maintenance: RuptureGuard Pressure Relief System Option (CTV-SVX06B-EN, or the most recent version).
- 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 crosses¹, elbows, tees or any other obstructions within the first nine inches of valve discharge. See the chiller installation manual and ASHRAE Standard 15-1992 for additional requirements on piping rupture disc and relief valve vent lines.

¹ A derate on the rated flow capacity for this configuration is published in E/CTV-EB-10 (*Engineering Bulletin: RuptureGuard™ Selection Guide*).

Figure 20. RuptureGuard—external vent line and drip leg (not provided)



- \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 discs on CenTraVac chillers, P is 15 lb. 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 (101.325 kPa).

Table 8. "C" values used to determine rupture disc vent line sizes

Evap. Size (EVSZ) (a)	Cond. Size (CDSZ) (b)	Rupture Disc 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. 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 [Figure 21, p. 30](#) to determine the vent line pipe diameter.
2. If piping multiple rupture discs (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 [Figure 21, p. 30](#).

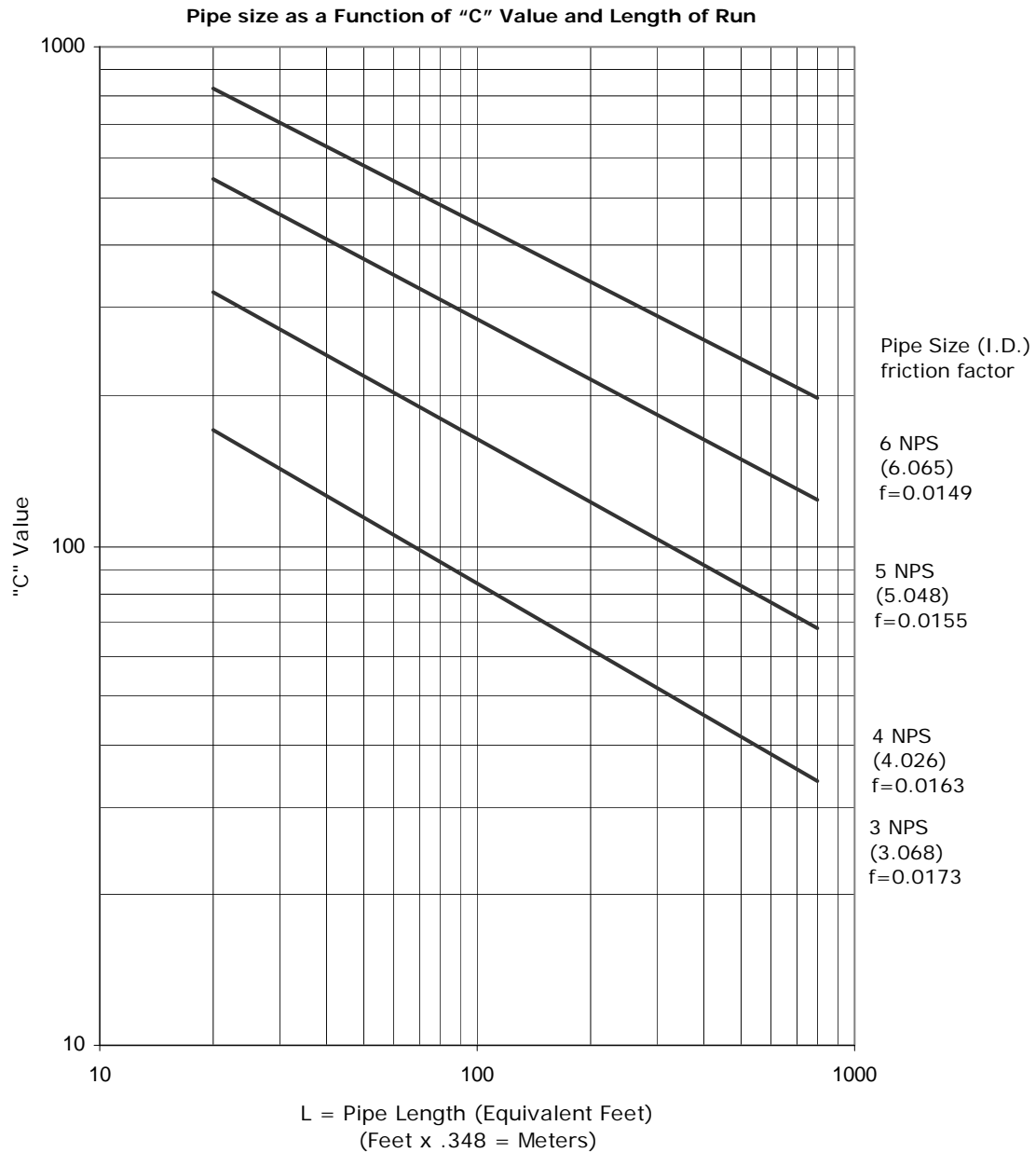
- (a) EVSZ = Evaporator Shell Size
A = Short Shell
B = Long Shell
(b) CDSZ = Condenser Shell Size
A = Short Shell
B = Long Shell

$$L = \frac{0.2146d^5(P_0^2 - P_2^2)}{fC_r^2} - \frac{d^5 \ln(P_0/P_2)}{6f}$$

For CenTraVac chillers using a rupture disc 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 [Table 8, p. 29](#) (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)

Figure 21. Rupture disc vent pipe sizing



ANSI/ASHRAE Standard 15-2007

$$L = \frac{.214 d^5 (P_0^2 - P_2^2)}{f C_R^2} - \frac{d * \ln(P_0 / P_2)}{6f}$$

$$P_0 = (0.5 * 15) + P_2$$

$$P_2 = 14.7 \text{ psia}$$

f = Moody Friction Factor in fully turbulent flow

Note: This figure, provided as a reference, is based on ASHRAE Standard 15-2007. Vent line size is typically dictated by state or local code which may be different from ASHRAE Standard 15-2007 requirements.

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 [Figure 22, p. 32](#).

The quantities of insulation required based on unit size and insulation thickness are listed in [Table 9](#). Insulation thickness is determined at normal design conditions which are:

- standard comfort-cooling leaving chilled water temperature
- 85°F dry bulb ambient temperature
- 75 percent relative humidity

Operation outside of normal design conditions as defined above 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 (LLIDs) and interconnecting four wire cable (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.

Table 9. CVHS standard unit insulation requirements

EVSZ	3/4 in. (19 mm) Insulation (Square Feet)
030 A	400
030 B	423

Insulation Thickness Requirements

Factory applied insulation. All low-temperature surfaces are covered with 3/4 in. (19 mm) Armaflex II or equal (thermal conductivity = 0.28 BTU/hr-ft sq.) (1.59 W/m²-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 K = 0.25. Chillers in high humidity areas or ice storage, low leaving water temperature (less than 36°F chilled water temperature/glycol) units may require double thickness to prevent formation of condensation.

NOTICE:

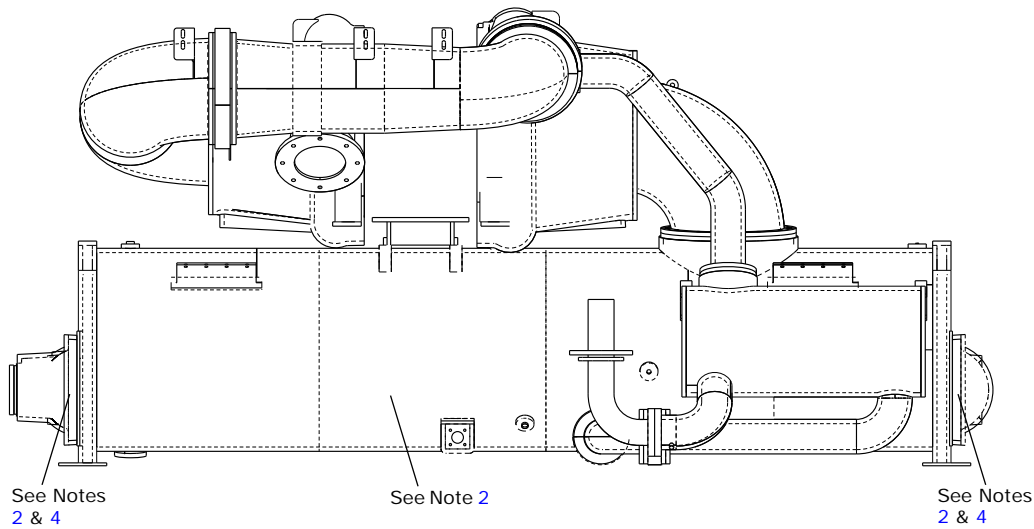
Insulation Damage!

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.

Failure to follow these instructions could result in insulation damage.

Figure 22. Recommended area for unit insulation



Notes:

1. Condenser not shown.
2. Bulbwells, drain and vent connections must be accessible after insulating.
3. Evaporators with ASME nameplates must have insulation cut out around the nameplate. Do not glue insulation to the nameplate.
4. All units with evaporator marine waterboxes wrap waterbox shell insulation with strapping and secure strapping with seal.
5. Apply two inch wide black tape on overlap joints. Where possible apply three inch wide strip of 0.38 thick insulation over butt joint seams.
6. 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-SVU01D-EN, or the most recent version).

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

Figure 23 illustrates the UC800 controller ports, LEDs, rotary switches, and wiring terminals. The numbered list following Figure 23 corresponds to the numbered callouts in the illustration.

Figure 23. Wiring locations and connection ports

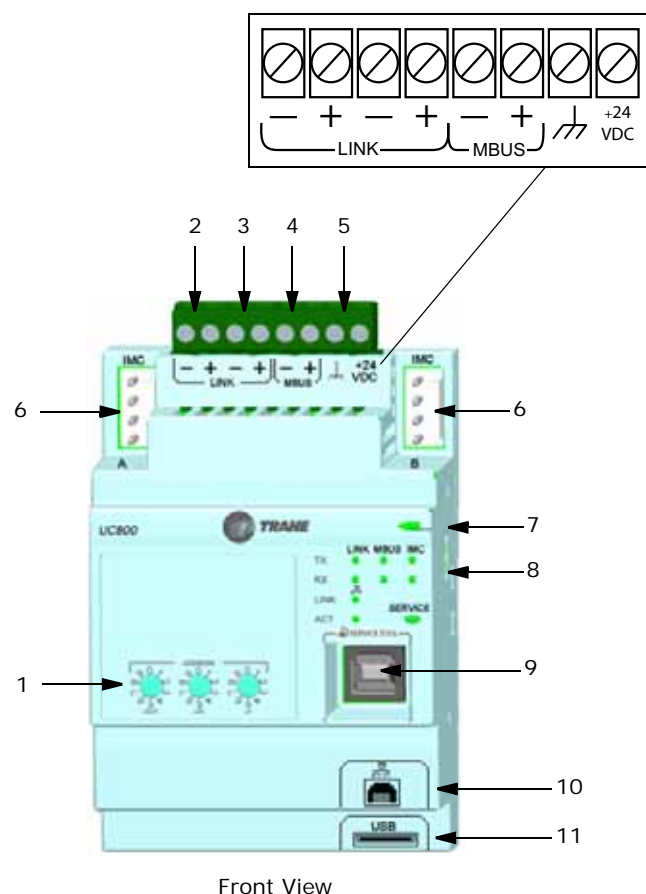
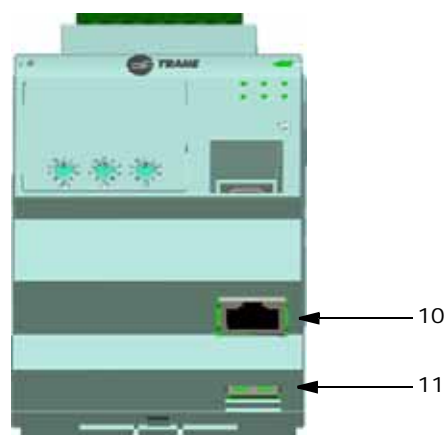


Figure 23. Wiring locations and connection ports



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 19.200 baud). *IPC3 Bus: used for Comm4 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. Not used.
7. Marquee LED power and UC800 Status indicator (Table 10, p. 34).
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 Figure 23, p. 33 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

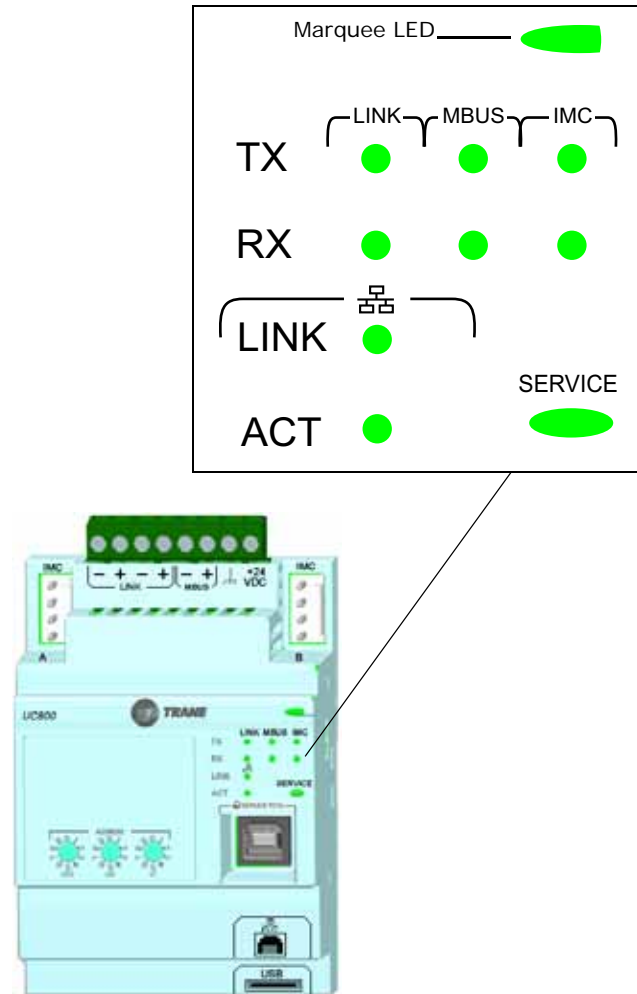
There are three rotary switches on the front of the UC800 controller. Use these switches to define a three-digit address when the UC800 is installed in a BACnet or MODBUS system (e.g., 107, 127, etc.).

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

LED Description and Operation

There are 10 LEDs on the front of the UC800. Figure 24 shows the locations of each LED and Table 10, p. 34 describes their behavior in specific instances.

Figure 24. LED locations

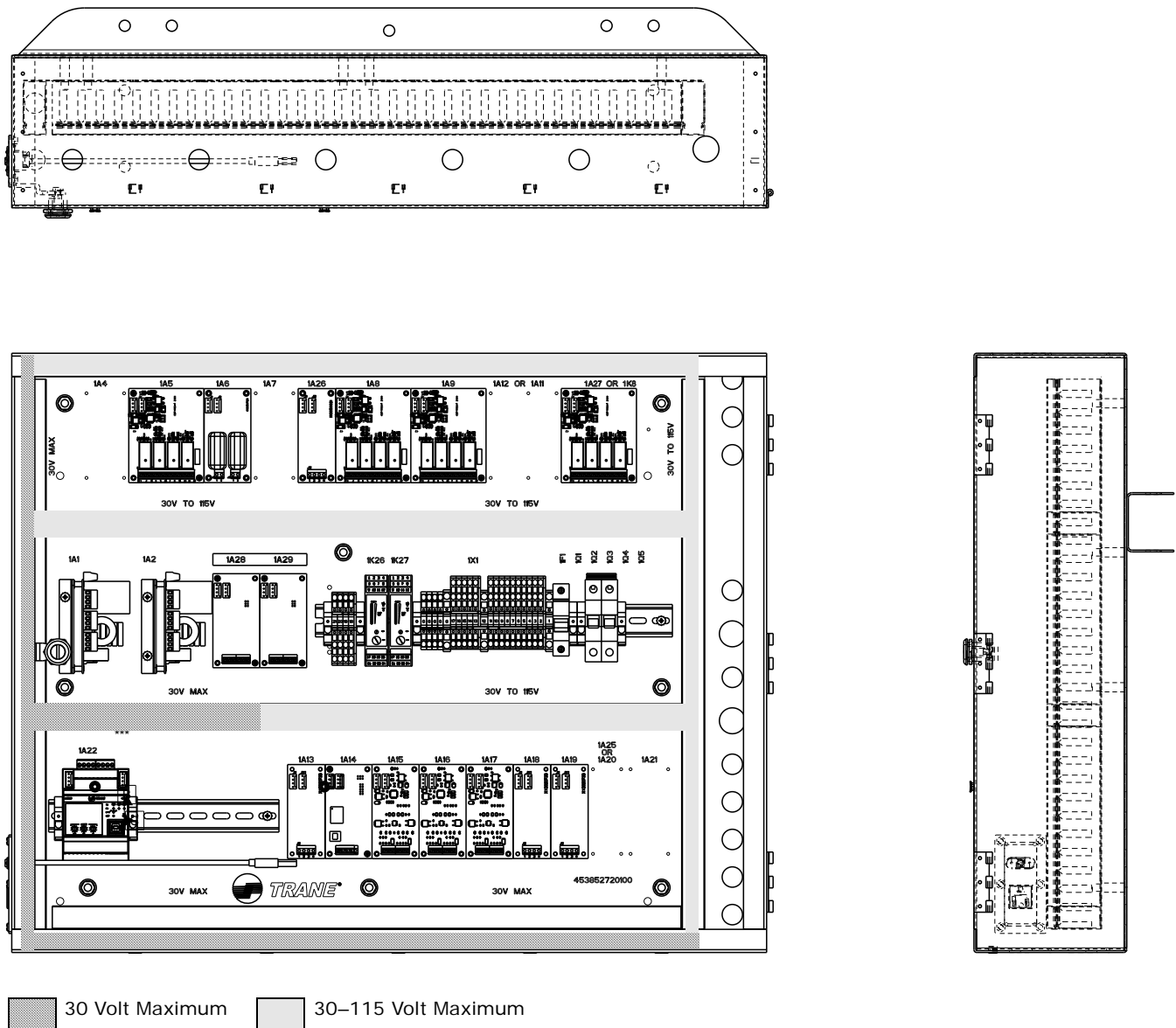


Important: Maintain at least 6 inches between low-voltage (<30V) and high voltage circuits. Failure to do so could result in electrical noise that could distort the signals carried by the low-voltage wiring, including IPC.

Table 10. LED behavior

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

Figure 25. Control panel: Tracer AdaptiView main unit assembly (showing low voltage and higher voltage areas for proper routing of field wiring)



Installing the Tracer AdaptiView Display

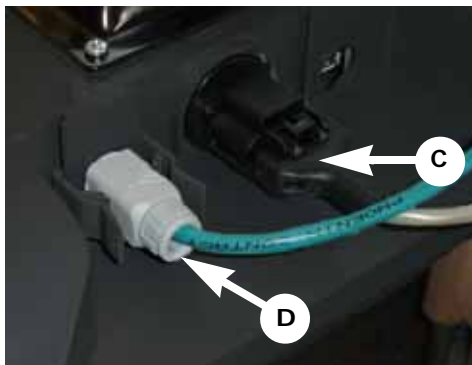
The Tracer AdaptiView display is boxed, shrink-wrapped, and strapped to the shear plate between the evaporator and condenser during shipment. The Tracer AdaptiView display must be installed at the site.

Important: The Tracer AdaptiView display is to be installed by Trane, or an agent of Trane.

1. Unwrap the chiller. Locate the box containing the Tracer AdaptiView display strapped to the shear plate between the condenser and the evaporator.



2. Remove the Tracer AdaptiView display from the box.
Note: Screws are M4 (metric size 4), 6 to 8 mm long, and are shipped with the display.
3. Plug the power cable (C) and the Ethernet cable (D) 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 Tracer AdaptiView display is horizontal.

⚠ CAUTION

Tension in Display Support Arm!

To prevent unexpected movement of the spring-loaded support arm, ensure that the support arm is in the full upright position when removing the Tracer AdaptiView display from the support arm. Failure to do so could result in personal injury.

Note: Review "Adjusting the Tracer AdaptiView Display Arm," p. 37 prior to 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.

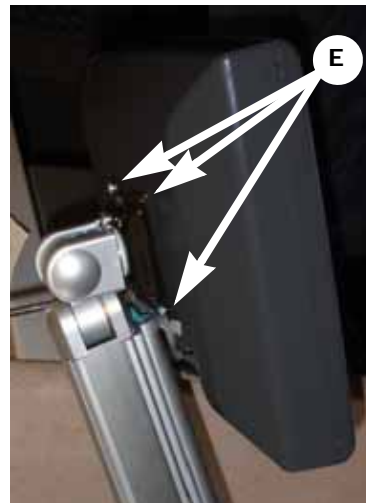
Note: Ensure the Trane logo is positioned so that it will be at the top when the Tracer AdaptiView display is attached to the display support arm.

NOTICE:

Do Not Drop Display!

As you position the Tracer AdaptiView display on top of the display support arm base plate, keep a firm grip on the display. Failure to do so could result in equipment or property-only damage.

6. Align the four holes in the display with the bolt holes in the display support arm base plate.
7. Attach the Tracer AdaptiView display to the display support arm base plate (E) using the M4 (metric size 4) screws referenced in [Step 2](#).



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 [Figure 26](#)).

Figure 26. Alternate location for Tracer Adaptiview display



1. Remove the wires from the display arm.
2. Unbolt the display arm from the display mounting bracket on the front side of the chiller.
3. Bolt the display arm to the suction elbow bracket reusing the bolts removed in [Step 2](#).
4. Reroute the wires and secure them to the display arm.

Adjusting the Tracer AdaptiView Display Arm

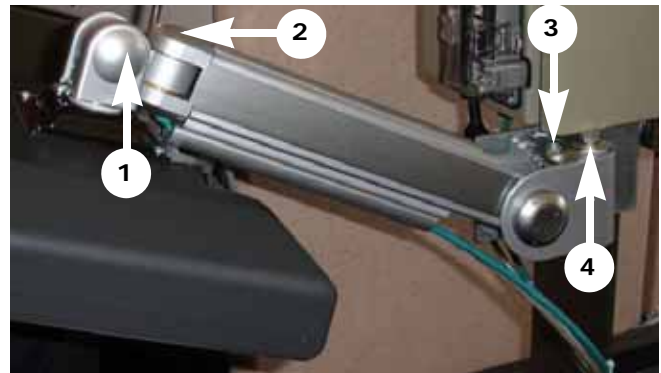
The Tracer AdaptiView display arm may become too loose or too tight and need adjustment. There are three joints on the display arm that allow the Tracer AdaptiView display to be positioned at a variety of heights and angles (refer to items labeled 1, 2, and 3 in [Figure 27](#)).

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.

Figure 27. Joint locations on the display arm



- 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 hex bolt. Adjust using a 13 mm wrench as necessary.
- To adjust the swivel rotation tension of the Tracer AdaptiView display, adjust the hex bolt located in the support arm base plate, as described in [Step 7](#) in [“Installing the Tracer AdaptiView Display,” p. 36](#). This adjustment must be done prior to attaching the Tracer AdaptiView 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 bolt labeled 4 in [Figure 27](#).



Electrical Requirements

Installation Requirements

⚠ WARNING

Electrocution and Fire Hazards with Improperly Installed and Grounded Field Wiring!

Improperly installed and grounded field wiring poses **FIRE & ELECTROCUTION** hazards. To avoid these hazards, you **MUST** follow requirements for field wiring installation and grounding as described in NEC and your local/state electrical codes. All field wiring **MUST** be performed by qualified personnel. Failure to follow these requirements could result in death or serious injury.

Unit-mounted 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,
- other unit control options present, and
- any field-supplied control devices.

Important: If the AFD ships separate or needs to be removed in the field, refer to "AFD Removal and Installation," p. 70.

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 state and local 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:

Component Damage!

Remove all debris from inside the AFD panel. Failure to do so could result in an electrical short and could cause serious 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-SVB06A-EN.

⚠ WARNING

Hazardous Voltage w/Capacitors!

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 an appropriate voltmeter that all capacitors have discharged. Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.

For additional information regarding the safe discharge of capacitors, see PROD-SVB06A-EN

⚠ WARNING

Personal Protective Equipment (PPE) Required!

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

⚠ WARNING**Live Electrical Components!**

During installation, testing, servicing and troubleshooting of this product, it may be 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. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.



Power Supply Wiring

⚠ WARNING

Ground Wire!

All field-installed wiring must be completed by qualified personnel. All field-installed wiring must comply with NEC and applicable local codes. Failure to follow this instruction could result in death or serious injuries.

Three-Phase Power

Review and follow the guidelines below to properly install and connect the power supply wiring to the 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:

AFD Damage!

Debris inside the AFD panel may cause an electrical short. Failure to follow this instruction could result in equipment damage.

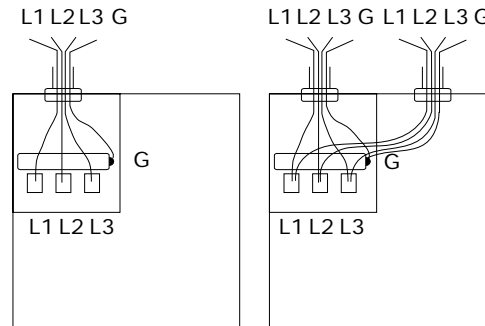
NOTICE:

Use Copper Conductors Only!

Unit terminals are not designed to accept other types of conductors. Failure to use copper conductors could result in equipment 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.
- 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 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 below) 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).

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 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!

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 an appropriate voltmeter that all capacitors have discharged. Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.

For additional information regarding the safe discharge of capacitors, see PROD-SVB06A-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!

Do not cut holes in adaptive frequency drive enclosure. Debris falling inside of adaptive frequency drive could cause failure of electronic components. Failure to follow this precaution could result in damaged equipment.

3. Once removed, 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 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 bolting 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 bolted 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 bolt or 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 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!

When tightening connections at the drive terminals, take care to avoid stressing the IGBTs. The IGBTs are connected to the other end of the terminal bar, and stressing them could cause equipment damage.

Cabinet Wire Routing

All wiring should be installed in conformance with the applicable local, 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.

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 the ground connections to 375 in-lb (42.4 N·m).

⚠ WARNING

Hazardous Voltage/Improper Grounding!

All field-installed wiring must be completed by qualified personnel. All field-installed wiring must comply with NEC and applicable local codes. Failure to follow this instruction could result in death or serious injuries.

NOTICE:

Equipment Damage!

Do not route signal and control wiring with power wiring in the same conduit. This can interfere with drive operation. Failure to observe this precaution could result in damage to the equipment.

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 65,000 amps.



System Control Circuit Wiring (Field Wiring)

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.

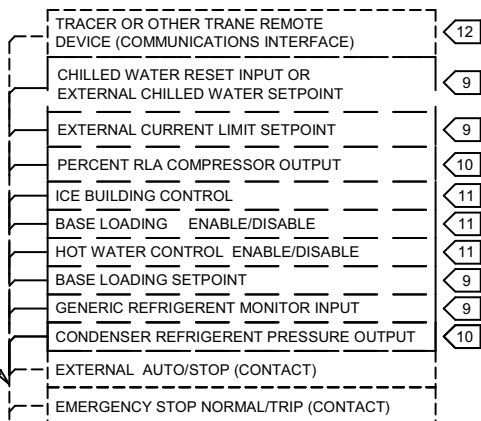
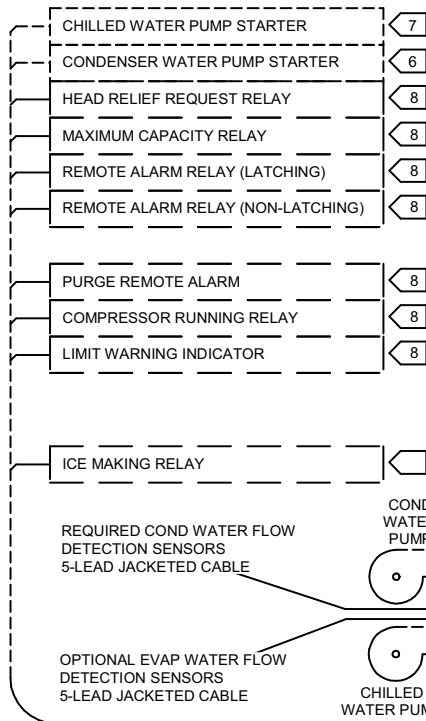
REQUIRED

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.

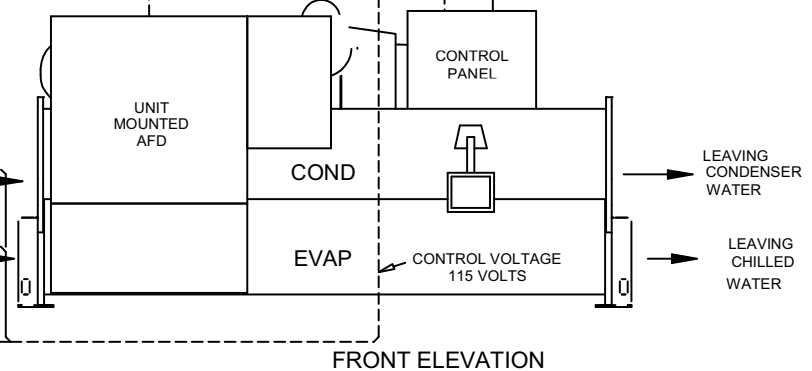
- 6 2 WIRES, 115 VAC CIRCUIT, SEPARATE POWER SUPPLY IS REQUIRED. MINIMUM CONTACT RATING AT 115 VAC - 2.88 INDUCTIVE 1/3 H.P. (.25 kW) AT 115 VAC REQUIRED.
- 7 2 WIRES, 115 VAC CIRCUIT, SEPARATE POWER SUPPLY IS REQUIRED. CONTACTS ARE N.O. CONTACT RATING - 2.88 INDUCTIVE 1/3 H.P. (.25 kW) AT 115 VAC OPTIONAL.
- 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.

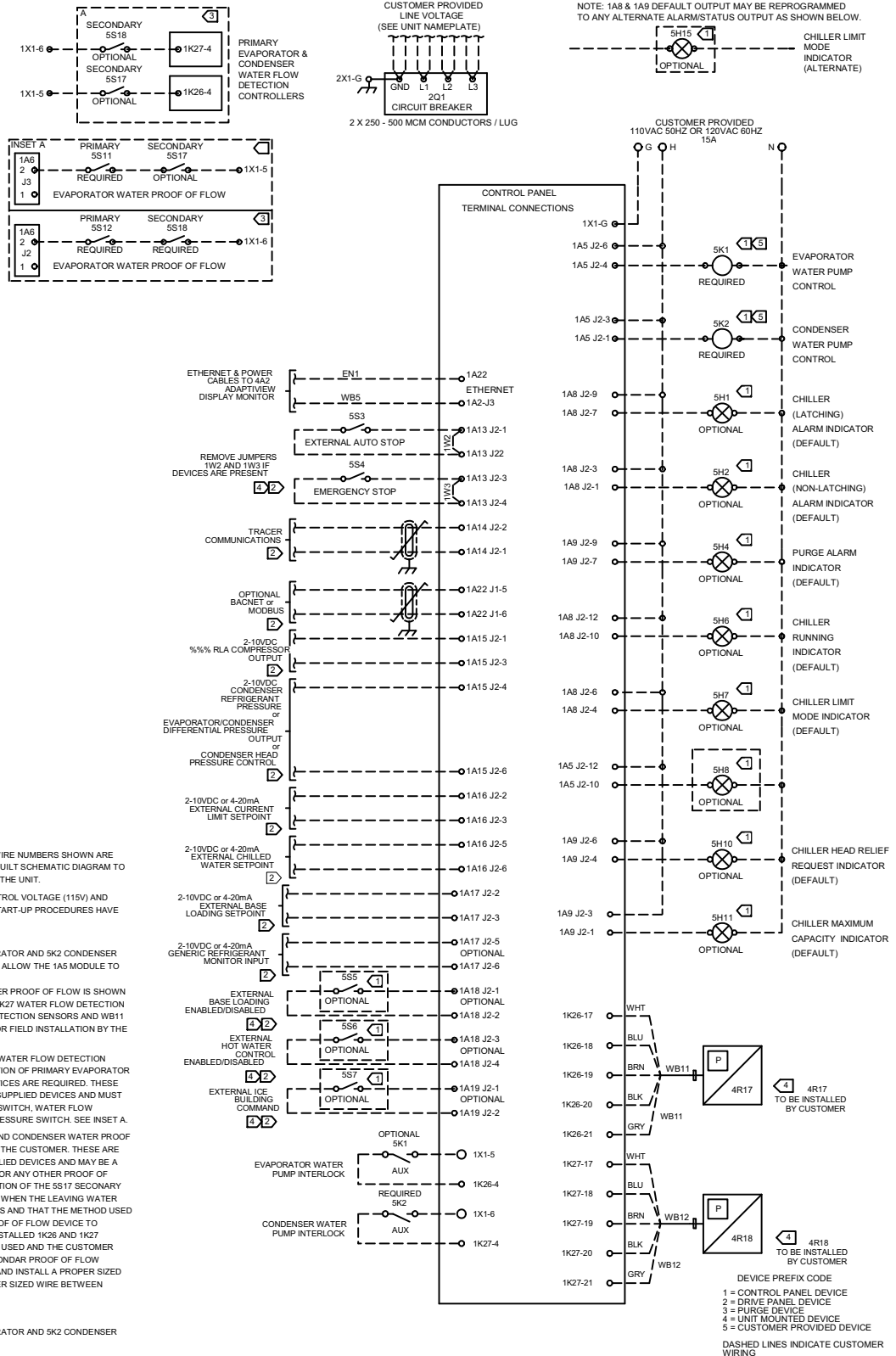
LOW VOLTAGE (30V MAX)
DO NOT RUN WITH HIGHER
VOLTAGE CIRCUITS



LINE
VOLTAGE
(SEE NAMEPLATE)



System Control Circuit Wiring (Field Wiring)





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 ^(a)	1X1-5 to 1A6-J3-2	Binary Input	Normally Open, closure with flow
Condenser Water Flow Proving Input ^(b)	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
Optional Control Circuits (120 Vac)			
Note: 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
Standard Low Voltage Circuits (less than 30 Vac)^(c)			
	Unit Control Panel Terminations	Input or Output Type	Contacts
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
Optional Low Voltage Circuits			
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	IPC bus Connection and sensor	Communication and sensor	
Tracer 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, 65(+) to 6(-)	Communication to BACnet or MODBUS	(as ordered, see sales order)

Note: All wiring to be in accordance with National Electrical Codes 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 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 1X1-5 to 1K27-4 (binary input; normally open, closure with flow). Remove factory jumper when used.

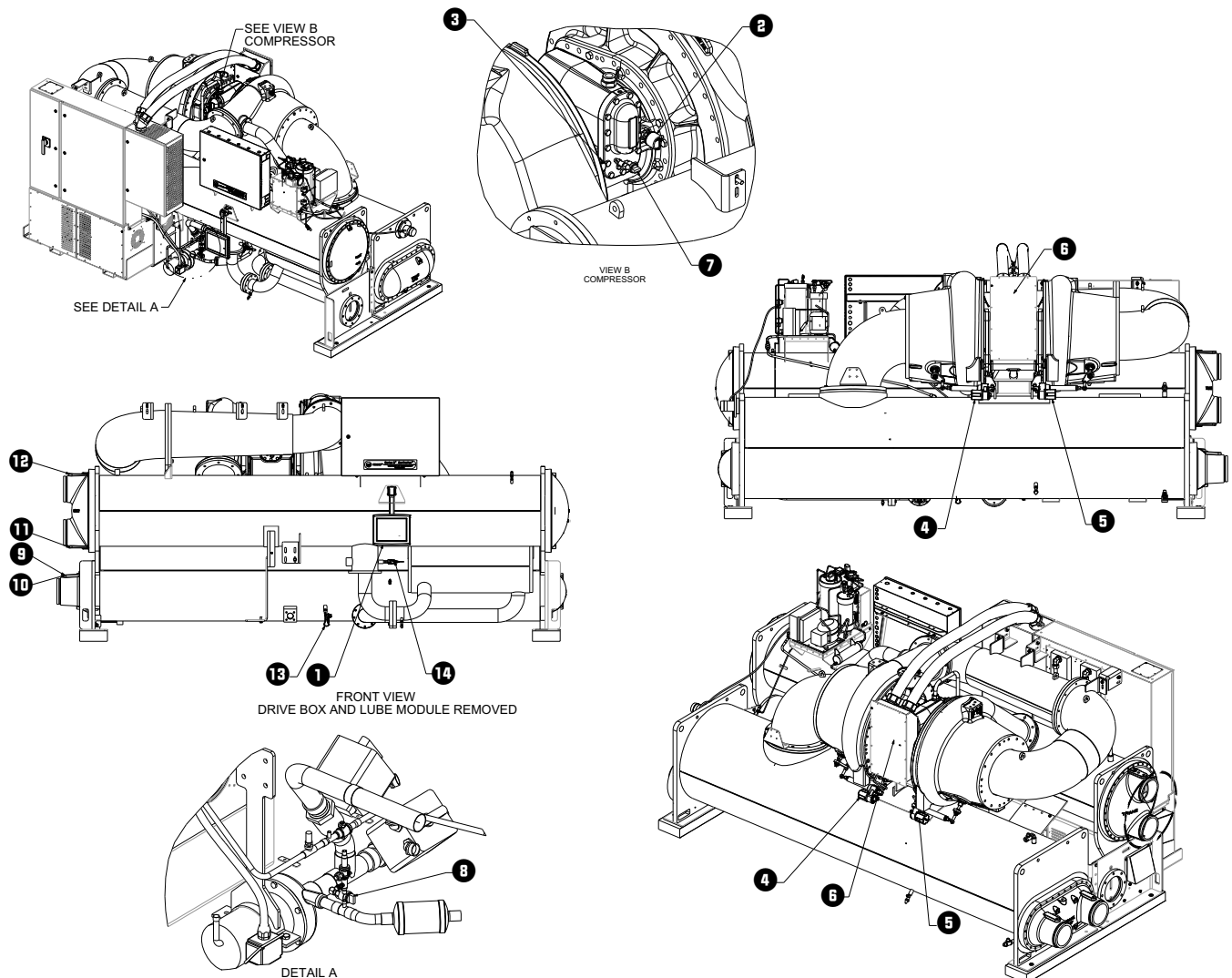
(c) Standard low-voltage circuits (less than 30 Vac) must be separated from 120 Vac or higher wiring.

Temperature Sensor Circuits

All temperature sensors are factory installed except the optional outdoor air temperature sensor. 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 28. CVHS sensor locations



1. 4A2, ADAPTIVIEW DISPLAY, MONITOR DISPLAY
2. 4B3, FIRST STAGE BEARING LUBE FLOW SENSOR, SENSOR - FLOW
3. 4B4, SECOND STAGE BEARING LUBE FLOW SENSOR, SENSOR - FLOW
4. 4M2, INLET GUIDE VANE FIRST STAGE ACTUATOR, ACTUATOR
5. 4M4, INLET GUIDE VANE SECOND STAGE ACTUATOR, ACTUATOR
6. 4M1R2, 3 MOTOR WINDING TEMPERATURE 1, 2 SENSOR - TEMP
7. 4R3, REFRIGERANT PUMP DISCHARGE PRESSURE TRANSDUCER, SENSOR - PRESS TRANSDUCER

8. 4R4, REFRIGERANT PUMP SUCTION PRESSURE TRANSDUCER, SENSOR - PRESS TRANSDUCER
9. 4R6, EVAPORATOR ENTERING WATER TEMPERATURE, SENSOR - TEMP
10. 4R7, EVAPORATOR LEAVING WATER TEMPERATURE, SENSOR - TEMP
11. 4R8, CONDENSER ENTERING WATER TEMPERATURE, SENSOR - TEMP
12. 4R9, CONDENSER LEAVING WATER TEMPERATURE, SENSOR - TEMP
13. 4R10, EVAPORATOR SATURATED REFRIGERANT TEMPERATURE, SENSOR - TEMP
14. 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 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 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 14–18 AWG 600V wires of sufficient length to reach the desired outdoor location with a maximum length 1000 feet (305 meters). The module four-wire bus must be connected to the



System Control Circuit Wiring (Field Wiring)

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 tape off the shield wire 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 inches between low-voltage (<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 (see [Table 11, p. 44](#)).

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 guide that ships with the Tracer.

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.

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 CVHS chillers are covered in this section. This includes both 50 and 60 Hz centrifugal chillers equipped with the Tracer AdaptiView UC800 control system. By carefully reviewing this information and following the instructions given, the owner or operator can successfully operate and maintain a CenTraVac unit. If mechanical problems do occur, however, contact a Trane service technician to ensure proper diagnosis and repair of the unit.

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 first stage impeller.

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 (see Figure 30). 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, passes through another orifice plate and into the evaporator.

Figure 29. Pressure enthalpy curve

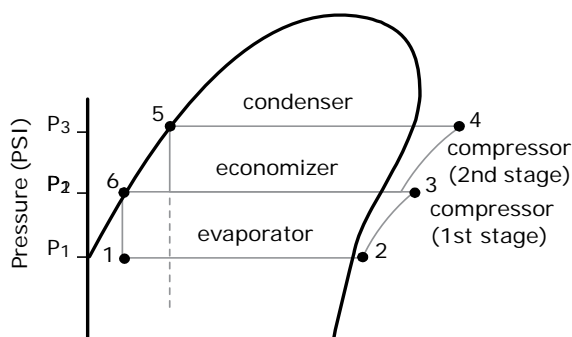
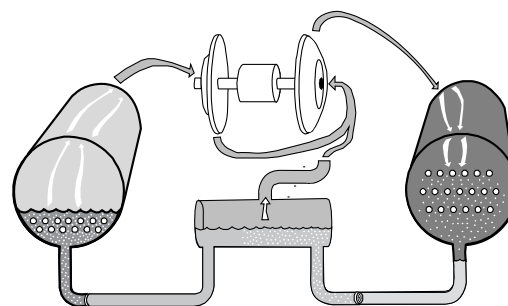
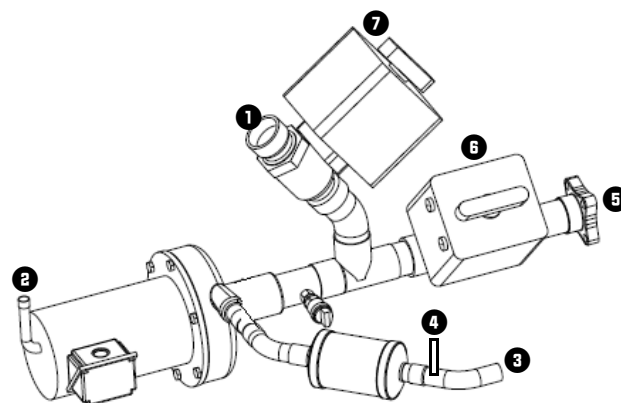


Figure 30. Refrigerant flow



Refrigerant Pump

Figure 31.



1. Condenser source line
2. Pump motor coolant return
3. To compressor motor
4. To drive
5. Evaporator source line
6. Evaporator source valve
7. Condenser source valve

The system has two refrigerant source valves (evaporator and condenser source valves) to supply liquid refrigerant from evaporator and/or condenser. The refrigerant pump



Operating Principles

supplies refrigerant liquid to lubricate and cool the compressor bearings, motor and AFD. The chiller control monitors the chiller parameters to provide refrigerant from the proper source (condenser and/or evaporator).

The condenser source valve provides system flexibility and allows smooth priming of the pump since it shields the pump from refrigerant vapor coming from the condenser to the pump during startups and restarts. The condenser source valve allows the end-user to operate the condenser water pump independently from the chiller without effecting the chiller starts and restarts.

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 and reports put information conveniently at your fingertips. For more information, refer to *Tracer AdaptiView™ Display for Water-Cooled CenTraVac™ Chillers Operations Guide* (CTV-SVU01D-EN, or the most recent version).

AFD

Introduction

The AFD refrigerant-cooled Adaptive Frequency Drive is a pulse width modulated (PWM) design incorporating an IGBT (Insulated Gate Bipolar Transistor) 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 350–900 Vdc with a steady state range of 480–780 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:

- Less than or equal to 5 percent total demand distortion (TDD). (Optional)

- 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 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 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

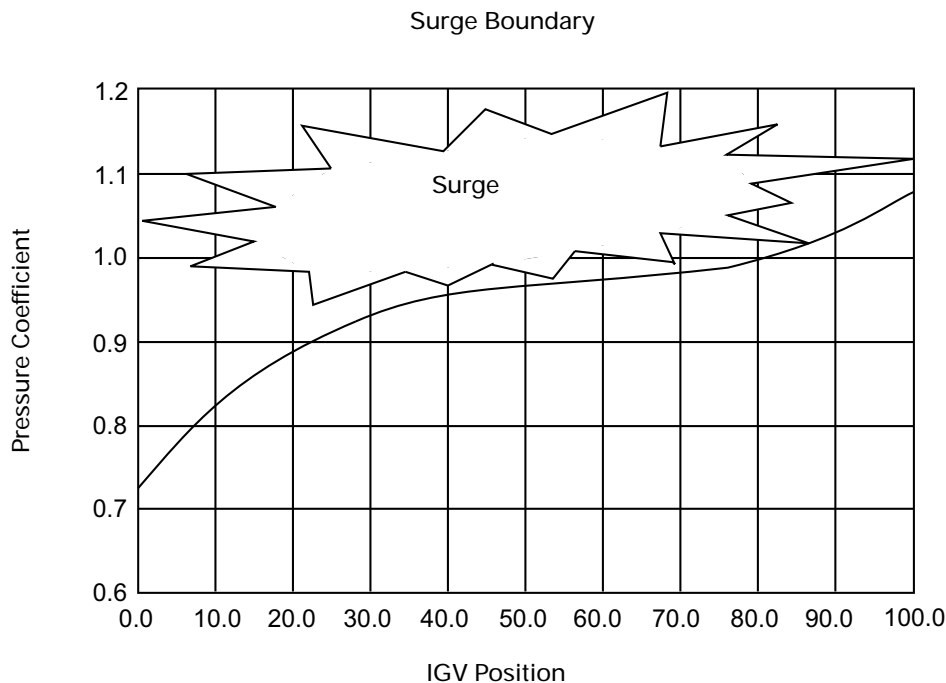
The adjustable speed control algorithm of the Tracer UC800 control was developed to operate near the surge boundary by periodically testing to find the surge boundary and then holding conditions at an optimal distance from surge. Once the optimal operating condition is found the algorithm can avoid the 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 AFD Sequence of Operation

In the UC800, the chiller/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.

Figure 32. Pressure coefficient surge boundary



AFD 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. At the heart of the control is a match model that describes the relationship between control parameters and actuators. This model has converted a complicated multi variable control problem to a system of algebraic equations. The equations cannot be solved directly, so a binomial search algorithm is used iteratively to find a solution. A new solution is found every 5 seconds. This is possible because of the increased performance of the microprocessor available with the UC800.

Compressor Pressure Coefficient

The non-dimensional pressure coefficient is derived based on turbo machinery principles. Fundamentally, the pressure coefficient is the ratio between the potential energy based on the pressure rise across the compressor and the kinetic energy of the refrigerant at the compressor discharge. This normalized equation uses enthalpy change across the compressor as a measure of potential energy and compressor parameters such as average impeller diameter, speed, and number of stages, to determine kinetic energy.

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.

Startup

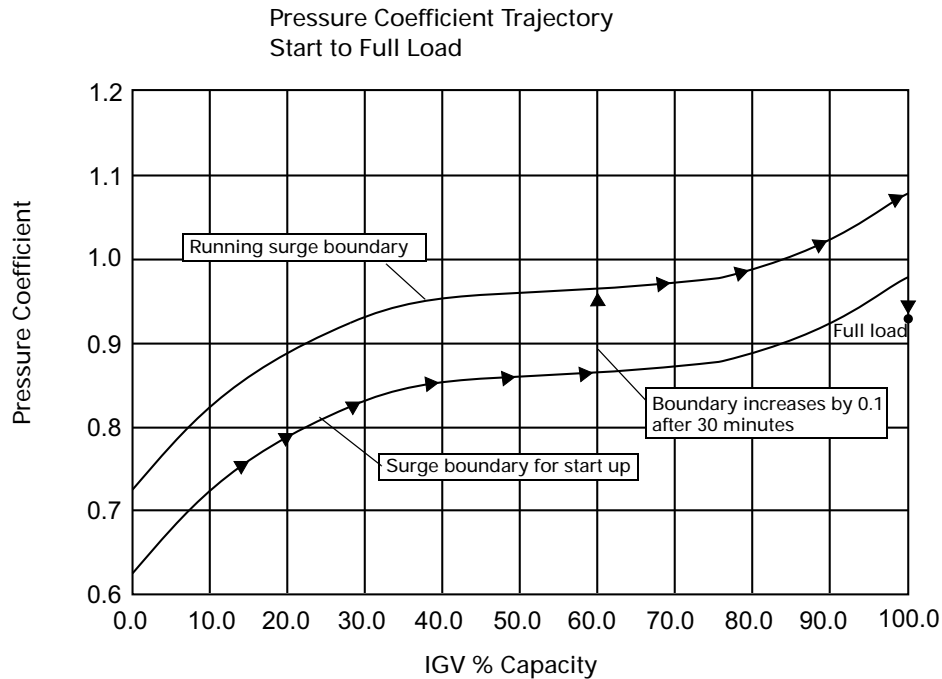
The starting speed for AFD under UC800 control will vary depending upon the pressure ratio across the compressor. For most starts, the pressure ratio will be small and the AFD will start at its minimum speed. The speed will be adjusted every 5 seconds in response to changing pressure ratio and load requirements.

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

Operating Principles

and water loop conditions. After reaching this condition the control will do a re-optimization.

Figure 33. Startup surge boundary



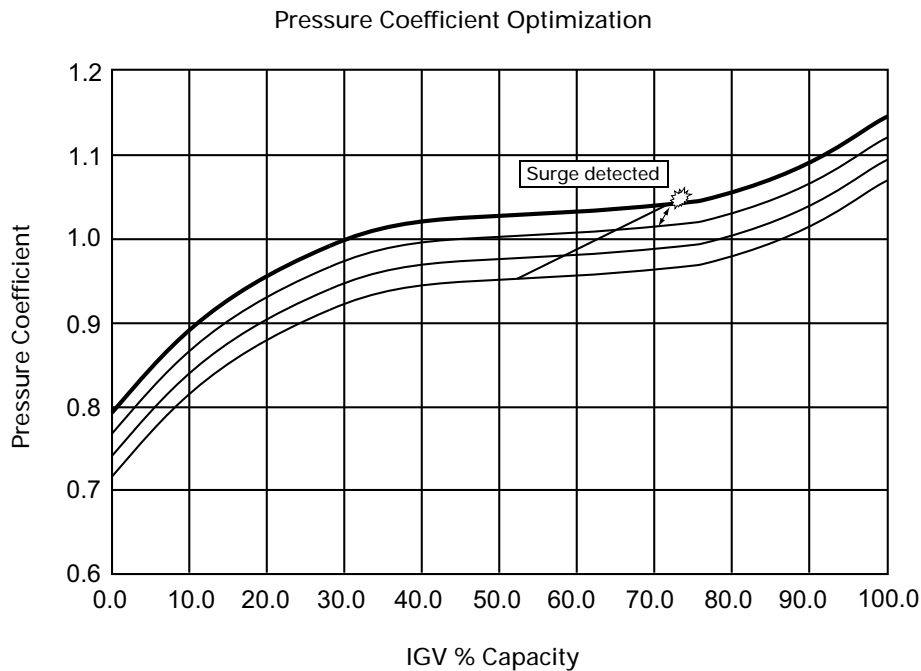
Re-optimization

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 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 34. Boundary re-optimization



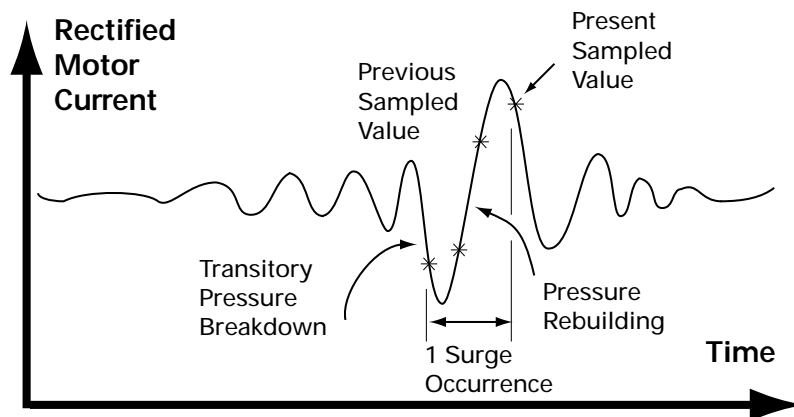
Surge Recovery

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 5 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 [Figure 35](#). 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 35. Motor current signature representing surge



Operating Principles

UC800 Interface to Adaptive Frequency Drive

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

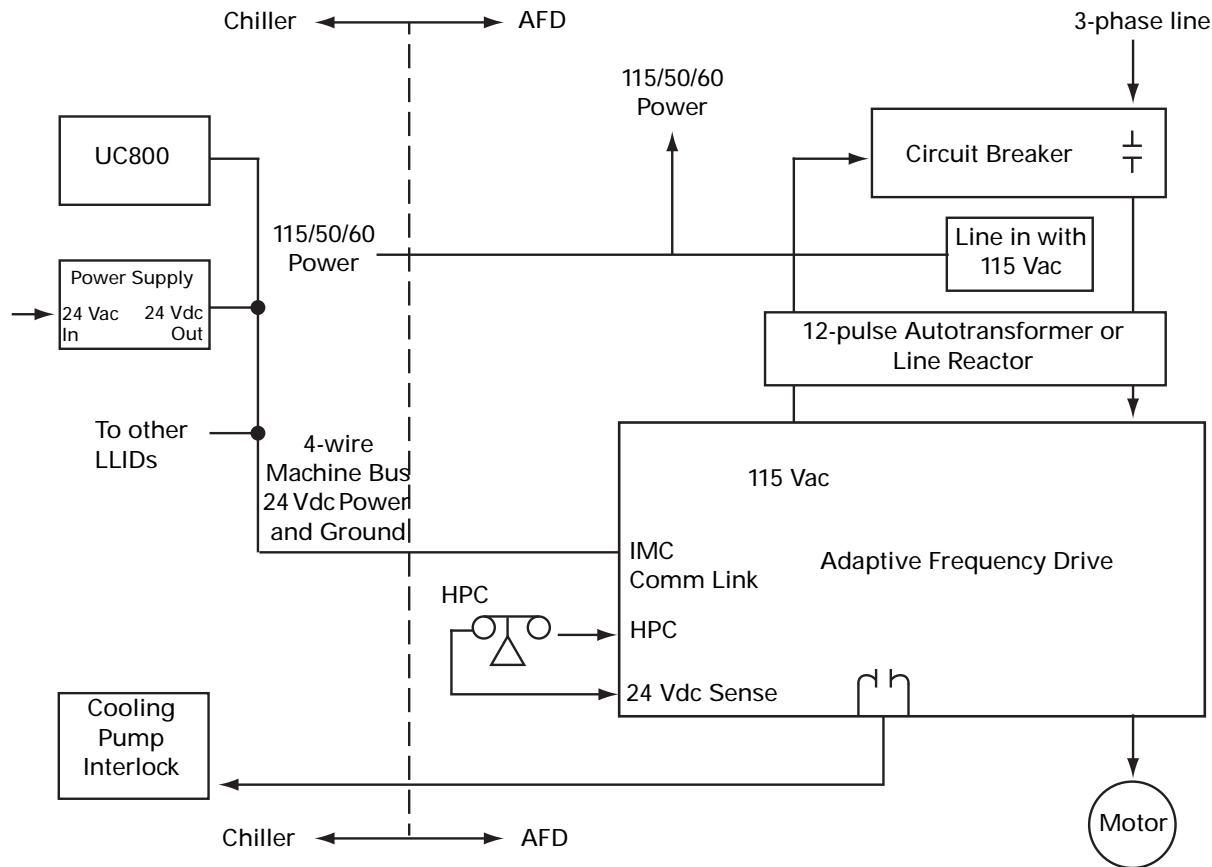
High Pressure Cutout – The inverter accepts a NC HPC switch (at terminals 2X2-22 and 2X2-23). In the event of a chiller high pressure condition, the HPC switch opens, the drive shall shut down and de-energize the motor.

Output contacts are required to control the load of the refrigerant pump motor. The contacts are Normally Open, and closed when the AFD energizes the motor.

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

The block diagram (see [Figure 36](#)) shows the communication of the UC800 to the AFD.

Figure 36. UC800 to unit mounted inverter interface block diagram



AFD Cooling Circuit

The AFD Adaptive Frequency Drive is cooled with liquid R-123 refrigerant from the chiller. The refrigerant pump on the chiller takes refrigerant from the chiller and pushes it upwards to the motor to provide motor cooling. The AFD taps into this refrigerant flow and diverts a portion of the refrigerant to the drive.

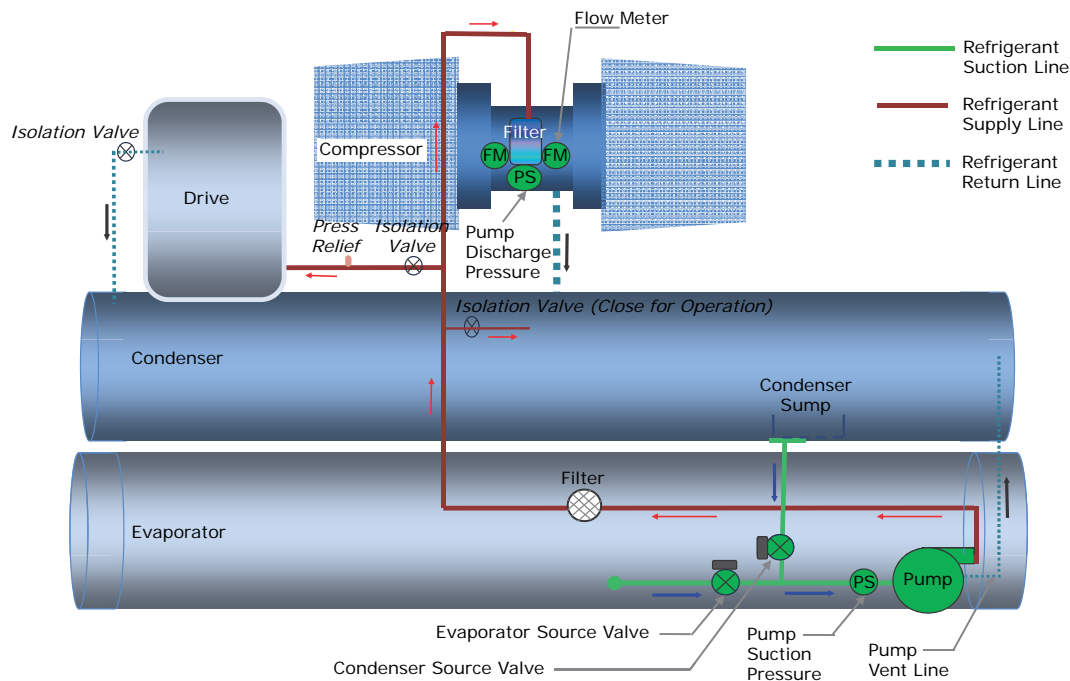
The refrigerant coolant enters the drive through the lower SAE fitting(s) on the back of the drive enclosure. The

refrigerant flows upwards through the drive and removes heat from the assembly. The refrigerant exits the drive at the top SAE fitting(s) and flows to join the refrigerant return from the motor.

The differential pressure across the refrigerant pump is normally 10 to 15 psid.

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 302°F (150°C).

Figure 37. Schematic of the cooling circuit



Start-up and Shut-down

This section will provide basic information on chiller operation for common events. With microelectronic controls, ladder diagrams cannot show today's complex logic, as the control functions are much more involved than older pneumatic or solid state controls.

Sequence of Operation

Adaptive control algorithms can also complicate the exact sequence of operation. This section illustrates common control sequences.

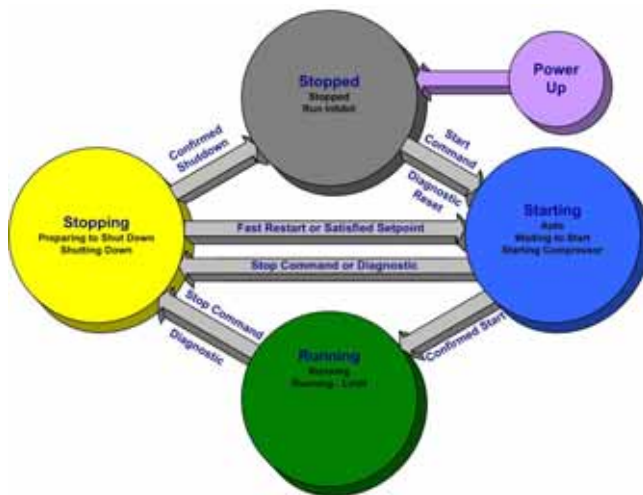
Software Operation Overview Diagram

Figure 38 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.

Descriptions

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

Figure 38. Software operation overview



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

- Power Up
- Stopped
- Starting
- Running
- Stopping

Descriptions

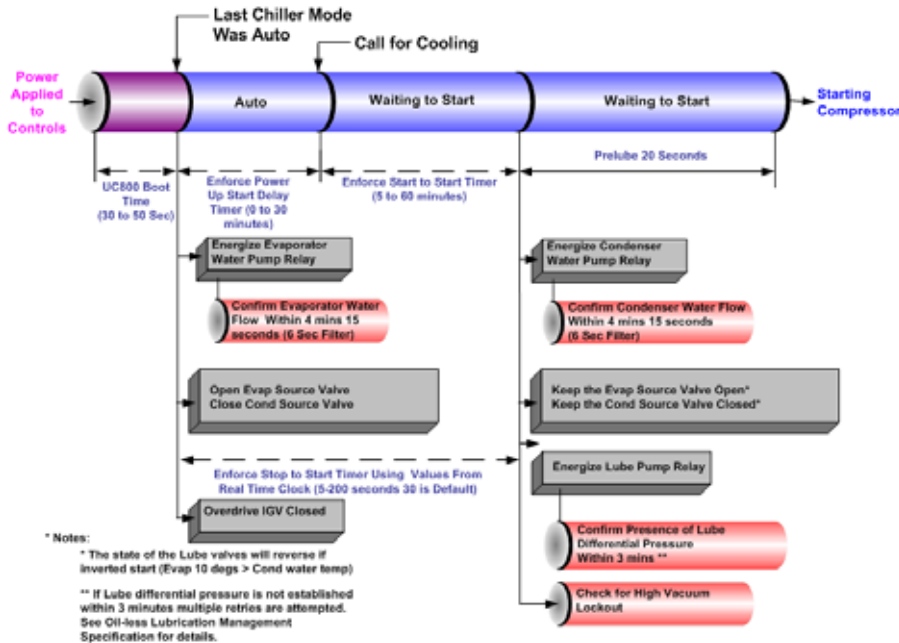
- The time line indicates the upper level operating mode, as it would be viewed on Tracer AdaptiView.
- The shading color of the cylinder indicates the software state.
- Text in parentheses indicates sub-mode text as viewed on Tracer AdaptiView.
- Text above the time line cylinder is used to illustrate inputs to the Main Processor. This may include User input to the Tracer AdaptiView Touch screen, Control inputs from sensors, or Control Inputs from a Generic BAS.
- Boxes indicate Control actions such as Turning on Relays, or moving the Inlet Guide Vanes.
- Smaller cylinders indicate diagnostic checks, text indicates time based functions, solid double arrows indicate fixed timers, and 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 main processors logic decides to start the chiller based on the differential to start setpoint. With the differential to start criteria met, the module then energizes condenser water pump relay with customer supplied power (see Figure 39, p. 55).

Based on the Restart Inhibit function and the Differential to Start setpoint, the refrigerant pump is energized. The refrigerant pump differential pressure must be at least X psid for 20 continuous seconds and condenser water flow verified within 4 minutes and 15 seconds for the compressor start sequence to be initiated.

Figure 39. Sequence of operation: power up to starting



Now that the compressor motor is running, the inlet guide vanes and 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 (see Figure 40).

If the chilled water temperature drops below the chilled water set point 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 refrigerant 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 main processor module monitors leaving chilled water temperature preparing for the next compressor motor start based on the “differential to start” setpoint.

Figure 41, p. 56 illustrates this sequence.

Figure 40. Sequence of operation: running

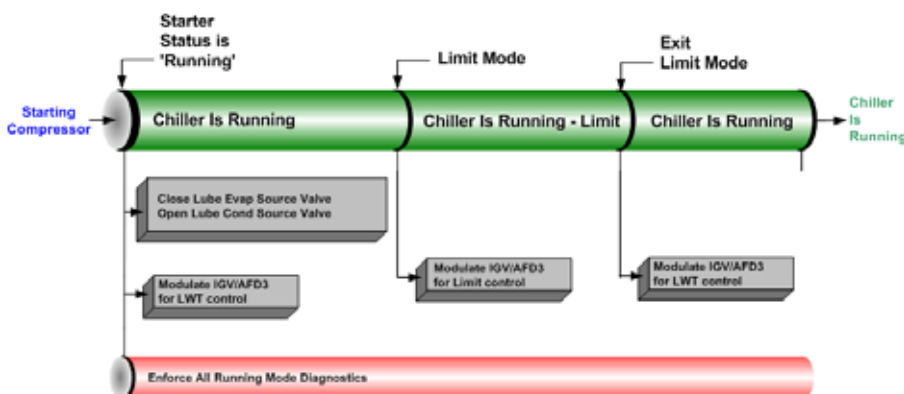
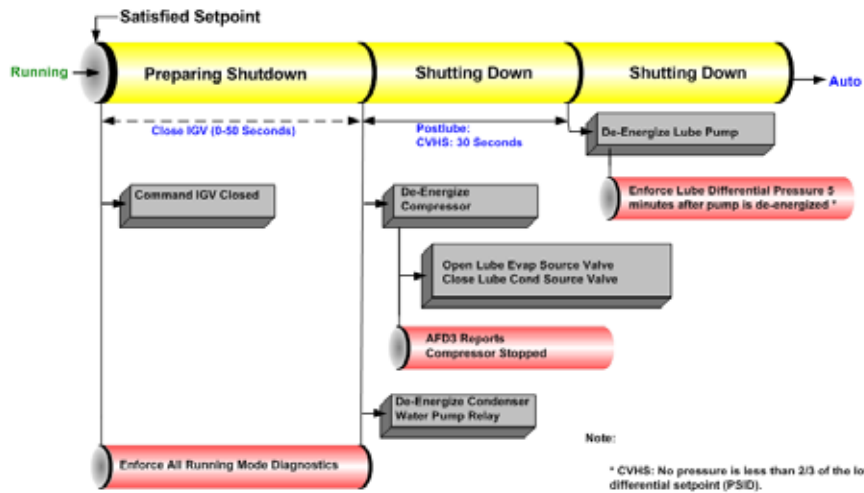


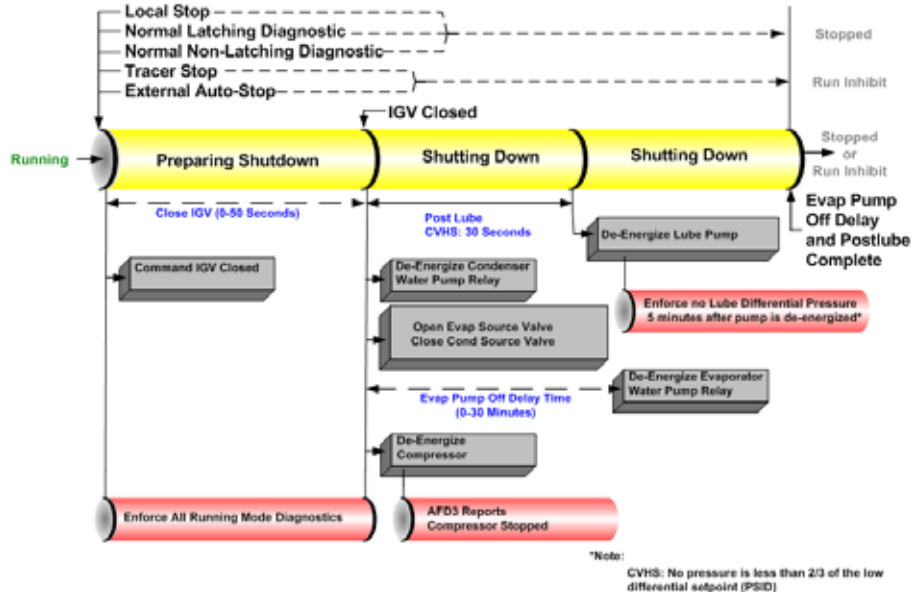
Figure 41. Sequence of operation: satisfied setpoint



If the STOP key is pressed on the operator interface, the chiller will follow the same stop sequence as above except the chilled water pump relay will also open and stop the chilled water pump after the chilled water pump delay timer has timed out after compressor shut down (see Figure 42).

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.

Figure 42. Sequence of operation: normal shut-down to stopped and run inhibit



Power Up Diagram

Figure 39, p. 55 illustrates Tracer AdaptiView during a power up of the main processor. This process takes from 30 to 50 seconds depending on the number of installed Options. On all power ups, the software model always will transition through the Stopped software state independent of the last mode. If the last mode before power down was Auto, the transition from Stopped to Starting occurs, but it is not apparent to the user.

Hot Water Control

Occasionally CTV 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 Main Processor 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 and 60°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).

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 and main processor 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-SVU01D-EN, or the most recent version).

The control panel houses several other controls modules called panel mounted LLID (Low Level Intelligent Device), power supply, terminal block, fuse, circuit breakers, and transformer. The IPC (Interprocessor communication) bus allows the communications between LLIDs and the main processor. 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 twenty-four other languages. Switching languages is simply accomplished from a language settings menu.

Unit Start-up and Shut-down Procedures

WARNING

Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be 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. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

⚠ WARNING**Toxic Hazards!**

Do not allow the chiller to increase above 110°F in temperature while unit is off. 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 Kpa). 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. Should a rupture disk fail, evacuate the area immediately and contact the appropriate rescue or response authority. Failure to follow instructions could result in death or serious injury.

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

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 30-second post-lube period. The evaporator pump may continue to run for the amount of time set using Tracer AdaptiView.

Once 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. When all air is removed from the system (including each 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. 58.](#)

Daily Unit Shut-down

Note: Also refer to [Figure 42, p. 56.](#)

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

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 [Table 13, p. 61](#) and [Table 14, p. 61](#) 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 noncondensables 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!

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 an appropriate voltmeter that all capacitors have discharged. Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.

For additional information regarding the safe discharge of capacitors, see *PROD-SVB06A-EN*

NOTICE:

Check Purge Run-Time for Unit Hermetic Integrity!

If frequent purging is required, monitor purge pumpout rate, identify and correct source of air or water leak as soon as possible. Failure to do so could shorten chiller life expectancy, due to moisture contamination caused by leakage.

NOTICE:

Do Not Use Non-Compatible Parts or Materials!

Only genuine Trane® replacement components with identical Trane part numbers should be used in Trane CenTraVac chillers. Use of non-compatible parts or materials could result in equipment damage. 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: EarthWise™ Purge System with Tracer AdaptiView™ Control for Water-Cooled CenTraVac™ Chillers* (PRGD-SVX01B-EN, or the most recent version).

Record Keeping Forms

An important aspect of the chiller maintenance program is the regular completion of records. Refer to [“Forms and Check Sheets,” p. 74](#) 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, he can systematically check, 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 / -9 to -6 psig
Approximate Condenser Pressure ^{(a), (b)}	17 to 27 psia / 2 to 12 psig (standard condenser)

(a) Condenser pressure is dependent on condenser water temperature, and should equal the saturation pressure of HCFC-123 at a temperature above that of leaving condenser water at full load.

(b) Normal pressure readings for ASME condenser exceed 12 psig.

Recommended Maintenance

Table 13. Recommended maintenance

Daily	Every 3 months	Every 6 months	Annually ^{(a), (b)}
Check the chiller's evaporator and condenser pressures. Compare the readings with the values provided in Table 12, p. 60 .			
Complete logs on a daily basis.			
	Clean all water strainers in the water piping system.		
		Lubricate vane operator tang O-rings.	
		Drain contents of the rupture disc and purge discharge ventline 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 "CVHS Annual Inspection List" (refer to "Forms and Check Sheets," p. 74).
			Perform the annual maintenance procedures referred to in the maintenance section of the purge manual.
			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 [-18°C to 32°C]), check its accuracy at six-month intervals.
			Inspect the condenser tubes for fouling; clean if necessary.
			Check sensors and controls for proper operation.

(a) Every three years, use a nondestructive 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.

(b) 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 and evaporator or condenser water tube leaks.

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. 64 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. 64 for more information.		
Gantries			Lubricate the gantries annually. Use ConocoPhillips MegaPlex® XD3 (gray in color), LPS® MultiPlex Multi-Purpose (blue in color), or equivalent.
Hinges			Lubricate the hinges annually. Use ConocoPhillips MegaPlex® XD3 (gray in color), LPS® MultiPlex Multi-Purpose (blue in color), or equivalent.

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 noncondensables 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 Trane EarthWise™ Purge is the only purge system available for the CenTraVac chiller. The purge is designed to remove noncondensable gases and water from the refrigeration system. EarthWise Purge unit operation, maintenance and troubleshooting is covered by a separate



Recommended Maintenance

operation and maintenance manual, which may be obtained from the nearest Trane office.

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.

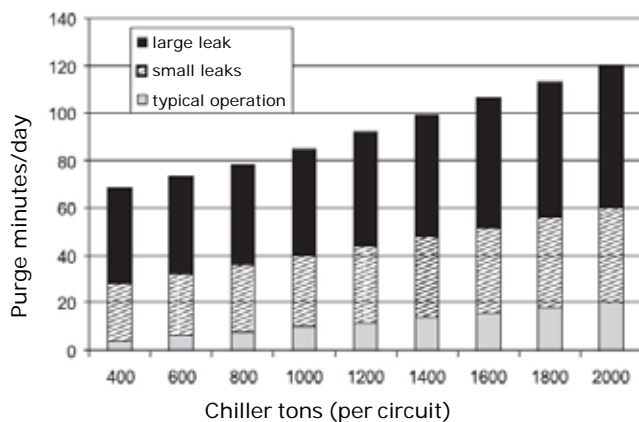
Formula: % annual leakage rate = $[(X \text{ min/day}) * (0.0001 \text{ lb R-123/min}) / (Y \text{ lb})] * 100$

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

Figure 43 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 the 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 43. 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!

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

NOTICE:

Freezing Tubes Hazard!

Ensure that water is not present in tubes during evacuation. Failure to follow this instruction could result in freezing tubes, damaging the chiller.

Refrigerant Charge

⚠ WARNING

Refrigerant May Be Under Positive Pressure!

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

Refer to *Installation, Operation, and Maintenance: Refrigerant Handling Guidelines - A Guide for the Service Technician's Conservation & Safe Handling of Low-Pressure Refrigerants in Trane® Chillers* (CTV-SVX05B-EN, or the most recent revision).

Leak Testing

⚠ WARNING

Hazard of Explosion!

Never use an open flame to detect gas leaks. Explosive conditions may occur. Use a leak test solution or other approved methods for leak testing. Failure to follow recommended safe leak test procedures could result in death or serious injury or equipment or property-only damage.

⚠ WARNING

Hazardous Pressures!

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. Failure to follow these safety precautions could result in a sudden rise of pressure possibly resulting in a violent explosion which could result in death or serious injury.

Important: If leak testing is required, contact a Trane service agency.

Recommended System Maintenance

NOTICE:

Proper Water Treatment!

The use of untreated or improperly treated water in a CenTraVac could result in scaling, erosion, corrosion, algae or slime. It is recommended that the services of a qualified water treatment specialist be engaged 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.

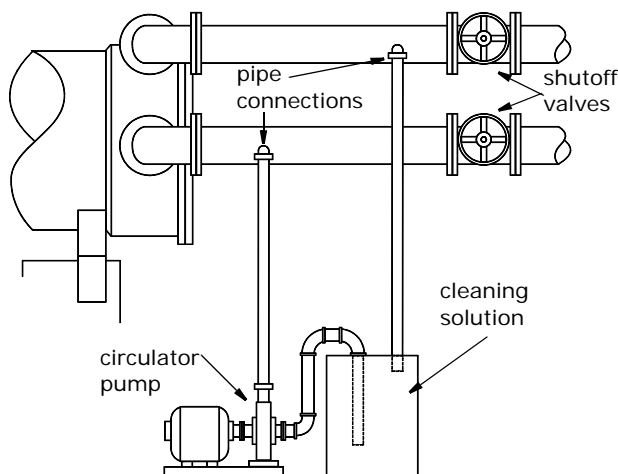
Condenser

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 44. Typical chemical cleaning setup



1. Follow all instructions in [“Waterbox Removal and Installation,” p. 67](#) 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.

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!

Proper procedures must be followed when using corrosive chemicals to clean water side of unit. It is recommended that the services of a qualified chemical cleaning firm be used. Proper personal protective equipment as recommended by the chemical manufacturer should be used. Refer to the chemicals MSDS sheet for proper safety procedures. Failure to follow proper procedures could result in corrosion damage to the unit and tubes.

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.



Recommended Maintenance

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 that anode inspection 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!

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. Failure to follow these instructions could result in equipment damage.

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

AFD

Visual Inspection—Power Removed

⚠ WARNING

Hazardous Voltage w/Capacitors!

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 an appropriate voltmeter that all capacitors have discharged. Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.

For additional information regarding the safe discharge of capacitors, see PROD-SVB06A-EN

1. Check the refrigerant coolant lines and SAE fitting connections to ensure they are tight and do not leak.
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.

Operational Inspection—Power Applied

⚠ WARNING

Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be 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. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

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. Make Chiller Service report to document all setpoints.
6. Check the UC800 alarm histories for any indications of operational problems.

Routine Maintenance

The AFD requires minimal routine maintenance. A routine visual inspection every one to two years is adequate.

⚠ WARNING

Hazardous Voltage w/Capacitors!

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 an appropriate voltmeter that all capacitors have discharged. Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.

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. After disconnecting input power, wait five (5) minutes for the DC capacitors to discharge and then check the voltage with a voltmeter to ensure the dc bus capacitors are discharged before touching any internal components. Failure to observe this precaution could result in death or serious injury.

For additional information regarding the safe discharge of capacitors, see PROD-SVB06A-EN

Check fuses between the auto-transformer and input to drive module.

1. Disconnect power to AFD.
2. Using an ohmmeter, measure across the fuse.
 - A good fuse will show 0 ohms.
 - An open fuse will read 120k or greater.

Perform a visual inspection including the following:

- 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 the bus MOV for signs of excessive heating or burning.

Recommended Maintenance

- 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 [Table 15](#). 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)
Phoenix MSTB 2,5/x-5,08 (Green Control Wiring Connectors)	0.6	0.4	5.3
M5	3.5	2.6	31.0
M6	5.9	4.4	52.2
M8	14.2	10.4	125
M10	36.6	27.0	324

Waterbox Removal and Installation

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

outside the United States, refer to literature provided by the applicable manufacturing location.

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.

2. Select the proper lift connection device from the [Table 18, p. 68](#). 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 bolt diameter [English/metric]).
4. Properly connect the lift connection device to the waterbox. Refer to [Figure 45, p. 67](#) and ensure that the lift connection device is securely fastened.

CTV units—Install hoist ring on to the lifting connection on the waterbox. Torque to 100 ft·lb for 3/4-in. threaded connections and 28 ft·lb for 1/2-in. threaded connections.

Procedure

⚠ WARNING

Heavy Objects!

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 [Table 17, p. 68](#) for waterbox weights. Failure to properly lift waterbox could result in death or serious injury.

⚠ WARNING

Straight Vertical Lift Required!

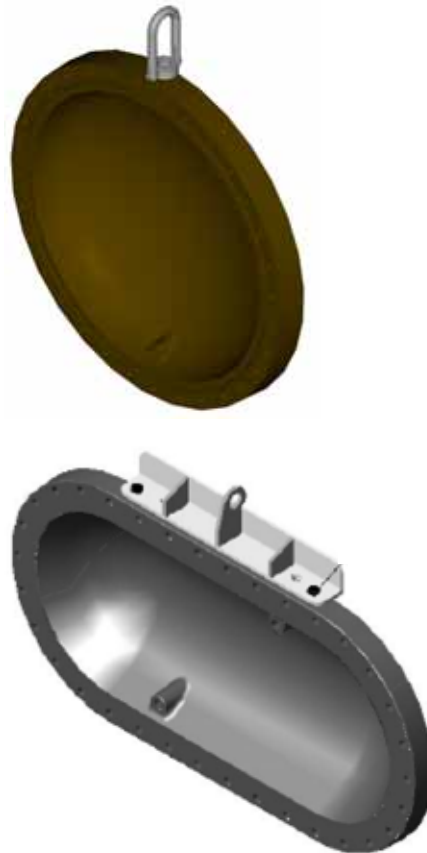
The proper use and ratings for eyebolts can be found in ANSI/ASME standard B18.15. Maximum load rating for eyebolts are based on a straight vertical lift in a gradually increasing manner. Angular lifts will significantly lower maximum loads and should be avoided whenever possible. Loads should always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

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 literature contains rigging and lifting information only for Trane CTV chillers built in La Crosse. For Trane CTV chillers built

Figure 45. Waterbox rigging and lifting—condenser and evaporator connections



5. Disconnect water pipes, if connected.
6. Remove waterbox bolts.
7. Lift the waterbox away from the shell.

Waterbox Removal and Installation

⚠ WARNING

Overhead Hazard!

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

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

Note: Do not leave waterbox suspended from lifting device.

Reassembly

Once service is complete, the waterbox should be reinstalled on the shell following all previous procedures

Table 17. CenTraVac 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 lb (kg)	Lifting Connection	Weight lb (kg)	Lifting Connection	Weight lb (kg)	Lifting Connection	Weight lb (kg)	Lifting Connection
030	Evaporator, 150 psi	397 (180)	3/4 - 10	397 (180)	Lifting Fixture	NA	NA	265 (120)	1/2 - 13
	Evaporator, 300 psi	353 (160)	3/4 - 10	NA	NA	NA	NA	265 (120)	1/2 - 13
	Condenser, 150 psi	265 (120)	1/2 - 13	265 (120)	1/2 - 13	NA	NA	265 (120)	1/2 - 13
	Condenser, 300 psi	551 (250)	3/4 - 10	NA	NA	NA	NA	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:
 Evaporator Size = EVSZ Condenser Size = CDSZ Evaporator Pressure = EVPR Condenser Pressure = CDPR
 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

in reverse. Use new O-rings or gaskets on all joints after thoroughly cleaning each joint.

- Torque waterbox bolts (see [Table 16](#)).

Torque Requirements

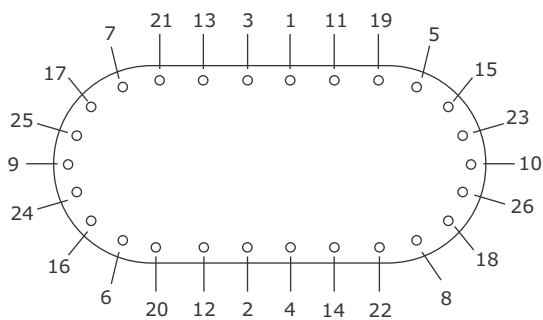
Table 16. CenTraVac torque

Botl Size Inch (mm)	Gasket type O-ring ft-lb (N-m)	Flat ft-lb (N-m)
3/8 (9.5)	25 (34)	12–18 (16–24)
1/2 (13)	70 (95)	33–50 (45–68)
5/8 (16)	150 (203)	70–90 (95–122)
3/4 (19)	250 (339)	105–155 (142–210)

Bolt-Tightening Sequence for Waterboxes

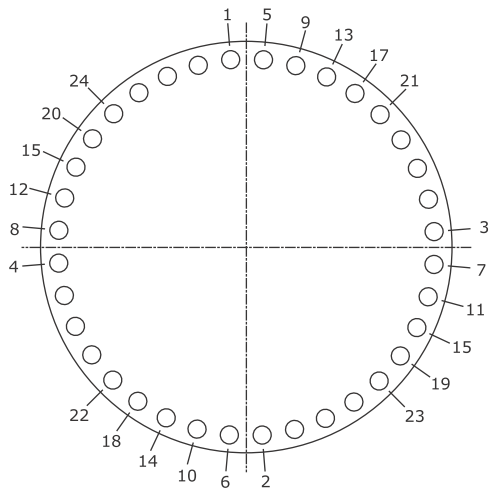
Evaporator Waterbox Covers

Ensure that the waterbox head rests tightly against the tube sheet, and then snugly tighten the 26 bolts in sequential order as shown in the figure below. If excessive tube sheet crown prevents the head from contacting the tube sheet, tighten the bolts located where the greatest gaps occur. Be sure to use an equal number of bolt turns from side to side. Then, apply final torque to each bolt in sequential order.



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.





AFD 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

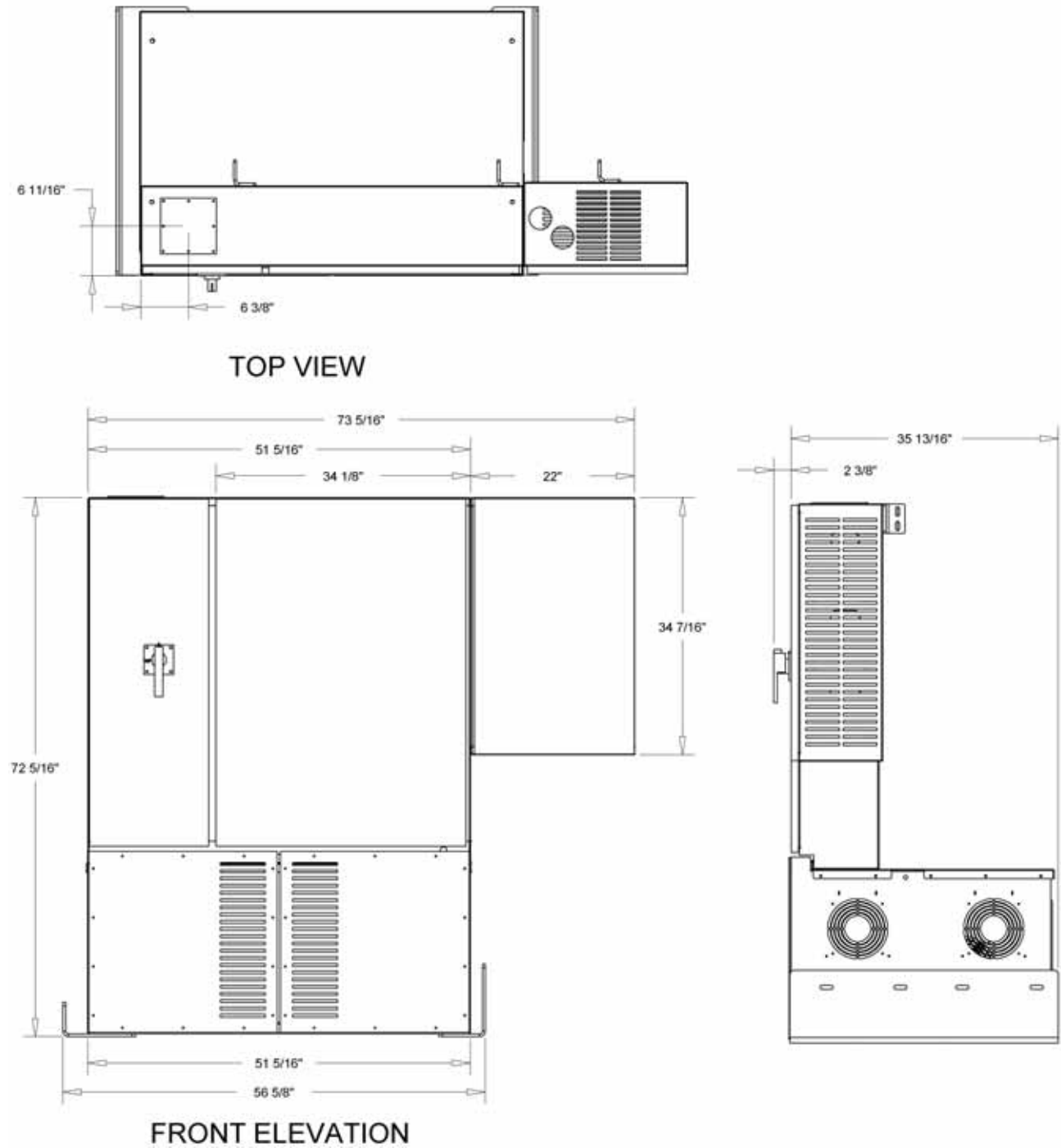
When a new fully assembled chiller is shipped and received from our Trane manufacturing location and, for any reason, it requires disassembly or partial disassembly—which could include but is not limited to the evaporator, condenser, control panel, compressor/motor, purge, factory-mounted Adaptive Frequency drive (AFD) 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 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.

Drive Cabinet Dimensions

Figure 46.





AFD Cabinet Removal

If you need to temporarily remove the entire 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 2800 lb.

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

⚠ WARNING

Heavy Objects!

Do not use cables (chains or slings) except as shown. Each of the cables (chains or slings) 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. Other lifting arrangements may cause equipment or property-only damage. Failure to properly lift unit could result in death or serious injury.

⚠ WARNING

Improper Unit Lift!

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. Failure to properly lift unit could result in death or serious injury or possible equipment or property-only damage.

1. Remove the AFD upper support bracket bolts at the wrap-around pipe side. There are two bolts in each bracket.
2. Close the isolation valves for the AFD cooling lines, both feed and return.

⚠ WARNING

Hazard of Explosion and Deadly Gases!

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

⚠ WARNING

Contains Refrigerant!

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

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

3. Disconnect the AFD cooling lines at the bottom of the elbows coming out of the chill plate, both feed and return. Cap the lines and chill plate elbows to prevent debris from entering the system.
4. Mark and disconnect the motor power wires at the output inductor terminals. There will be six power wires and two ground wires. Remove the two large conduit nuts and pull the motor feed conduits out of the output inductor cabinet.

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. Mark and disconnect the high pressure cutout switch wires at the terminal block and pull the conduit out of the AFD cabinet.
6. 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.
7. Mark and disconnect the refrigerant pump wires from the terminal block and pull conduit out of the AFD cabinet.
8. Unplug the global bus connector from the back of the AFD cabinet.
9. Support the weight of the AFD cabinet with a fork truck or another suitable lifting device (minimum 2-ton rated capacity).
10. Loosen and remove the bolts that secure the AFD cabinet to the lower mounting brackets. Unhook the right side at the C-channel brackets welded to the condenser, nine bolts total. Unhook the left side at the condenser support leg, four bolts and nuts total.
11. Carefully lift the AFD cabinet away from the chiller. Do not bump or jolt the AFD while lifting.

Installation of the AFD cabinet is essentially the reverse of the removal procedure. All mounting bolts should be torqued to ANSI standards based on the bolt diameter. The

motor power wires connecting to the output inductor 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. Refer to the as-built wiring diagrams for connection locations.



Forms and Check Sheets

The following forms and check sheets are included for use with Trane start-up of CVHS 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.

- [“CenTraVac™ Installation Completion Check Sheet and Request for Trane Service”](#) (CTV-ADF001-EN)
- [“CVHS Start-up Task List”](#)
- [“CVHS Annual Inspection List”](#)
- [“Operator Log”](#)



CenTraVac™ Installation Completion Check Sheet 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: _____

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

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.

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

1. CenTraVac

☐ 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
- ☐ Air handling units
- ☐ Pumps

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

- ☐ CenTraVac
- ☐ Pumps
- ☐ Cooling tower
- ☐ Heating loop (as applicable)

- ☐ Make-up water connected to cooling tower
- ☐ Water supply connected to filling system
- ☐ Systems filled

- ☐ Pumps run, air bled from system
- ☐ Strainers cleaned
- ☐ Rupture disc or RuptureGuard™ ventilation piping 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 Starter by Others specification (available from your local Trane Sales Office)

- ☐ Full power available
- ☐ 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)
- ☐ 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

6. Testing

☐ Dry nitrogen available for pressure testing (for disassembled units)

☐ Trace gas amounts of R-22 or R-134a available for leak testing, if necessary

7. ☐ Refrigerant on job site and in close proximity to chiller

Total amount in cylinders: _____ lb

Number of 200 lb cylinders: _____

Number of 50 lb cylinders: _____

8. ☐ Systems can be operated under load conditions

9. ☐ Electrical, control man, and contractor's representative are available to evacuate, charge, and test the CenTraVac 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 equipment room have proper mechanical ventilation?

☐ Does the installation have properly placed and operating audible and visual refrigerant alarms?

☐ 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 of refrigerant HCFC-123?

☐ Does the owner have a copy of the MSDS for refrigerant HCFC-123?

☐ Was the owner given a copy of the Refrigerant Handling Guidelines?

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 will therefore require the presence of Trane service on this site, for the purpose of start-up and commissioning, by _____ (date).

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

Additional comments/instructions:

CenTraVac, RuptureGuard, Trane, and the Trane logo are trademarks or registered trademarks of Trane in the United States and other countries.



Trane optimizes the performance of homes and buildings around the world. A business of Ingersoll Rand, the leader in creating and sustaining safe, comfortable and energy efficient environments, Trane offers a broad portfolio of advanced controls and HVAC systems, comprehensive building services, and parts. For more information, visit www.Trane.com.

Trane has a policy of continuous product and product data improvement and reserves the right to change design and specifications without notice.

CVHS Start-up Task List

Start-up Tasks to be Performed By Trane

WARNING

Safety Alert!

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

- Follow all instructions in the chiller'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.

Failure to do so could result in death or serious injury.

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 disc piping, and 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.

Pre-Start Operations

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

NOTICE:

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

Applying electrical power to a motor in a vacuum could cause damage to the motor. In addition, on units with inside-the-delta solid state starters, all power to the unit must be disconnected prior to evacuating the unit as line power is directly applied to the motor terminals 4, 5, and 6. Failure to disconnect power to units with inside-the-delta solid state starters during evacuation or when the unit is in a deep vacuum could cause compressor motor damage.

- Check electrical and controls.
 - Inspect 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.
 - Verify and record control parameters.
 - Verify all control interlocks are installed and properly functioning.
- 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.
- Verify vane operator is working properly and moves without binding.
- Remove separate source power and reconnect wiring.

Preparation for Start-up

- Relieve nitrogen holding charge.
- Evacuate and charge the system.
- Apply power to the AFD panel.

Chiller Start-up

- Set Purge mode to “On.”
- Start chiller compressor and verify compressor motor operation.
- Verify no unusual noises or vibrations and observe operating conditions.
- Measure and verify refrigerant pump pressure.
- 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



CVHS Annual Inspection List

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

Compressor Motor

- Motor continuity.
- Motor meg test.
- Check motor terminals.
- Inspect motor terminal board.

AFD

- Inspect contacts.
- Check all connections per manufacturer specifications.
- Follow all manufacturer recommendations for AFD maintenance.
- Record all applicable AFD settings.

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.

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.

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.

Leak Test Chiller

- Check purge times and unit performance logs. If warranted, pressure leak test.
- Submit refrigerant sample for analysis.
- Inspect unit for any signs of refrigerant leakage.
- Check unit for any loose bolts on flange, volutes, or casing.

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.

Exterior

- Inlet guide vane linkage.
- Clean and touch-up painted surfaces as needed.
- Repair deteriorated, torn, or missing insulation.

Optional Accessories

- If applicable, lubricate factory-installed gantries.
- After the first month of operation, inspect Heresite® or Belzona® coated waterboxes after first month; thereafter, inspect as needed.
- Inspect anodes.
- Inspect and lubricate hinged waterboxes.
- With water flow sensing option, bleed tubing from waterboxes to transformers.



Operator Log

Water-Cooled CVHS CenTraVac Chiller with UC800 Controller			
Tracer AdaptiView Reports—Log Sheet	Log 1	Log 2	Log 3
Evaporator			
Evaporator Entering Water Temperature			
Evaporator Leaving Water Temperature			
Evaporator Saturated Refrigerant Temperature			
Evaporator Refrigerant Pressure			
Evaporator Approach Temperature			
Evaporator Water Flow Status			
Condenser			
Condenser Entering Water Temperature			
Condenser Leaving Water Temperature			
Condenser Saturated Refrigerant Temperature			
Condenser Refrigerant Pressure			
Condenser Approach Temperature			
Condenser Water Flow Status			
Compressor			
Compressor Starts			
Compressor Running Time			
Lube Pump Suction Pressure			
Lube Pump Discharge Pressure			
Lube Differential Pressure			
IGV1 Position			
IGV1 Position Steps			
IGV2 Position			
IGV2 Position Steps			
Motor			
Average Motor Current % RLA			
AFD Motor Current U, V, W %RLA			
AFD Motor Current U, V, W			
AFD Motor Voltage UV, VW, WU			
Starter Input Power Consumption			
Starter Power Demand			
Motor Winding Temperature #1			
Motor Winding Temperature #2			
Motor Frequency			
Speed Command			
Motor Speed			
AFD Transistor Temperature			
Purge			
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			
Purge Refrigerant Compressor Suction Temperature			
Purge Liquid Temperature			
Carbon Tank Temperature			
Date:			
Technician:			
Owner:			



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