

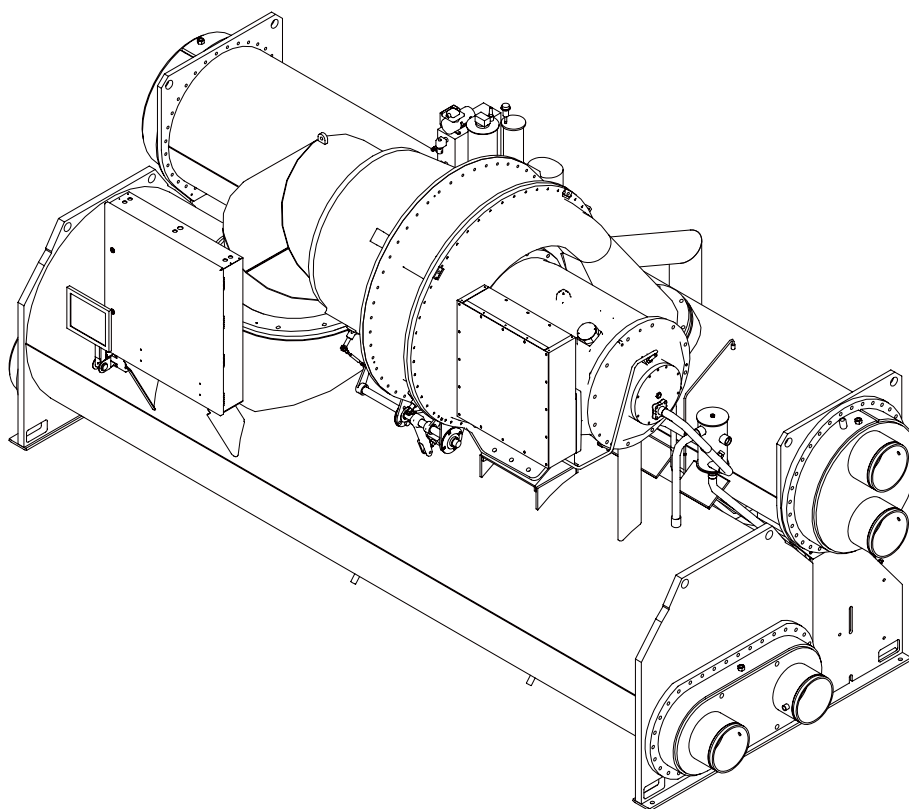


Installation, Operation and Maintenance

CVHE, CVHF, CVHG Water-Cooled

CenTraVac Chillers

With Symbio™ Control



X39641300002

⚠ 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.

Dec. 2023

TCVHE-SVX04K-EN
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Warnings, Cautions and Notices

Warnings, Cautions and Notices Note that warnings, cautions and notices appear at appropriate intervals throughout this manual. Warnings are provided to alert installing contractors to potential hazards that could result in death or personal injury. Cautions are designed to alert personnel to hazardous situations that could result in personal injury, while notices indicate a situation that could result in equipment or property-damage-only accidents.

Your personal safety and the proper operation of this machine depend upon the strict observance of these precautions.

ATTENTION: Warnings, Cautions and Notices appear at appropriate sections throughout this literature. Read these carefully:

⚠ 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

Important Environmental Concerns!

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

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.

This Installation, Operation, and Maintenance manual applies to CenTraVac chillers with two different refrigerant and oil systems:

- R-123 and OIL00372
- R-514A and OIL00371/ OIL00373

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

⚠ WARNING

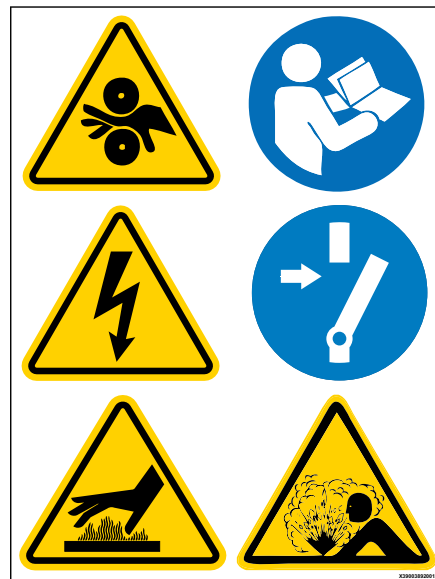
Proper Field Wiring and Grounding Required!

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

Note: Graphic labels (shown above) are used for CE application only.

Important:

- Before servicing, disconnect all power sources and allow at least 30 minutes for capacitors to discharge.
- All electrical enclosures—unit or remote—are IP2X.





Warnings, Cautions and Notices

⚠ WARNING

Contains Refrigerant!

System contains oil and refrigerant under high 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.

⚠ 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 Personal Protective Equipment (PPE) recommended 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 MSDS sheets and OSHA guidelines for proper PPE.
- When working with or around hazardous chemicals, **ALWAYS** refer to the appropriate MSDS sheets and OSHA guidelines for information on allowable personal exposure levels, proper respiratory protection and handling recommendations.
- If there is a risk of arc or flash, technicians **MUST** put on all necessary Personal Protective Equipment (PPE) in accordance with NFPA70E 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 recommendations could result in death or serious injury.

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Unit Model Number Description

The unit nameplate is located on the left side of the left hand control panel. A typical unit nameplate is illustrated below 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

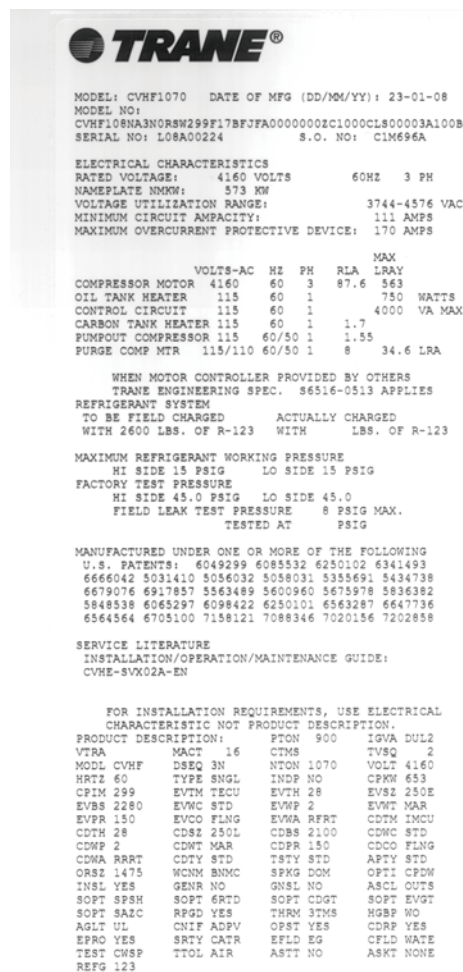
Serial Number. The unit serial number provides the specific chiller identity. Always provide this serial number when calling for service or during parts identification.

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 starters are identified by a separate number found on the starter.

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 Digit Description

Digit	Description
1-3	Unit Type
4	Development Sequence
5-7	Nominal Tonnage
8	Unit Voltage
9	Unit Type
10-11	Design Sequence
12	Hot Gas Bypass
13	Starter Type
14	Control Enclosure
15	Compressor Motor Power (CPKW)
16-18	Compressor Impeller Cutback
19	Evaporator Shell Size
20	Evaporator Tube Bundle (Nominal Tons)
21	Evaporator Tubes
22	Evaporator Waterbox
23	Condenser Shell Size
24	Condenser Tube Bundle (nominal tons)
25	Condenser Tubes
26	Condenser Waterbox
27	Heat Recovery Condenser Shell Size
28	Heat Recovery Condenser Tube Bundle (nominal tons)
29	Heat Recovery Tubes
30	Heat Recovery Condenser Waterbox
31	Auxiliary Condenser Size & Waterbox
32	Auxiliary Condenser Tubes
33	Orifice Size
34	Orifice Size
35	Unit Option-Insulation & Rupture Guard
36	Enhanced Protection
37	Generic BAS
38	Extended Operation
39	Tracer™ Communication
40	Condenser Refrigerant Control
41	Manufacturing Location
42	Special Options
43	Water Flow Control
44	Chilled Water Reset
45	Heat Recovery Temperature Sensors
46	Gas Powered Chiller
47	Compressor Motor Frame Size
48	Volute Discharge Angle
49	Operating Status
50	Industrial Chiller Package
51	Control Power Transformer
52	Motor & Terminal Board Config



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 relief valves must be properly piped to the outdoors.
- If required by local or other codes, a self-contained breathing apparatus should be available in close proximity to the equipment room.

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

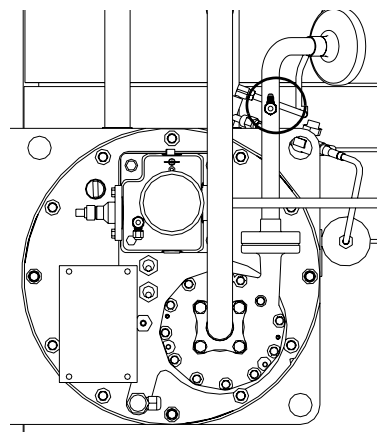
Unit Shipment

Inspect unit while it is still on the truck for any shipping damage.

The chiller ships shrink-wrapped in a 0.254 mm (0.010-in.) 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 piped, 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 evaporator 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 to verify. This access valve is located on the front of the oil tank, which is at the right rear corner of the chiller. If the charge has escaped, contact your local Trane sales office for instructions.

3. The loose parts box and isolator pads ship on top of the control panel box.
4. Check the oil sump sight glasses to verify that the oil level should be visible in the lower sight glass. If no oil level is visible, contact your local Trane sales office.

General Information

Regulations regarding waste handling are constantly changing. To ensure that personnel are in compliance with the latest federal, state and local regulations, contact your local waste management office for the proper procedures on handling, disposal, transporting and storage of oil, oil filters, refrigerant filters, and filter dryer cores.



Pre-Installation

Installation requirements and Contractor responsibilities

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

Unit Start-up must be completed by a qualified Trane service technician.

⚠ WARNING

Combustible Material!

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

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			Meet foundation requirements
Rigging			- Safety chains - Clevis connectors - Lifting beam
Isolation		Isolation pads or spring isolators	Isolation pads or spring isolators
Electrical	- Circuit breakers or fusible disconnects (optional) - Unit mounted starter (optional) - PFCCs (optional)	- Jumper bars - Temperature sensor (optional outdoor air) - Flow switches (may be field supplies) - Remote mounted starter (optional)	- Circuit breakers or fusible disconnects (optional) - Electrical connections to unit mounted starter (optional) - Electrical connections to remote mounted starter (optional) - Wiring sizes per submittal and NEC - PFCCs (remote mounted starter optional only) - Terminal lugs - Ground connection(s) - Jumper bars - BAS wiring (optional) - IPC wiring (AFD and remote mounted starters only) - Control voltage wiring (AFD and remote mounted starters only) - Oil pump interlock wiring (AFD and remote mounted starters only) - High condenser pressure interlock wiring (AFD and remote mounted starters only). - Chilled water pump contactor and wiring including interlock - Condenser water pump contactor and wiring including interlock - Option relays and wiring
Water piping		Flow switches (may be field supplied)	- 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 (1 each per pass) - Pressure relief valves (for waterboxes as required)
Relief	Rupture disc assembly	Rupture guard (optional)	Vent line and flexible connector and vent line from rupture disc to atmosphere
Insulation	Insulation (optional)		- Insulation - Chiller feet insulation
Water Piping Connection Components	Flanged Welded on flange for 150 and 300 psig waterboxes		Victaulic - Victaulic coupling for 150 and 300 psig waterboxes - Fasteners for flanged-type connections (optional)
Other Materials			- HCFC-22 refrigerant (1 lb maximum per machine as needed) - Material and equipment to perform leak testing - Dry nitrogen (8 psig maximum per machine as needed)



Pre-Installation

Storage Requirements for Chillers Not Yet Installed

⚠ Notice

Insulation Damage!

Direct exposure to sunlight may damage factory installed insulation. Failure to follow these instructions could result in insulation damage.

Less than 1 month	1 – 6 months	Greater than 6 months
Location requirements: • solid foundation • vibration free • dry • temperature range -40°F to 158°F (-40°C to 70°C)	Location requirements: • solid foundation • vibration free • dry • temperature range -40°F to 158°F (-40°C to 70°C)	Location requirements: • solid foundation • vibration free • dry • temperature range -40°F to 158°F (-40°C to 70°C)
• Do not remove any plastic coverings • Do not charge the chiller with refrigerant • If additional refrigerant is on site, follow manufactures storage requirements	• Do not remove any plastic coverings • Do not charge the chiller with refrigerant • If additional refrigerant is on site, follow manufactures storage requirements	• Do not remove any plastic coverings • Do not charge the chiller with refrigerant • If additional refrigerant is on site, follow manufactures storage requirements
• 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	• 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	• 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
• Do not operate purge unit	• Do not operate purge unit • Verify waterbox and tube bundles are clean and dry	• Do not operate purge unit • Verify waterbox and tube bundles are clean and dry • Conduct an oil analysis and verify no oil breakdown • Repeat yearly • Replace oil if breakdown has occurred • If no oil analysis program has been followed, replace oil prior to start up
		• Every 6 months start the oil pump and rotate compressor shaft 450 degrees to prevent bearing issues • Contact your local Trane office to preform this task
Note: Chillers stored 5 years or longer should be inspected every 5 years by a qualified service organization for leaks.		

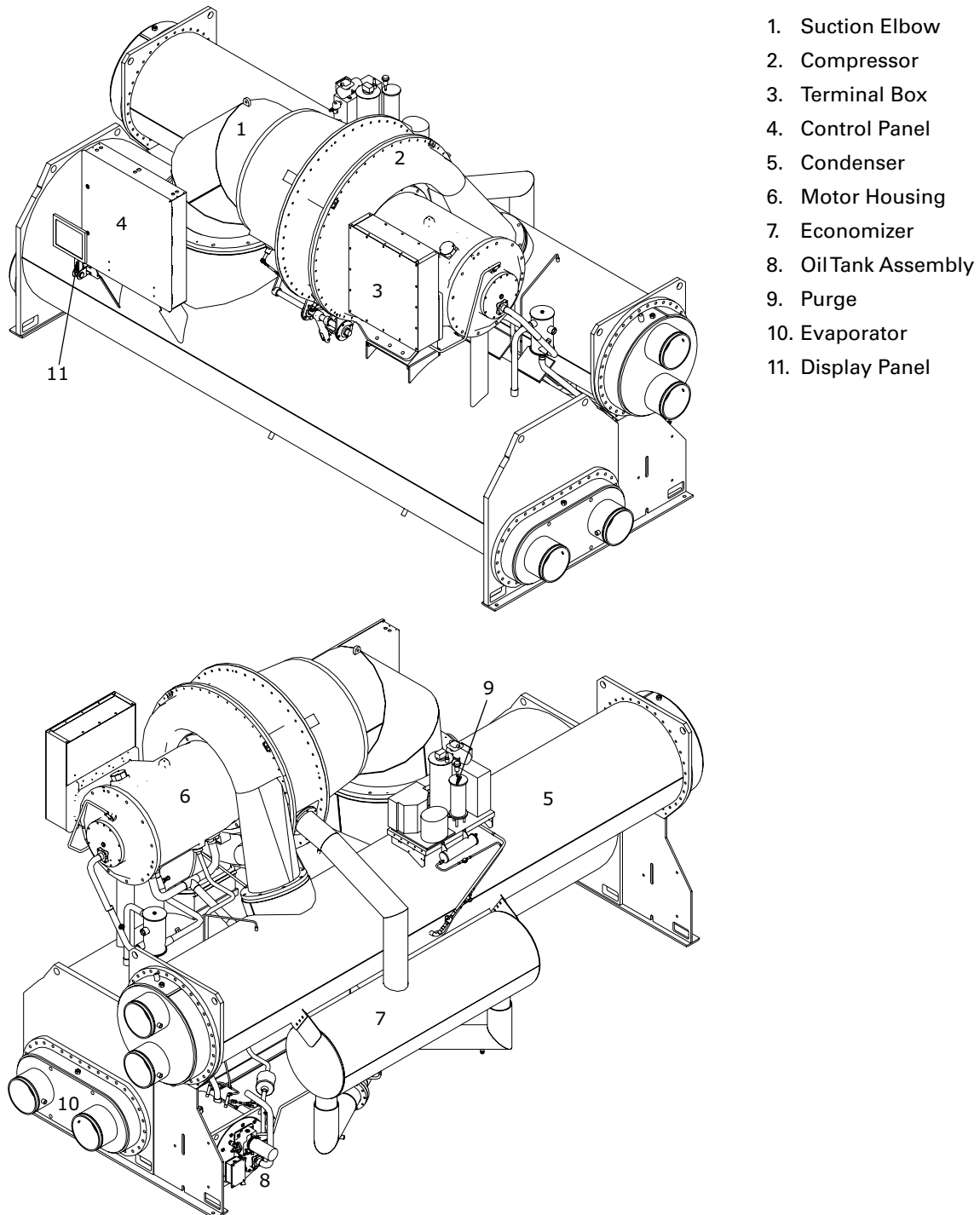
(a) If protective plastic coverings need to be removed for access and/or service, contact your local Trane office.



Unit Components

Note: Components are identified from a viewpoint that faces the front side of the control panel.

Figure 2. Typical CVHF CenTraVac Chiller





Unit Dimensions 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.

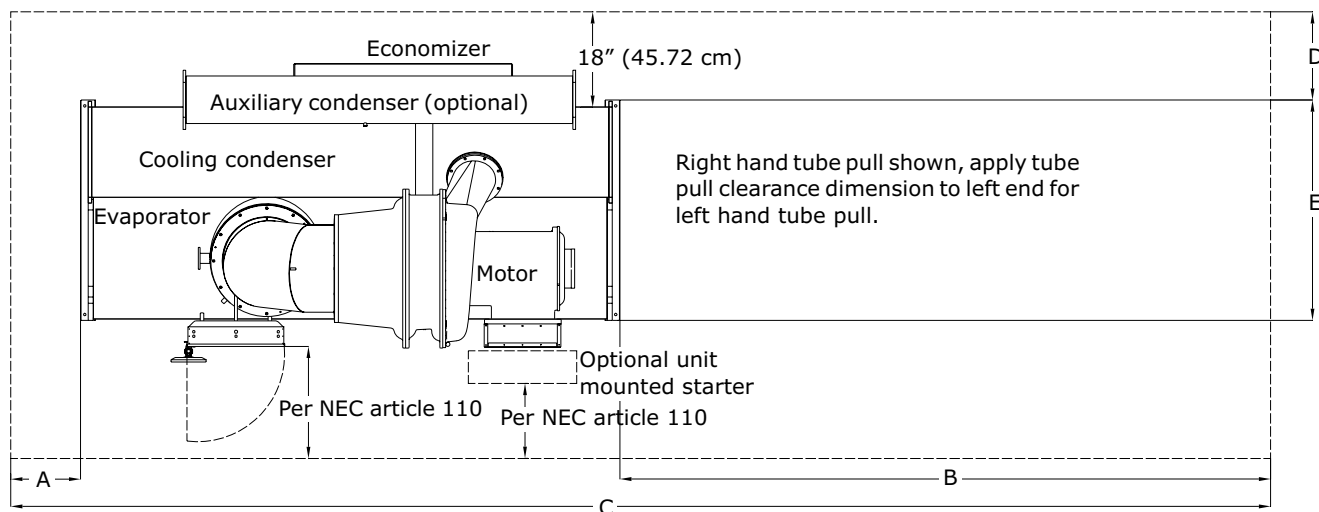
- Minimum vertical clearance above the unit is 3 feet (91.44 cm).

- Use a housekeeping pad to provide better service clearances; refer to submittal for more information.

Per NEC Article 110 - Unit mounted starters from 0-600V require a 42 inch (106.68 cm) clearance, 601-2500V require a 48 inch (121.92 cm) of clearance and 2501-9000V require a 60 inch (152.4 cm) clearance.

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

Figure 3. Clearance requirements



Clearance requirements

Evaporator Size	Shell Combination	A		B		C		D		E	
		inch	cm	inch	cm	inch	cm	inch	cm	inch	cm
050 Short/Long	Short/Short	45	114	141	358	321	815	40	101	62	157
	Short/Long	78	198	219	556	431	1094	40	101	62	157
	Long/Long	45	114	187	474	411	1043	40	101	62	157
080 Short/Long/Medium	Short/Short	53	134	141	358	329	835	36	91	76	193
	Short/Long	85	215	219	556	439	1115	36	91	76	193
	Medium/Medium	53	134	167	422	379	961	36	91	76	193
142 Medium/Long/Extended	Long/Long	53	134	187	474	419	1064	36	91	76	193
	Medium Long	78	198	207	525	444	1127	44	111	92	233
	Long/Long	58	147	187	474	424	1076	44	111	92	233
210 Long	Extended/Long	58	147	209	530	469	1191	44	111	92	233
	Long/Long	59	149	187	474	426	1082	47	119	102	259
250 Long	Long/Long	63	160	187	474	426	1082	43	109	115	292
250 Extended	Extended/Long	63	160	209	530	475	1206	43	109	115	292

Note: All dimensions are approximate, refer to the unit submittal package for exact dimensions for your unit



Unit Dimensions and Weights

The weight information provided here 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.

These values represent chiller weights do not include the following:

- TECU 0.028" tubes
- 150 psig non-marine waterboxes
- INDP (Industrial Control Panel), add 50 lb (23kg)
- CPTR (Control Panel Transformer) option, add 130 lb (50 kg)
- SMP (Supplemental Motor Protection) option, add 500 lb (230 kg)
- Operating weights include the heaviest possible refrigerant charge weight
- Chillers with starter values include the weight of the heaviest possible starter
- Heaviest possible bundle and heaviest possible motor voltage combination for the applicable family of chillers

Table 1. Unit Weights

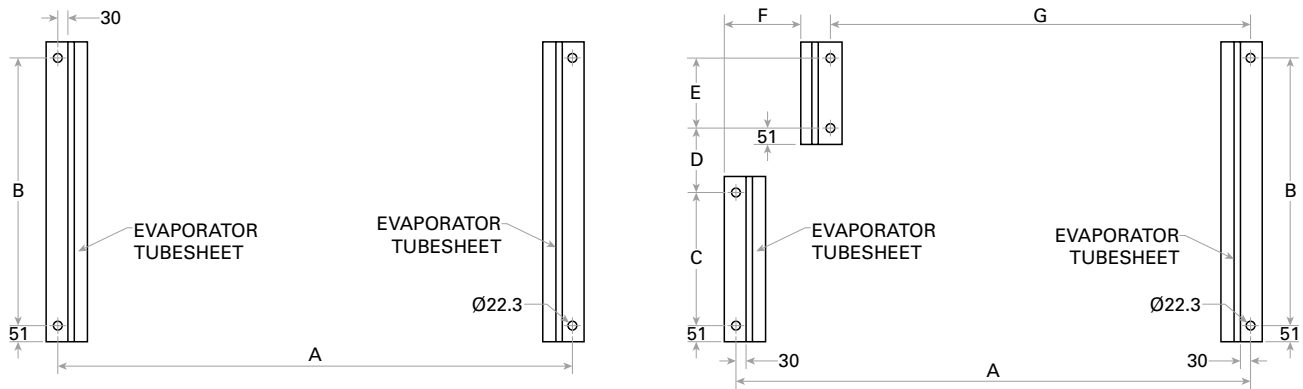
MODEL	NTON	CPKW	EVSZ	CDSZ	Without Starters				With Starters			
					Operating lb	Weights kg	Shipping lb	Weights kg	Operating lb	Weights kg	Shipping lb	Weights kg
C V H F	350-570	588	050L	050L	21152	9595	18617	8445	222234	10085	19699	8935
	350-570	588	050S	050S	19814	8988	17668	8014	20896	9478	18750	8505
	350-570	588	060S	050S	18925	8584	16937	7683	20007	9075	18019	8173
	350-570	588	080L	080L	30751	13949	26866	12186	31833	14439	27948	12677
	350-570	588	080M	080M	28994	13151	25691	11653	30076	13642	26773	12144
	350-570	588	080S	080L	28589	12968	25254	11455	29671	13459	26336	11946
	350-570	588	080S	080S	26876	12191	23787	10790	27958	12682	24869	11281
	650-910	957	080M	080M	30931	14030	27628	12532	32492	14738	29189	13240
	650-910	957	080L	080L	32688	14827	28803	13065	34249	15535	30364	13773
	650-910	957	080S	080L	30526	13847	27191	12334	32087	14555	28752	13042
	650-910	957	080S	080S	2883	13070	25724	11668	30374	13778	27285	12376
	650-910	957	142L	142L	42739	19386	36476	16546	44300	20094	38037	17254
	650-910	957	142M	142M	40982	18589	35301	16012	42543	19297	36862	16720
	650-910	957	142M	142L	41548	18846	35653	16172	43109	19554	37214	16880
	1070-1300	1228	142E	142L	44647	20252	37997	17235	46064	20894	39414	17878
	1820	1119	142L	210L	49415	22414	41409	18781	51167	23209	43161	19577
	1070-1300	1228	142M	142M	41613	18875	35932	16298	43030	19518	37349	16941
	1070-1300	1228	142L	142L	43370	19672	37107	16831	44787	20315	38524	17474
	1820	1119	142E	210L	52816	23957	44810	20325	54233	24600	46227	20968
	1070-1300	1228	142M	142L	42179	19132	36284	16458	43596	19775	37701	17101
	1070-1300	1228	210L	210L	52816	23957	44810	20325	54233	24600	46227	20968
	1820	1119	210L	210L	56217	25500	48211	21869	57299	25991	49293	22359
	1470	1340	210L	210L	56217	25500	48211	21869	57299	25991	49293	22359
	1820	1119	210L	250L	62305	28262	53009	24045	63387	28752.5	54091	24535.5
	1470-1720	1340	250E	250L	68393	31023	57807	26221	69475	31514	58889	26712
	1820	1119	250E	250L	68393	31023	57807	26221	69475	31514	58889	26712
C V H E	230-320	287	050L	050L	20650	9367	18081	8202	21732	9858	19163	8692
	230-320	287	050S	050L	19312	8760	17132	7771	20394	9251	18214	8262
	230-320	287	050S	050S	1278	8291	16248	7370	19360	8782	17330	7861
	360-500	453	050L	050L	22187	10064	19618	8899	23269	10555	20700	9390
	360-500	453	050S	050L	20849	9457	18669	8468	21931	9948	19751	8959
	360-500	453	050S	050S	19815	8988	17785	8067	20897	9479	18867	8558
	360-500	453	080L	080L	30758	13952	26806	12159	31840	14443	27888	12650
	360-500	453	080S	080L	18595	12971	25194	14428	29677	13461	26276	11919
	360-500	453	080S	080S	27155	12318	24016	10894	28237	12808	25098	11384



Unit Dimensions and Weights

Table 1. Unit weights (continued)

MODEL					Without Starters				With Starters			
	NTON	CPKW	EVSZ	CDSZ	Operating Weights		Shipping Weights		Operating Weights		Shipping Weights	
					lb	kg	lb	kg	lb	kg	lb	kg
C V H G	480-565	489	050L	050L	23384	10607	20815	9442	24466	11098	21897	9932
	480-565	489	060S	060L	22046	10000	19866	9011	3128	10491	20948	9502
	480-565	489	050S	050S	21323	9672	19324	8765	22405	1063	20406	9256
	480-565	489	080M	080M	30198	13698	26828	12169	31280	14188	27910	12660
	480-565	489	080L	080L	31955	14495	28003	12702	33037	14986	29085	13193
	480-565	489	080S	080L	29792	13514	26391	11971	30874	14004	27473	12462
	480-656	489	080S	080S	29154	13224	26065	11823	30236	13715	27147	12314
	670-780	621	080M	080M	31509	14292	28139	12764	32591	14783	29221	13254
	670-780	621	080L	080L	33266	15089	29314	13297	34348	15580	30396	13788
	670-780	621	080S	080L	31103	14108	27702	12566	32185	14599	28784	13056
	670-780	621	080S	080S	30465	13819	27376	12418	31547	14310	28458	12909
	670-780	621	142L	142L	44705	20278	38442	17437	45787	20769	39524	17928
	670-780	621	142M	142L	43514	19738	37619	17064	44596	20229	38701	17555
	920-1067	621	142L	142L	45545	20659	39282	17818	46627	21150	40364	18309
	920-1067	621	142M	142L	44354	20119	38459	17445	46436	20610	39541	17936
	920-1067	621	210L	210L	57319	26000	49375	22397	58401	26491	50457	22887
C V H E	1100	621	142M	142M	43868	19898	38187	17321	44950	20389	39269	17812
	1100	621	142L	142L	45625	20695	39362	17854	46707	21186	40444	18346
	1100	621	142M	142L	44434	20155	38539	17481	45516	20646	39621	17972
	1100	621	210L	210L	57399	26036	49455	22432	58481	26527	50537	22923
	190-270	242	050L	050L	20678	9380	18109	8214	21760	9870	19191	8705
	190-270	242	050S	050L	19340	8773	17160	7784	20422	9263	18242	8275
	190-270	242	050S	050S	18306	8304	16276	7383	19388	8794	17358	7874
	300-420	379	050L	050L	21569	9784	19000	8618	22651	10274	20082	9109
	300-420	379	050S	050L	20231	9177	18051	8188	21313	9668	19133	8679
	300-420	379	050S	050S	19197	8708	17167	7787	20279	9199	18249	8278
C V H E	300-420	379	080L	080L	30140	13672	26188	11879	31222	14162	27270	12370
	300-420	379	080S	080L	27977	12690	24576	11148	29059	13181	25658	11638
	300-420	379	080S	080S	26567	12037	23398	10613	27619	12528	24480	11104



EVSZ	050	080	142M&L		210		050 DSTF	080 DSTF	142 DSTF	210 DSTF	080M- 14HM	080L- 14HL	142L- 14HL	142L- 21HL	210L- 21HL	210L- 25HL
			150 psi	300 psi	150 psi	300 psi										
B	1473	1822	2194	2222	2454	2486	1646	2080	2344	2583	2666.4	2666.4	2720.4	2949	3063	3332

SHELLLENGTH TYPE	S	L	M	E
A	3489	4638	4124	5210

EVSZ	142E		250E	250E-25HL
	150psi	300psi		
B	2194	2222	2797	3495
C	1270	1301	1705	1706
D	293	293	343	453
E	406	406	483	965
F	572	572	572	644
G	4506	4506	4506	4506



Installation Mechanical

Operating Environment

To assure 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 maximum ambient temperature for chiller operation is 104°F (40°C).

⚠ Notice

Equipment Failure!

Unit operating at ambient temperatures exceeding 110°F (43°C) can fatigue the unit's rupture disc, causing it to break at a reduced refrigerant pressure (<15 psig). Starter component damage can also occur because of the panel's inability to dissipate heat adequately. If any of these adverse operating conditions are present, take whatever action is necessary to improve the equipment room environment.

Foundation Requirements

Chiller mounting surface must be:

- Rigid non-warpage 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, oil and water.)

For proper unit operation, the chiller must be level within 1/16" (1.6 mm) over its length and width when set into place on the mounting surface.

The tables provided in this manual show approximate weights for various chiller sizes and options. For more specific weight information refer to the unit submittal package.

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 the standard chiller lift section.

Note: The lifting beam used for simplex units must be at least 16 feet (4.88 meters) long.

⚠ WARNING

Heavy Objects!

Do not use cables (chains or slings) except as shown in [Figure 4, p. 16](#). 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. Do not lift chiller utilizing waterbox lifting lug. Waterbox lifting lug is to be used only for removing waterbox from chiller. Do not lift chiller utilizing elbow lifting tab. Elbow lifting tab and approved clevis are used when removing elbow from chiller. 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. 16](#). 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 casing of the compressor and the lifting beam. There should not be tension on this safety cable; the cable is used only to prevent the unit from rolling during the lift.
4. Position isolator pads or spring isolators beneath the chiller feet (see "[Unit Isolation](#)" [p. 16](#) for instructions).

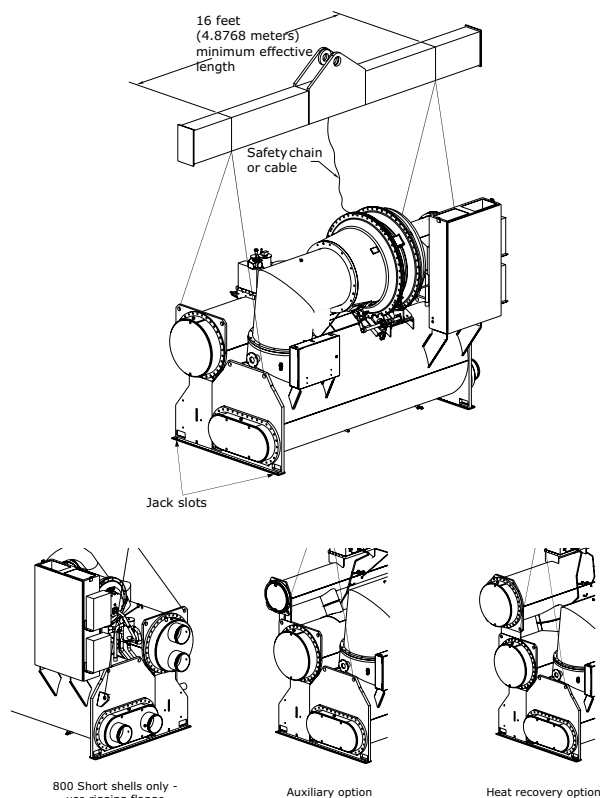
Note: Follow instructions provided by spring isolator manufacturer, being careful to not damage isolator adjustment bolt.

5. Once the isolators are in place, lower the chiller working from end to end in small increments to maintain stability.
6. When lift is complete, detach the clevis connections and safety chain.



Installation Mechanical

Figure 4. Rigging arrangements for Simplex units



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) dowel-pin the compressor and remove it from the unit. Be sure to contact a qualified service organization for specific rigging instructions. Do not attempt to rotate chiller on to side.
- When lifting the chiller is either impractical or undesirable, attach cables or chains to the jacking slots shown in [Figure 4, p. 16](#); then push or pull the unit across a smooth surface. Should the chiller be on a shipping skid, it is not necessary to remove the shipping skid from the chiller before moving it into place.
- If removal of the compressor or economizer assembly is necessary to move the chiller to the operating location, contact Trane for special instructions concerning chiller disassembly and reassembly procedures.

Unit Isolation

To minimize sound and vibration transmission through the building structure, and to assure 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.

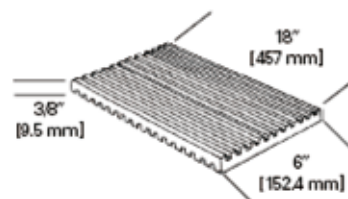
Specific isolator loading data is provided in the unit submittal package. If necessary, contact your local Trane sales office for further information.

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" sides) end for end under the full length of the chiller leg. The pads measure 6"x18" (152.4x457 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" (1.6 mm) over its length and width after it is lowered

Special lift requirements

⚠ Notice

Oil Loss!

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

⚠ 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.

⚠ Notice

Compressor Alignment!

Lifting the compressor/motor assembly from the shells without factory-installed doweling in the compressor casting flanges could result in misalignment of the compressor castings. Failure to preserve compressor alignment could result in equipment or property-only damage.



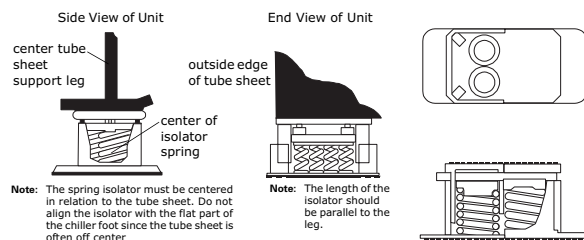
Installation Mechanical

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 7, p. 17](#).

Figure 6. Chiller foot and isolator orientation



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 7, p. 17](#). Make sure that each isolator is centered in relation to the tube sheet.

Note: Spring isolators shipped with the chiller may not be identical. Be sure to 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. Be sure to 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.

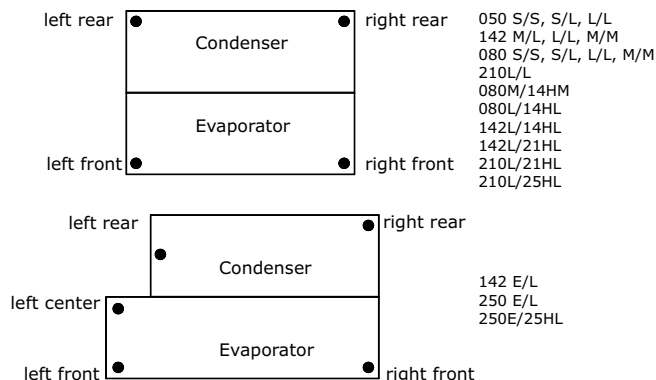
4. If the chiller must be fastened to the isolators, insert capscrews through the chiller base and into holes drilled and tapped in the upper housing of each isolator. Do not allow the screws to protrude below the underside of the isolator upper housing, or interfere with the adjusting bolts. An alternative method of fastening the chiller to the isolators is to cement the neoprene pads.
5. Set the chiller on the isolators; refer to rigging section for lifting instructions. The weight of the chiller will force the upper housing of each isolator down, and could cause it to rest on the isolator's lower housing. ([Figure 6](#) illustrates spring isolator construction.)
6. Check the clearance on each isolator. If this dimension is less than 1/4" (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" (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. Be sure to work from one isolator to the next. Remember that the chiller must be level to within 1/16" (0.15875 cm): over its length and width, and that clearance of each isolator must be at least 1/4" (6.35 mm).

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



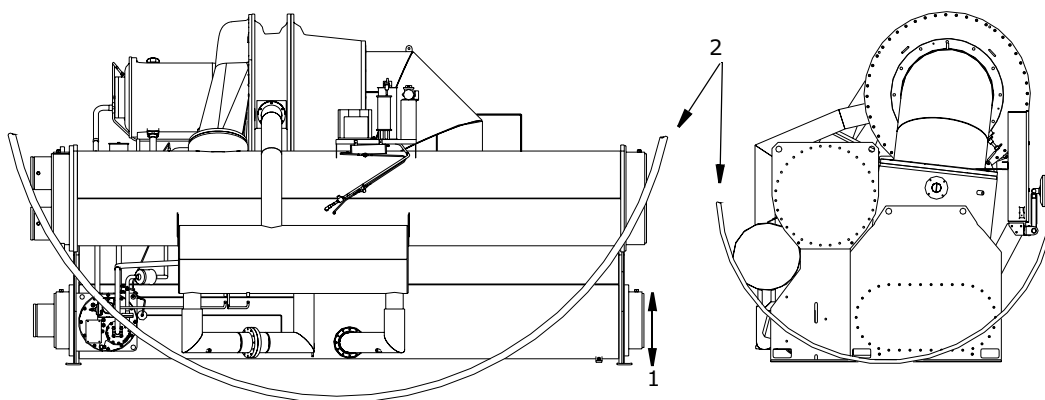
Unit Leveling

Follow the instructions outlined below determined whether or not the chiller is set level within 1/16" (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 below.
3. Fill the tube with water until the level aligns with the punch mark at one end of the chiller; then 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.
4. Once the unit is level across its length, repeat Step 1 through Step 3 to level the unit across its width.



Installation Mechanical



Use of a laser level is an acceptable alternative method to level the unit.

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



Installation Water Piping

Overview

Several water piping circuits must be installed and connected to the chiller.

Note: Piping must be arranged and supported to avoid stress on the equipment. It is strongly recommended that the piping contractor refrain from piping closer than 3 feet (0.91 m) minimum to the equipment. This will allow for proper fit-up 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.

- Pipe the evaporator into the chilled water circuit;
- Pipe the condenser into the cooling tower water circuit.
- A heat-recovery condenser water circuit, (optional);
- An auxiliary condenser water circuit, (optional)

Piping suggestions for each of the water circuits listed above are outlined later in this section. 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. Trane strongly recommends engaging the services of a qualified water treatment specialist to determine necessary water treatment. A label with a customer note 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 tap a minimum of one pipe diameter downstream of any elbow, orifice etc. Example, for a 6" (152 mm) pipe, the tap would be at least 6" (152 mm) from any elbow, orifice, etc.

Valves - Drains and Vents

⚠ NOTICE

Waterbox Damage!

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

1. Install field-supplied air vents and drain valves on the water boxes. Each water box is provided with a 3/4" (19 mm) National Pipe Thread Female (NPTF) vent and drain connection. Plastic plugs are factory-installed in both openings for shipment; remove and discard these plugs before installing the water box vents and drain valves.

⚠ 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 water boxes. To do so, add a tee with the relief valve attached to the drain valve. Follow local codes for determining if drain connection is large enough for relief devices.

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 assure 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.



Installation Water Piping

Flow-Sensing Devices

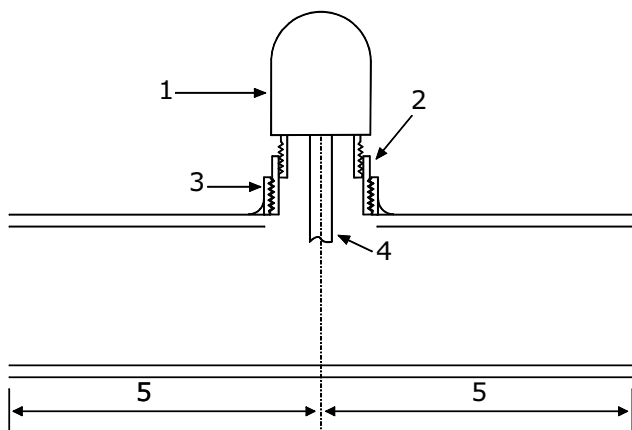
Use either flow switches or differential pressure switches in conjunction with the pump interlocks to verify evaporator and condenser water flows.

To assure adequate chiller protection, wire the chilled-water and condenser-water flow switches in series with the appropriate water pump interlock. Refer to the wiring diagrams that shipped with the unit for specific electrical connections.

Unless stated otherwise, all flow sensing devices must be field supplied. Be sure to follow the manufacturer's recommendations for device selection and installation.

The requirements of paddle flow switch are as follows:

Figure 8. Flow switch installation



1. Flow switch body
2. One (1) pipe size larger bushing to avoid paddle interference
3. Pipe coupling
4. Flow switch paddle
5. Five (5) pipe diameters (no turns or fittings)

Also, review the general flow switch installation guidelines listed below.

1. Mount the flow switch upright in horizontal section of pipe. Allow at least five pipe diameters of straight, horizontal run on each side of the switch. Avoid locations adjacent to elbows, orifices and valves whenever possible.
2. To assure that the flow switch operates as designed, adjust the length of the flow switch paddle to compensate for the pipe diameter and the height of the coupling tee used to install the switch.
3. Install the flow switch using a coupling that is large enough to allow the insertion of a bushing one pipe diameter larger than the flow switch base (Figure 8, p. 20). This will prevent interference with the flow switch paddle.
4. Verify that the direction-of-flow arrow on the switch points in the same direction as actual water flow through the piping circuit.
5. Remove all air from the piping circuit to prevent possible flow switch "fluttering."

6. Adjust the flow switch to open when water flow is less than normal.

⚠ NOTICE

Proof of Flow Switch!

Evaporator and condenser water circuits require proof of flow switches. Failure to provide flow switches or jumping-out of switches could result in severe equipment damage.

Evaporator and condenser proof of flow switches (either flow or Delta-P) are required in series with the pump contactor auxiliary shown on wiring diagrams. 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. Failure to include the condenser proof of flow switch and jumping out this switch could cause the unit to stop on a secondary level of protection such as high condenser pressure. 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.) resulting in premature failure.

For the thermal flow switch, the specific installation and maintenance requirements can be found in the thermal flow switch instructions, which is attached with the unit.

water temperature sensor

If there is high accuracy requirement for water temperature control, the water temperature sensor can be installed at the distance of 5 times pipe diameter from water box.

Evaporator and Condenser Water Piping

Figure 9 and Figure 10 illustrate the typical water piping arrangements recommended for the evaporator and condenser.

Note: Piping must be arranged and supported to avoid stress on the equipment. It is strongly recommended that the piping contractor refrain from piping closer than 3 feet (0.91 m) minimum to the equipment. This will allow for proper fit-up upon arrival of the unit at the job site. Any adjustment that is necessary can be made to the piping at that time. Expenses that result from a failure to follow this recommendation will not be paid by Trane.

Water piping connection sizes are identified in Table 2, p. 22, Table 3, p. 23, and Table 4, p. 23. Remember that with many waterboxes the entering and leaving evaporator water can be piped to either water box connection when the tube bundles are split vertically. However, large evaporator waterboxes, with entering and leaving connections not at the same level, must be



Installation Water Piping

connected with the entering water at the bottom and the leaving water at the top.

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

Note: *Assure 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.*

Note: *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 is not obeyed) Some shells may be piped as desired since both connections are at the same level.*

Note: *The temperature sensor located at water tank of evaporator is used to control the evaporator water temperature. It is difficult to indicate the accurate water temperature due to different water temperature distribution. If accurate water temperature controlling is required, it is recommended that the temperature sensor could be moved to straight water piping connecting to chillers from water tank. The sensor should be less than 2 meters far from the water tank. Accessory including an Communication cable of 2 meters, 1/2"-14NPT adaptor and 1/2"-14NPT plug is provided by Trane to install this temperature sensor to water piping.*

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.

See CTV-PRB006-EN, *Condenser Water Temperature Control for CenTraVac Centrifugal Chiller Systems - Engineering Bulletin*, for additional application information.

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.*

Note: *Whenever a CVHE, CVHF, and CVHG unit is*

equipped with an auxiliary condenser, use a bypass valve system to avoid circulating water through the auxiliary shell during unit shutdown. Temperature and optimal water flow sensor changes will also be required.

Water Box Locations

If necessary, the non-marine-style water boxes on each shell whether evaporator or condenser can be switched end-for-end to obtain the desired piping arrangement. Contact Trane Chiller Marketing for switching of marine-style boxes.

Note: *Do not exchange positions of marine-style water boxes. Failure to follow this recommendation could alter designed water flow piping configuration and prevent proper unit operation.*

If removal of waterboxes is necessary, refer to the water-box removal section of this manual.

If the water boxes 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 water box cover.



Installation Water Piping

Water Piping Connections

Figure 9. Typical evaporator water piping circuit

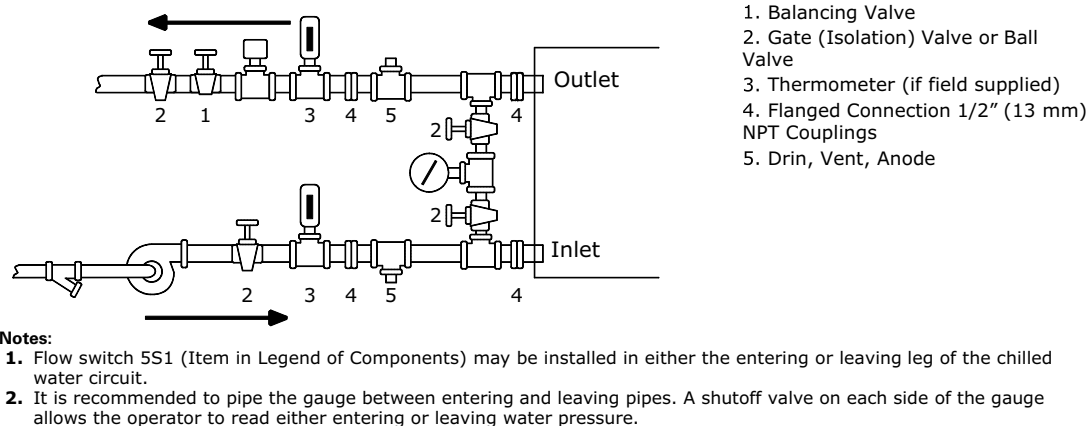
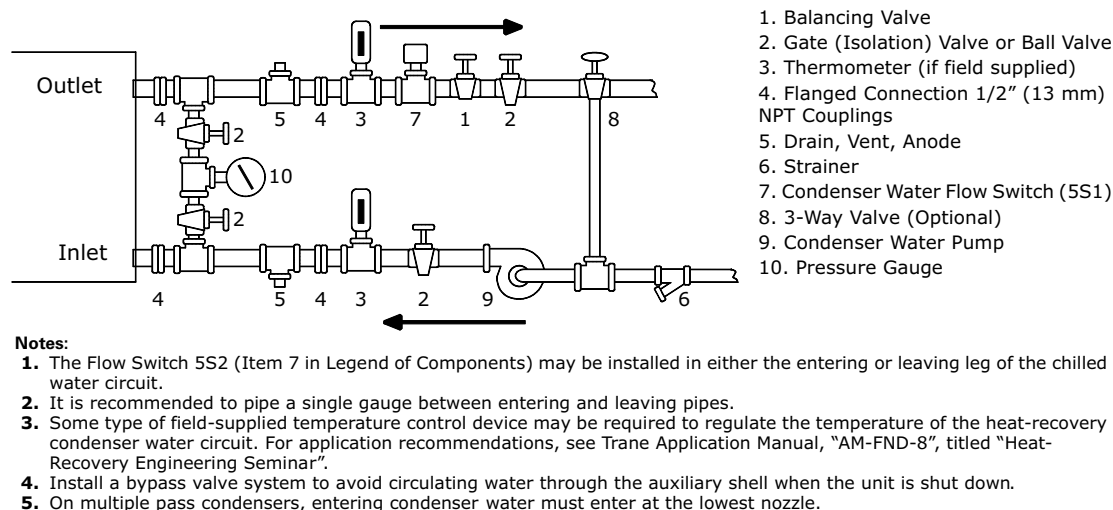


Figure 10. Typical condenser water piping circuits



All standard units use grooved-pipe connections. These are cut-groove end NSP (Victaulic™ style) pipe connection. Flanged connections for 300 PSI waterboxes use welded flanges.

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 2. Evaporator water piping connection sizes

EVSZ	nominal Pipe Size					
	1 Pass		2 Pass		3 Pass	
	Inch	mm	Inch	mm	Inch	mm
050S, 050L	10	273.0	8	219.1	6	168.3
080S, 080M, 080L	12	323.9	10	273.0	8	219.1
142S, 142M, 142L	16	406.4	12	323.9	10	273.0
210L	16	406.4	14	355.6	12	323.9
250L, 250E	16	406.4	14	355.6	12	323.9

Note: EVSZ = Evaporator Shell Size; S = Short Shell, L = Long Shell, E = Extended Shell, M = Medium



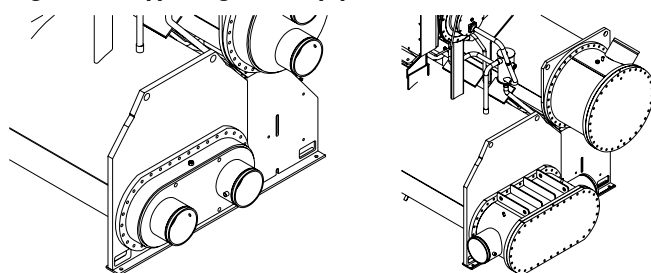
Installation Water Piping

Table 3. Condenser water piping connection sizes

CDSZ	Nominal Pipe Size	
	2 pass	
	Inch	mm
050S, 050L	8	219.1
080S, 080M, 080L	10	273.0
142L, 14HL, 142M, 14HM	12	323.9
210L, 21HL	14	355.6
250L, 25HL	14	355.6

Notes: CDSZ = Condenser Shell Size;
S = Short Shell, L = Long Shell, M = Medium

Figure 11. Typical grooved pipe connection



Grooved Pipe Coupling

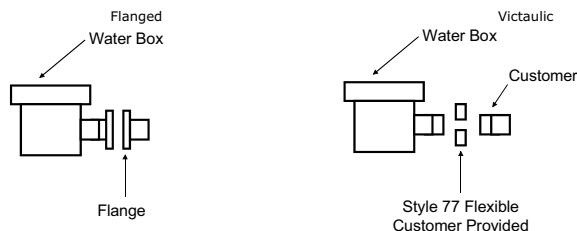
A customer-supplied, standard flexible grooved pipe coupling (Victaulic Style 77 or equivalent) should be used to complete the Victaulic connection for both 150 psig or 1035 kPa and 300 psig or 2068 kPa water boxes.

Table 4. Water piping connection components

Unit Model	Unit Connection Type	Customer Piping Connection	
		Victaulic™	Flanged
CVHE and CVHG	Flanged (Condenser 050 150 psig and 1035 kPa non-marine only)	Customer provided victaulic adapter	No Adapter Required
CVHE, CVHF, and CVHG	Victaulic (All others)	Customer provided Victaulic Coupling	Customer provided victaulic adapter

When a flexible coupling such as this is installed at the water box 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 12. 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.

Note: 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.

Bolt-Tightening Sequence for Water Piping Connections

A bolt-tightening sequence for flanges with flat gaskets or O-rings is described in the following tables and figures. Remember that improperly tightened flanges may leak.

Note: Before tightening any of the bolts, align the flanges. Flange bolt torque requirements are given below.

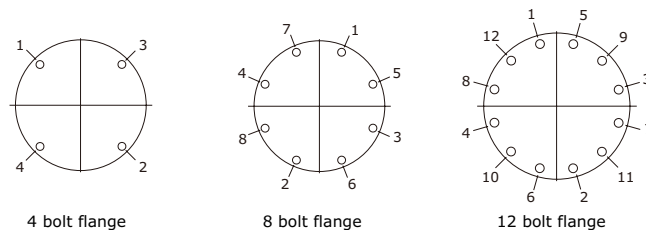
Table 5. Flange bolt torque recommendations for O-ring and flat-gasket piping connections

Bolt Size	Gasket Type		
		O-Ring	Flat
3/8"		25 (34)	12-18 (16-24)
1/2"		70 (95)	33-50 (45-68)
5/8"		150 (203)	70-90 (95-122)
3/4"		250 (339)	105-155 (142-210)

Note: Torques provided in ft/lb (Newton/metres). Bolt size is determined by the diameter of bolt shank.

Flanges with 4, 8 or 12 Bolts

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



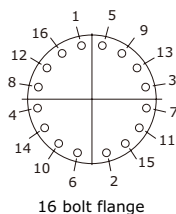
Flanges with 16, 20 or 24 Bolts

Following the appropriate numbered sequence, tighten only the first half of the total number of bolts to a snug tightness. Next, sequentially tighten the remaining half

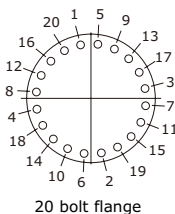


Installation Water Piping

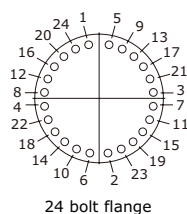
of the bolts in the proper order.



16 bolt flange



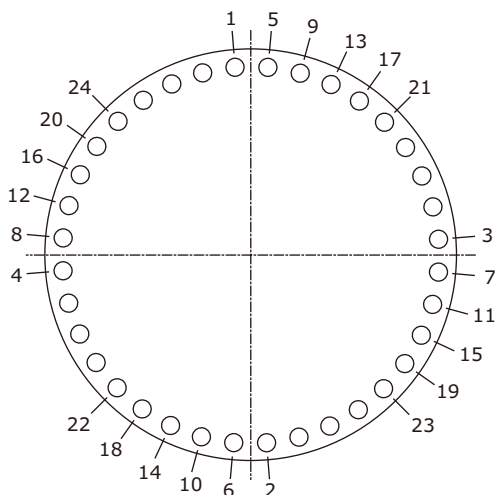
20 bolt flange



24 bolt flange

Flanges with More than 24 Bolts

Sequentially tighten the first 12 bolts to a snug tightness. Tighten the next 12 consecutively numbered bolts in sequence, to the final torque. Then, apply final torque to the first 12 bolts and the bolts not yet tightened (i.e., unnumbered bolts in the figure at right) sure to start with bolt "1" and move progressively around the flange in a clockwise direction.



Pressure Testing Waterside Piping

Water side design pressure is either 150 or 300 psig refer to unit nameplate or to submittal documentation.

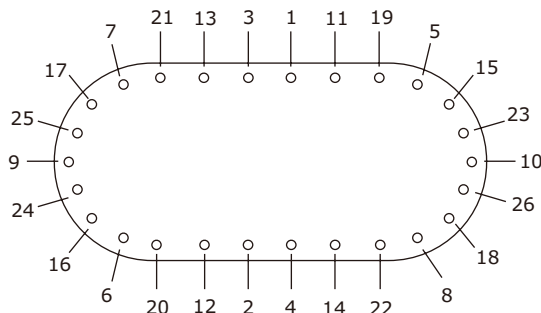
⚠ NOTICE

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 water boxes. Failure to follow these recommendations could result in equipment damage.

Evaporator Water Box Covers

Ensure that the water box head rests tightly against the tube sheet; then snugly tighten the 26 bolts in sequential order. 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.





Purge Piping

EarthWise Purge Requirements - Purge Installation

For certain CenTraVacs, the purge system is not mounted on the chiller when it ships. For 800-ton heat recovery chillers and 1250- and 1400-ton chillers with auxiliary condensers, the EarthWise™ Purge is shipped in a separate container that is secured to the chiller shipping skid.

Install the purge system in accordance with the following instructions.

1. Remove purge from its shipping brackets or container.
2. Disconnect purge gas and liquid lines and conduit from shipping bracket that spans purge supports on top of the heating or auxiliary condenser.
3. Remove shipping bracket and screws from purge supports and discard.
4. Locate purge on top of supports (purge base goes outside supports).
5. Secure the purge to the supports with the hardware provided.

⚠ 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.

6. Using proper brazing techniques as per American Welding society (A.W.S.) braze the following four copper lines at the factory disassembly points:

- Purge suction line (larger)
- Purge liquid drain line
- Regeneration line
- High pressure cutout switch

Note: Verify that the high-pressure cutout switch is connected to the line, which proceeds to the chiller condenser. (Check the copper tube routing to verify.)

- Assure braze joints are leak free

⚠ 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.

7. Remove purge panel cover and connect the unit wiring per the unit wiring diagrams:
 - Interprocessor communications bus (IPC).
 - Chiller motor temperature sensor wires to motor temperature module.
 - Conduit to control panel and interconnecting wires.
 - After inspection of terminations reassemble purge panel cover.
8. With completion of brazing and electrical connections, the unit valves can be opened for unit operation.



Vent Piping

Refrigerant Vent-Line

General Recommendations

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. The 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, make sure that both the pipe material and the adhesive have been tested for refrigerant compatibility. Also, verify that the local code permits 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 - Hercules, PVC Primer #60-465, RectorSeal PVC Cleaner - Smiling Sam CL-3 Adhesive - Hercules, Clear PVC, Medium Body, Medium Set, #60-020 RectorSeal PVC Cement - Green Gene 104.

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—but 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 15, 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 assure that the vent-line system provides sufficient flow capacity.

As a further aid, [Table 6, p. 29](#) in the ASHRAE Standard 15 lists the capacities of various vent-line sizes and lengths; however, that data only applies 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.

[Table 6, p. 29](#) and [Figure 15, p. 30](#) provide a simplified method to determine the appropriate vent-line size. Enter [Figure 15, p. 30](#) 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) to this total.

Note: *The Table and Figure are only applicable 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 Piping

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

When constructing the rupture disc vent line, be sure to consult local codes for applicable guidelines and constraints.

All CenTraVac centrifugal chillers are equipped with carbon rupture discs. A cross-section of the rupture disc assembly appears in [Figure 13, p. 28](#) along with an illustration indicating the location of the rupture disc on the suction elbow. If refrigerant pressure within the evaporator exceeds 15 psig the rupture disc breaks and shell pressure is relieved as refrigerant escapes from the chiller.

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

1. Verify that the vacuum support side of the rupture disc is positioned as shown in the cross-section view that appears in [Figure 13, p. 28](#).

Note: If the rupture disc was removed for any reason, it must be reinstalled (as shown in [Figure 13](#)) using the following installation procedure: and contact CenTraVac Technical Service when reinstalling the rupture disc.

- a. Install the two bottom bolts through the pipe flanges.
 - b. 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 per [Figure 13, p. 28](#).
 - c. Install the two top bolts.
 - d. Center the disc and gaskets to the flange bore.
 - e. Hand tighten all bolts assuring equal pressure.
 - f. Use a torque wrench set to 240 in·lb (27 Nm) with a 9/16" (14 mm) socket.
 - g. Tighten bolts in a star pattern, one half turn each, to maintain even pressure on the disc.
 - h. Final torque on all bolts should be 240 in·lb (27 Nm).
2. 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 recommendation could result in damage to the rupture disc assembly.

3. Provide support as needed for the vent-line. Do not use the rupture disc assembly to support the vent-

line piping.

4. 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. See [Figure 14, p. 28](#) for a recommended relief piping arrangement.
5. 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 14, p. 28](#) does not apply for manifolded vent-lines.
6. 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.

⚠ CAUTION!

Pressure-Relief Device Discharge Hazard!

When a pressure-relief device operates, it could discharge a large amount of fluid and/or vapor. An improper vent-line termination could result in personal injury and/or property-only damage.

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

⚠ NOTICE

Proper Refrigerant Vent Line Termination!

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.

7. Provide a drip leg on the vent-line (see [Figure 14, p. 28](#)). Provide a standard 1/4" FL x 1/4" NPT, capped refrigerant service valve to facilitate liquid removal.



Vent Piping

⚠ 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 assure that it does not overflow and allow fluid to flow into the horizontal portion of the vent-line. Trane assumes no responsibility for equipment damage caused by insufficient drainage of the drip leg.

8. Consult local regulations and codes for any additional relief line requirements and refer to CFC-Guide-2.

Figure 13. Illustrates rupture disc location, cross section of rupture disc

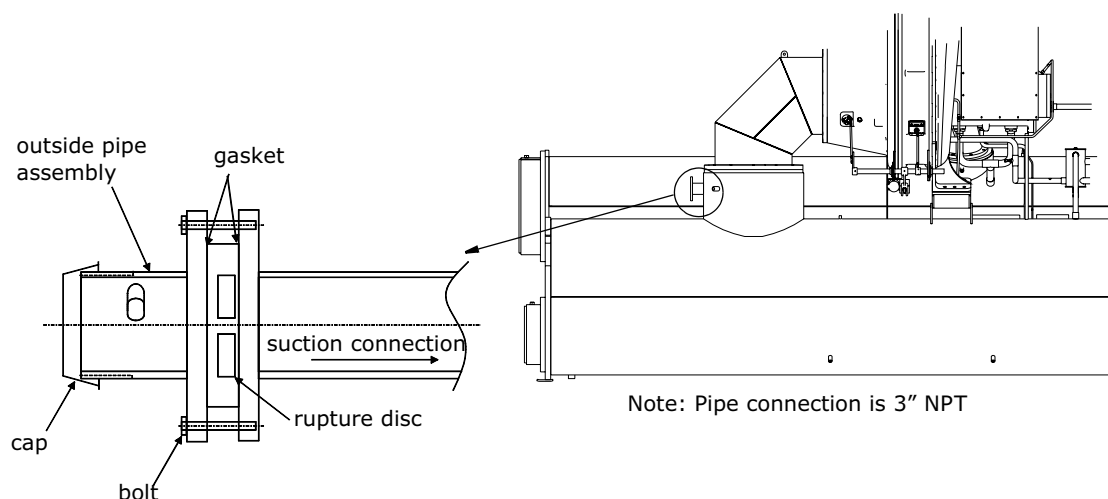
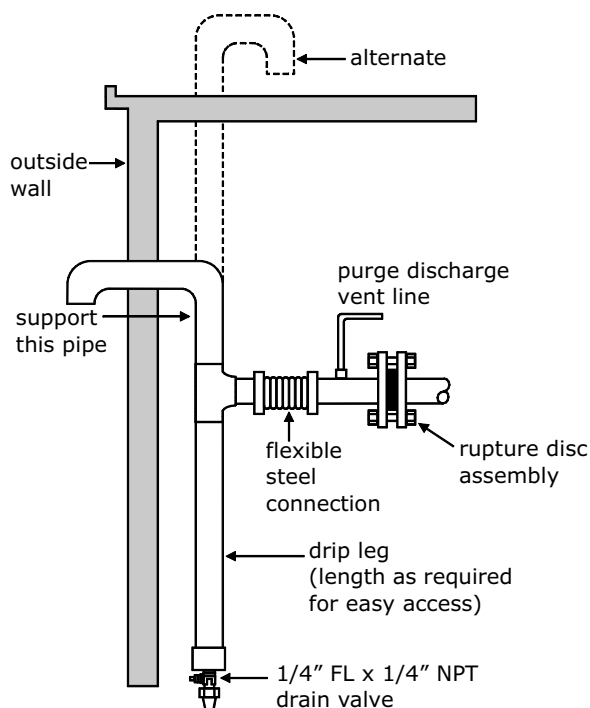


Figure 14. Arrangement for rupture disc relief piping



Note: If a RuptureGuard™ is to be installed, refer to CTV-SVX06B-EN, Installation, Operation, and Maintenance - Rupture Guard Pressure Relief System Option, or the most recent version.

Table 6. "C" values used to determine rupture disc vent line sizes

Evaporator Size (EVSZ) (a)	Condenser Size (CDSZ) (b)	"C" Values for Unit Components				
		Total "C" value	Short H.R. Condenser	Long H.R. Condenser	Auxiliary Condenser	Free Cooling Econ.
050S	050S	64.2				
050S	050L	72.1	23.55	31.45	15.30	5.50
050L	050L	83.17				
050S	080S	69.71				
050L	080L	90.52	N/A	N/A	N/A	N/A
080S	080S	86.48				
080S	080L	96.22	29.06	38.80	15.30	5.38
080L	080L	111.50				
080L	142L	117.53	N/A	N/A	N/A	N/A
142M	142L	127.49				
142L	142L	134.89				
142E	142L	143.11	51.01	56.80	15.30	7.13
210L	210L	149.91				
250E	250L	175.74	N/A	62.12	15.30	N/A
080M	14HM	165.61	N/A	N/A	N/A	N/A
080L	14HL	174.33	N/A	N/A	N/A	N/A
142L	14HL	191.69	N/A	N/A	N/A	N/A
142L	21HL	196.69	N/A	N/A	N/A	N/A
210L	21HL	206.71	N/A	N/A	N/A	N/A
210L	25HL	217.35	N/A	N/A	N/A	N/A
250E	25HL	237.86	N/A	N/A	N/A	N/A
080M	080M	111.50	N/A	N/A	N/A	N/A
080M	142M	117.53	N/A	N/A	N/A	N/A
142M	142M	134.89	N/A	N/A	N/A	N/A
250L	250L	175.74	N/A	N/A	N/A	N/A

Notes:

1. Rupture disc diameter is 3 inches (76 mm).
 2. 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" values to this total. With this new sum, refer to [Figure 15, p. 30](#) to determine the vent line pipe diameter.
- (a) EVSZ = Evaporator shell size
(b) CDSZ = Condenser shell size

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

For CenTraVacs using a rupture disc relief:

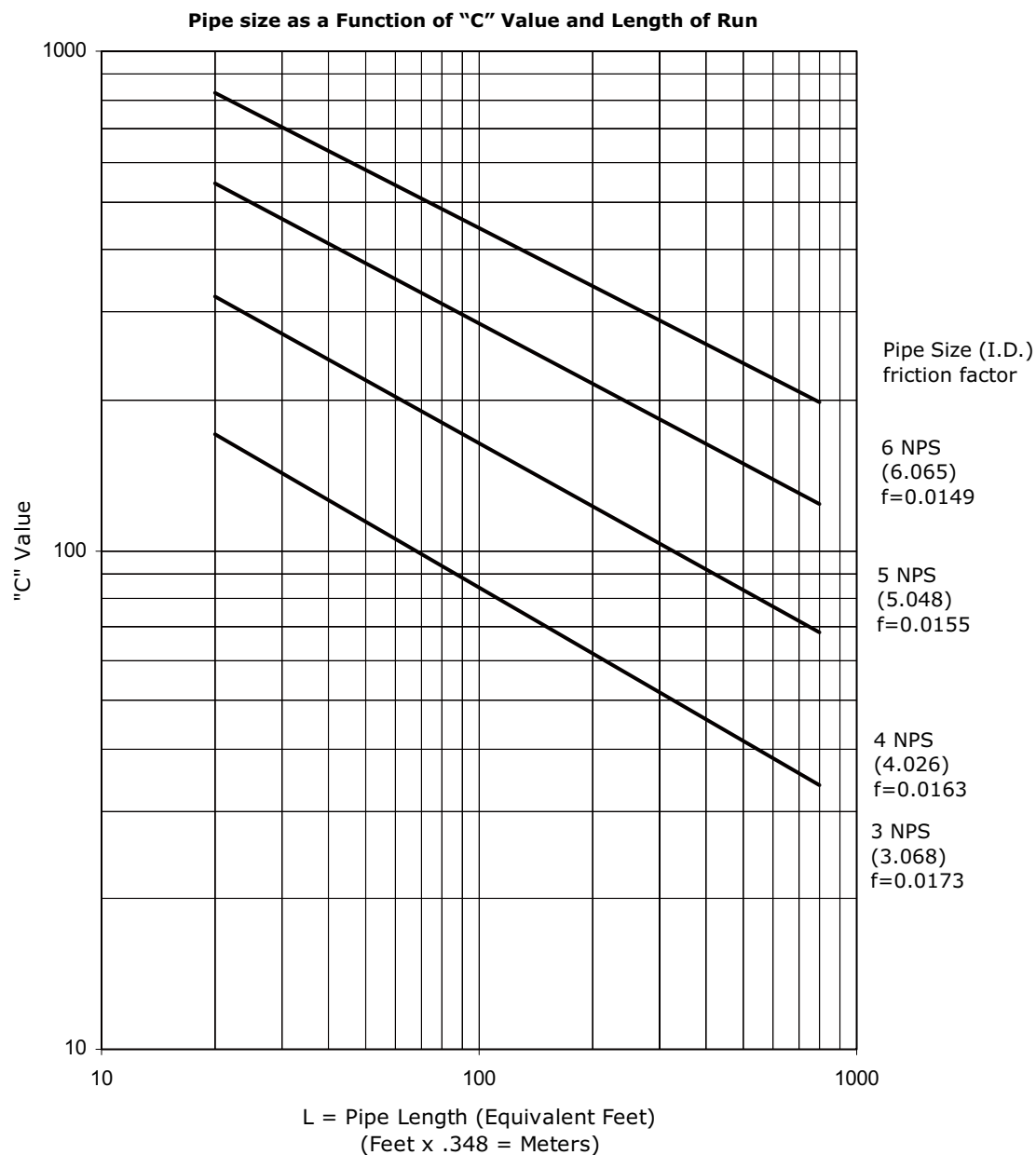
- L = equivalent length of discharge piping, ft (m)
- Cr = rated capacity as stamped on the relief device in lb/min (kg/s), or SCFM multiplied by 0.0764 lb/min (convert multiplier in lb/min to kg/s for SI)
 $Cr = C$ value from [Table 6, p. 29](#) (convert C in lb/min to kg/s for SI)
- f = Moody friction factor in fully turbulent flow
- d = inside diameter of pipe or tube, in (mm)
- $\ln$ = 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).



Vent Piping

Figure 15. Rupture disc vent pipe sizing



ANSI/ASHRAE Standard 15-2007

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

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

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

f = Moody Friction Factor in fully turbulent flow

Note: This chart, 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.

In those instances where the chiller is not factory-insulated, install insulation over the areas outlined and highlighted with dashed lines. It may also be necessary to insulate the compressor suction cover and motor barrel if the unit is installed in an area subjected to high humidities.

Insulate all 1/4" (6.4 mm) eductor lines, one from the suction cover and one from the evaporator to prevent sweating.

The quantities of insulation required based on unit size and insulation thickness are listed in [Table 7](#). Insulation thickness is determined at normal design conditions which are:

- standard comfort-cooling leaving chilled water temperature
- 85°F Dry bulb ambient temperature
- 75% Relative humidity

Note: If the unit is not factory insulated: install insulation around the evaporator bulbwells and ensure that the bulbwells and connections for the water box drains and vents are still accessible after insulation is applied. The sensor modules (LLIDs) and interconnecting four wire cable (IPC Buss) must be raised up above the field-installed insulation. Secure the IPC Buss to the insulation top/outer surface after insulation is completed. Do not insulate over the wiring or sensor devices.

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

Table 7. Evaporator insulation requirements

EVSZ (Note 1)	Standard Unit		Free Cooling	
	3/4" (19 mm) Insulation (Note 1) (Square Feet)	3/8" (9.5 mm) Insulation (Note 2) (Square Feet)	3/4" (19 mm) Insulation (Note 1) (Square Feet)	3/8" (9.5 mm) Insulation (Note 2) (Square Feet)
050 Short	385	63	398	72
050 Long	420	63	436	72
080 Short	505	84	515	97
080 Medium	525	84	538	97
080 Long	553	84	566	97
142 Medium	555	98	555	133
142 Long	578	98	578	133
142 Extended	603	104	629	133
210 Long	700	98	710	133
250 Long	750	98	760	133
250 Extended	770	97	780	133

Notes:

1. 3/4" (19 mm) sheet insulation is installed on the evaporator, evaporator water boxes, compressor motor, suction elbow and suction cover.
2. 3/8" (9.5 mm) sheet insulation is installed on all economizers. All liquid lines and other pipes require the use of 1/2" (13 mm) pipe insulation or 3/8" (9.5 mm) sheet insulation. Copper oil eductor tube lines require pipe insulation.
3. Refrigerant Pump equipped units are NOT insulated on the motor or refrigerant drain lines.

Insulation Thickness Requirements

Factory applied insulation. All low temperature surfaces are covered with 3/4" (19 mm) Armaflex II or equal (thermal conductivity = 0.28 BTU/hr-ft sq.) (1.59 W/m²-K), including the evaporator, water boxes and suction elbow. The economizer and motor cooling lines are insulated with 3/8" (10 mm) and 1/2" (13 mm) insulation respectively.

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-degree chilled water temperature/glycol) units may require double thickness to prevent formation of condensation.

⚠ NOTICE

Insulation Damage!

To prevent damage to factory installed insulation:

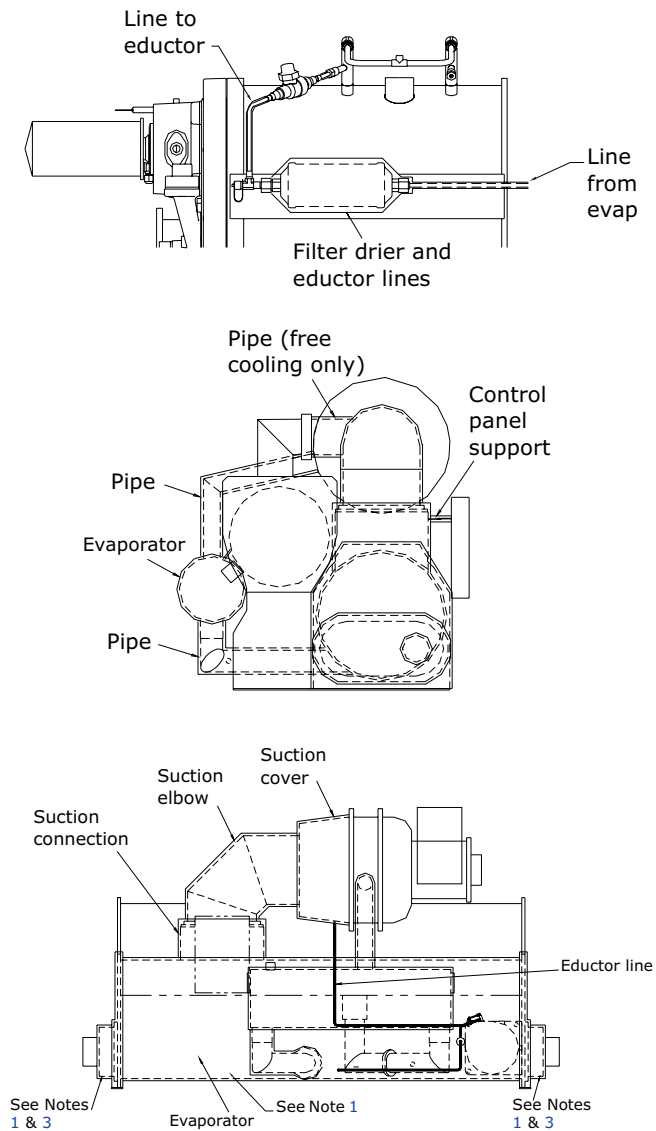
- Do not allow the insulation to be exposed to excessive sunlight. Store indoors or cover with canvas to prevent exposure.

- Do not use thinners and solvents or other types of paint. Use only water base latex. Failure to follow these recommendations could result in insulation damage.



Insulation

Figure 16. Recommended area for unit insulation



Notes:

1. Bulbwells, drain and vent connections must be accessible after insulating.
2. Evaporators with ASME nameplates must have insulation cut out around the nameplate. Do not glue insulation to the nameplate.
3. All units with evaporator marine waterboxes wrap waterbox shell insulation with strapping and secure strapping with seal.
4. 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.
5. Insulate all economizer supports.



Installation Controls

This section covers information pertaining to the Symbio™ 800 controller hardware. For information about the Tracer® AdaptiView™ display, which is used to interface with the internal chiller data and functions provided by the Symbio 800, refer to Tracer AdaptiView Display for Water-cooled CenTraVac Chillers with Symbio Controls User Guide (CTVSVU004*-EN).

Symbio 800

The Symbio™ 800 controller is a factory-installed, application specific and programmable controller designed to control chillers and large packaged HVAC equipment. A 12 inch user interface features a touchsensitive color screen that provides facility managers at-a-glance operating status, performance monitoring, scheduling changes, and operating adjustments. Other advanced features include automated controller backup, and optional features such as secure remote connectivity, wireless building communications, mobile device connectivity, and custom programming with expandable I/O.

For more information, see Symbio 800 Installation, Operation, and Maintenance manual BAS-SVX080*-EN.

AdaptiView Display

Information is tailored to operators, service technicians, and owners. When operating a chiller, specific information is needed on a day-to-day basis— setpoints, limits, diagnostic information, and reports. This information is provided through the AdaptiView™ display. Logically organized groups of information— chiller modes of operation, active diagnostics, settings and reports put information conveniently at your fingertips.

For more information, see CenTraVac Water-Cooled Chillers AdaptiView Display User Guide, CTV-SVU004*-EN.

Tracer TU

The AdaptiView™ TD12 operator interface allows for daily operational tasks and setpoint changes. However, to adequately service chillers, Tracer®TU service tool is required. (Non-Trane personnel, contact your local Trane office for software purchase information.) TracerTU adds a level of sophistication that improves service technician effectiveness and minimizes chiller downtime. This portable PC-based service-tool software supports service and maintenance tasks, and is required for software upgrades, configuration changes and major service tasks.

TracerTU serves as a common interface to all Trane chillers, and will customize itself based on the properties of the chiller with which it is communicating. Thus, the service technician learns only one service interface.

The panel bus is easy to troubleshoot using LED sensor

verification. Only the defective device is replaced.

TracerTU can communicate with individual devices or groups of devices.

All chiller status, machine configuration settings, customizable limits, and up to 100 active or historic diagnostics are displayed through the service-tool software interface.

LEDs and their respective TracerTU indicators visually confirm the availability of each connected sensor, relay, and actuator.

TracerTU is designed to run on a customer's laptop, connected to the Tracer AdaptiView control panel with a USB cable. Your laptop must meet the following hardware and software requirements:

- 1 GB RAM (minimum)
- 1024 x 768 screen resolution
- CD-ROM drive
- Ethernet 10/100 LAN card
- An available USB 2.0 port
- Windows 7 Enterprise or Professional operating system (32-bit or 64-bit)

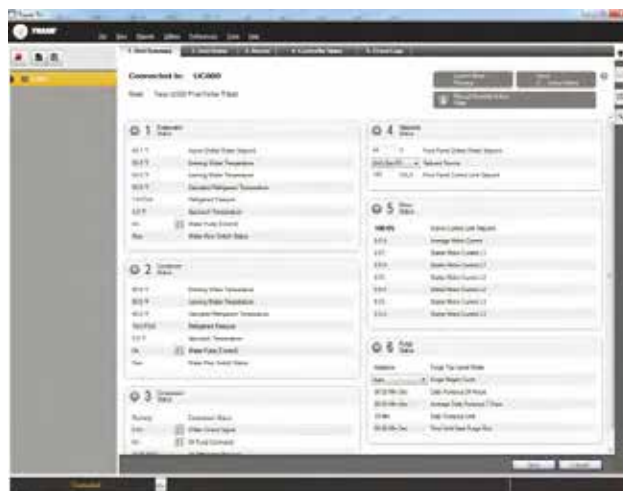
Note: TracerTU versions 8.6 and earlier will also support Microsoft® Windows® XP Professional operation system with Service Pack 3 (SP3).

- Microsoft .NET Framework 4.0 or later

Notes:

- Tracer®TU is designed and validated for this minimum laptop configuration. Any variation from this configuration may have different results. Therefore, support for TracerTU is limited to only those laptops with the configuration previously specified.
- For more information, see TTU-SVN01*-EN Tracer®TU Getting Started Guide.

Figure 17. TracerTU

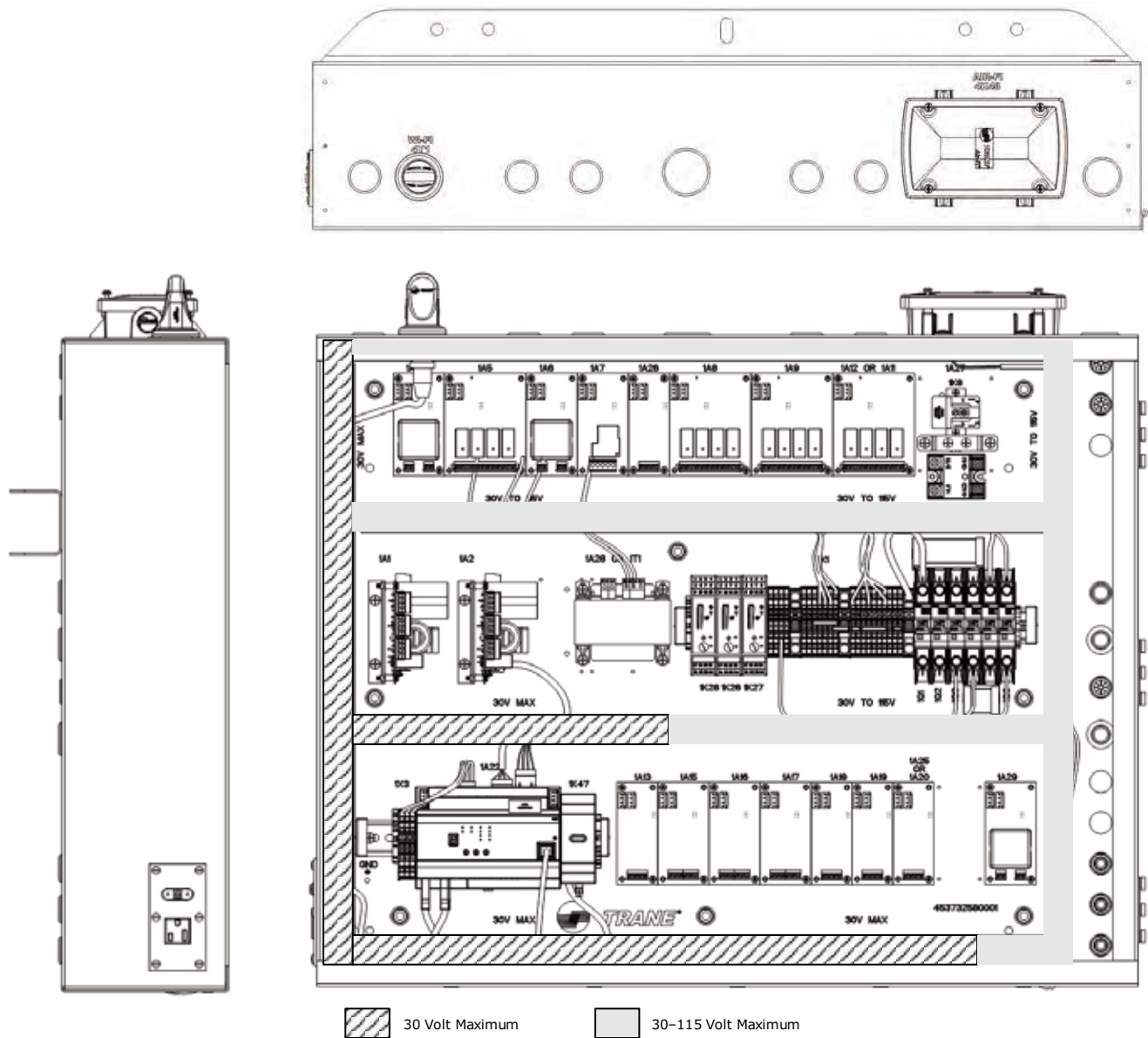




Installation Controls

Control Panel

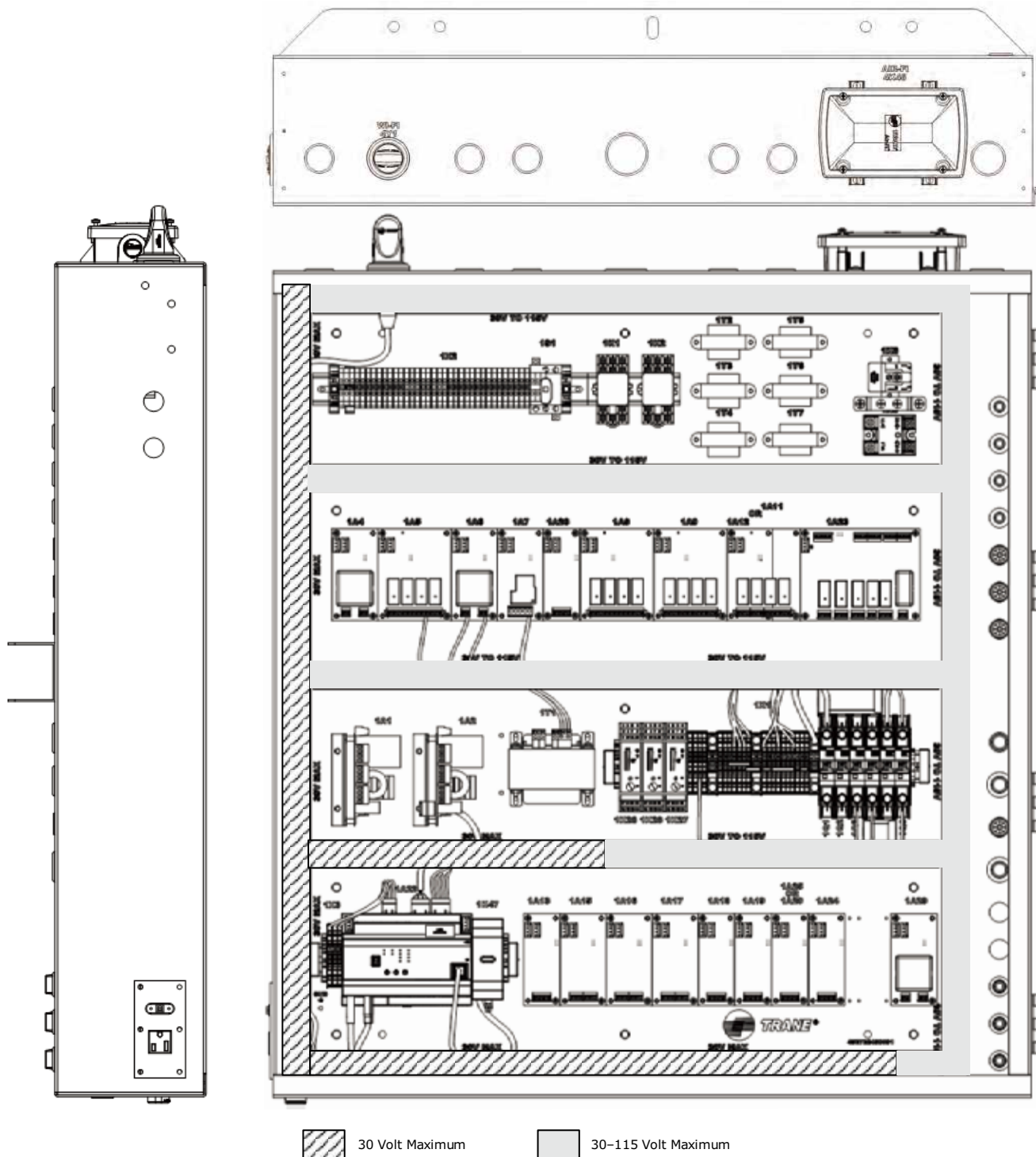
Figure 18. Standard control panel: main unit assembly
(showing low voltage and higher voltage areas for proper routing of field wiring)





Installation Controls

Figure 19. Optional control panel: main unit assembly
(showing low voltage and higher voltage areas for proper routing of field wiring)





Installation Controls

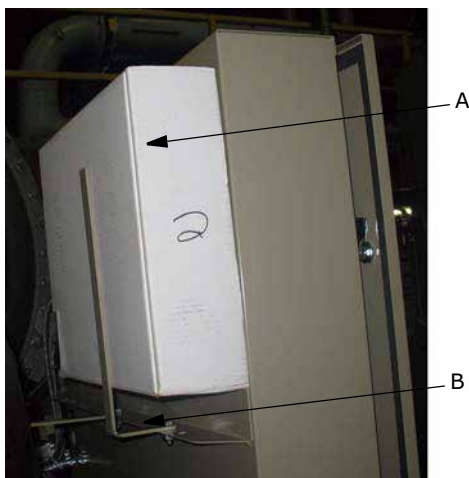
Installing the Tracer AdaptiView Display

The Tracer AdaptiView display is boxed and shrink-wrapped behind the control panel during shipment. The Tracer AdaptiView display must be installed at the site.

Important: The Tracer AdaptiView display and display arm are to be installed by Trane, or an agent of Trane, for best results.

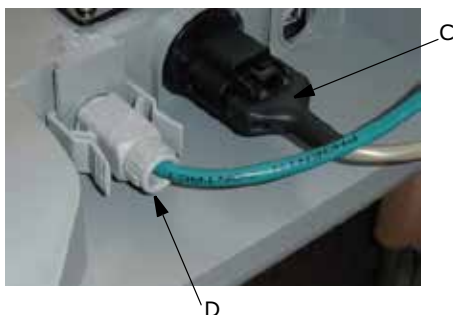
1. Unwrap control panel and display arm. Locate the box containing the Tracer AdaptiView display behind the control panel (labeled A).
2. After the box containing the display has been removed, remove the shipping bracket from the back of the control panel (B).
3. Remove the Tracer AdaptiView display from the box.

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



4. 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.



5. 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.

6. Position the Tracer AdaptiView display, with the LCD screen facing up, on top of the display support arm base plate.

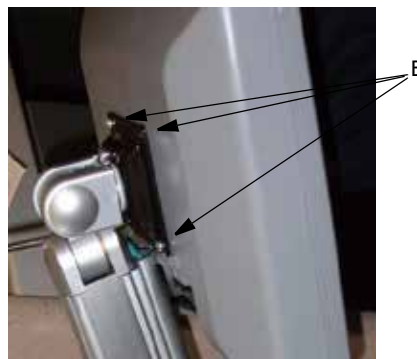
Note: Make sure the Trane logo is positioned so that it will be at the top when the Tracer AdaptiView display is attached to the display support arm.

⚠ 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.

7. Align the four holes in the display with the bolt holes in the display support arm base plate.
8. Attach the Tracer AdaptiView display to the display support arm base plate (E). The Tracer AdaptiView display is now installed and ready for use.



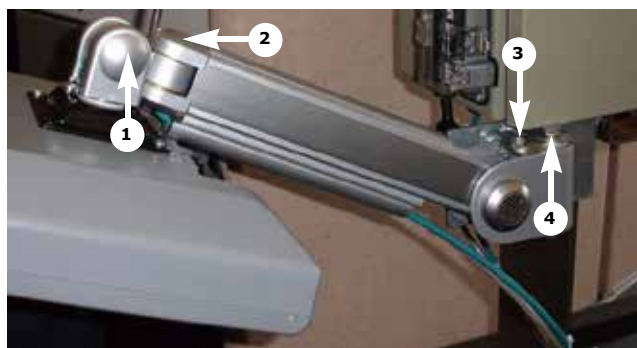
Adjusting the Tracer AdaptiView Display Arm

The Tracer AdaptiView display arm may be too loose or too tight and in need of adjustment. To adjust the tension on the display arm:

1. 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 20](#)). 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 20. Joint locations on the display arm



2. 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.
3. 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.
4. To adjust the swivel of the Tracer AdaptiView display (the spin right and left similar to the steering wheel on a car), you need to adjust the hex bolt located inside the display arm back plate. This adjustment needs to be done BEFORE attaching the display. Use a 9/16" or 14 mm wrench.
5. Use a 13 mm wrench to adjust the bolt (item labeled 4 in [Figure 20](#)) that allows the entire display arm to swivel to the left and right.



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 starters are available as an option on most units with nominal voltages of up to 600 volts and unit mounted medium voltage across-the-line starters. While this option eliminates most field-installed wiring requirements, the electrical contractor must still complete the electrical connection for:

- Power supply wiring to the starter
- Other unit control options present, and
- Any field-supplied control devices

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 loa 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.

The operation conditions of the electrical parts of the existing units are announced as follows:

General Operating Condition		
Environment	Low Voltage Circuits	Medium and High Voltage Circuits
Ambient Air Temperature	The temperature of indoor electric should be, at -5°C ~40°C, and the average temperature measured during 24 hours should be, no more than 35°C the temperature of outdoor electric should be at -25°C ~52°C, and the average temperature measured during 24 hours should be no more than 35°C	The temperature should be at -5°C ~40°C, and the average temperature measured during 24 hours should be no more than 35°C
Humidity Condition	The relative humidity should be no more than 50% when the temperature is 40°C, and 5%~95% no condensation	The relative humidity average measured, during 24 hours should be no more than 95%; the water vapor pressure average measured during 24 hours should be no more than 2.2kpa; the monthly relative humidity average should be no more than 90%; the monthly water vapor pressure average, should be no more than 1.8 kpa. No condensation.
Polluting Level	Polluting level is 3,	The ambient air is not significantly affected by dust, smoke, corrosive, or flammable gas, steam or salt spray
Elevation	Tri-star and soft start should be no more than 2000 meters; frequency conversion should be no more than 1000 meters	No more than 1000 meters

⚠ NOTICE:

Component Damage!

Remove all debris from inside the starter 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 starter enclosure must be cut to provide electrical access, exercise care to prevent debris from falling inside the enclosure. Refer to installation information shipped with the starter or submittal drawings.

If there is a special condition, it is decided by customers' requirements.

Electrical Requirements

- Follow all lockout-tagout procedures prior to performing installation and/or service on the unit.



Electrical Requirements

- 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.

For AWG/MCM equivalents in mm², refer to [Table 8](#):

Table 8. Wire sizing reference

AWG/MCM	mm ² equivalent
22	0.32
21	0.35
20	0.5
18	0.75
17	1.0
16	1.5
14	2.5
12	4
10	6
8	10
6	16
4	25
2 or 1	35
1/0	50
2/0	70
2/0 or 3/0	95
4/0 or 250	120
300	150
350 or 400	185
450 or 500	240

note: AWG=American Wire Gauge

Important: Important: Customers are responsible for all field wiring in compliance with local, national, and/or international codes.

⚠ 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.

Note: For additional information regarding the safe discharge of capacitors, see PROD-SVB06A-EN or PROD-SVB06A-FR.

⚠ 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.



Electrical Requirements

Trane-Supplied Starter Wiring

Table 9. Standard field power wiring requirements

Power Supply Wiring to Starter Panel	Starter Panel Terminals			
3-Phase Line Voltage: Terminal Block (2TB3 or 2X3)	2X3-L1, L2, L3, and GROUND			
3-Phase Line Voltage: Circuit Breaker	2Q1-L1, L2, L3, and GROUND			
Starter to Motor Power Wiring	Starters			
Remote Starter to Chiller Motor Junction Box	T1 through T6			
Starter to Control Panel 120 Vac Control Wiring	Starter Panel Terminals	Unit Control Panel Terminations	Max Terminal Wire Size	Minimum Circuit Ampacity
120 Vac Power Supply (from starter to control panel)	2X1-1, 2X1-2 2X1-20 (Ground)	1X1-1, 1X1-12 1X1-18 (Ground)		
High Pressure Cutout to Starter	2X1-4	1X1-4	14 ga. (2.5 mm ²)	20
1Q1 Circuit Breaker to Starter	2X1-6	1X1-3	14 ga. (2.5 mm ²)	20
Oil Pump Interlock	2X1-7, 2X1-8	1A7-J2-4, 1A7-J2-2	14 ga. (2.5 mm ²)	20
Low Voltage Circuits less than 30 Vac	Starter Panel Terminals	Unit Control Panel Terminations		
Standard Circuits				
Inter Processor Communications (IPC) Remote Mounted	2A1- J3-3-4, or 2X1-12 to 13 if present (do not ground shield at starter)	1A1-J5-1-2, 3-4 Shield ground at 1X1- 22 (GND) only.	2 wire with ground Comm link.	

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

2. Auxiliary equipment must be powered from other sources as the chiller control panel power supplies are sized for the chiller loads only.

(a) Ground lug for a unit-mounted solid state starter or wye-delta starter is sized to accept 14 AWG solid to 8 AWG strand wire. For AWG/MCM equivalents in mm², refer to [Table 8, p. 39](#). If local codes require different lug size, it must be field-supplied and -installed.

(b) Refer to submittal and ship-with wiring schematics for voltage requirements.

(c) Must be separated from 120 Vac and higher wiring.



Customer-Supplied Remote Starter Wiring

Table 10. Standard customer-supplied remote field wiring requirements

Power Supply Wiring to Starter Panel	Starter Panel Terminals			
Starter by others 3-phase power wiring	See starter by others schematic			
Starter to Motor Power Wiring	Starters	Motor		
Remote starter to chiller motor junction box	T1 through T6 terminals	T1 through T6 terminals		
Starter to Control Panel 120 Vac Control Wiring	Starter Panel Terminals	Unit Control Panel Terminations	Max Terminal Wire Size	Minimum Circuit Ampacity
120 Vac Power Supply (from starter to control panel)	See starter by others schematic 5X1-1, 5X1-2, 5X1-20 (ground)	1X1-1, 1X1-12, 1X1-18 (ground)	8 ga. (10 mm ²)	40
Power from control panel 1Q1	5X1-3	1X1-3, 1A23-J6-3	14 ga. (2.5 mm ²)	20
Interlock relay signal	5X1-4	1A23-J10-1	14 ga. (2.5 mm ²)	20
Start contactor signal	5X1-5	1A23-J8-1	14 ga. (2.5 mm ²)	20
Oil pump interlock	5X1-7, 5X1-8	1A7-J2-4, 1A7-J2-2	14 ga. (2.5 mm ²)	20
Run contactor signal	5X1-10	1A23-J6-12	14 ga. (2.5 mm ²)	20
Transition complete	5X1-14	1A23-J12-2	14 ga. (2.5 mm ²)	20
Low Voltage Circuits less than 30 Vac	Starter Panel Terminals	Unit Control Panel Terminations		
Standard Circuits				
Current Transformers* (see table next page) (Required)	5CT4- white, black 5CT5- white, black 5CT6- white, black	1A23-J7-1,2 1A23-J7-3,4, 1A23-J7-5,6,	Note: Phasing must be maintained	
Potential Transformers (Required)	5T17-236,237 5T18-238,239 5T19-240,241	1A23 -J5-1,2, 1A23 -J5-3,4, 1A23 -J5-5,6	Note: Phasing must be maintained	

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

Note: Starter by others specification available from your local Trane sales office.

2. Refer to ship-with wiring schematics; some terminals may vary based on unit.

- (a) For AWG/MCM equivalents in mm², refer to [Table 8, p. 39](#). Wires, lugs, and fuses/breakers are sized based on National Electric Code NEC [NFPA 70] and UL 1995.
- (b) Refer to submittal and ship-with wiring schematics for voltage requirements.
- (c) Solid State Starter Fault input is used with low-and medium-voltage, customer-supplied solid state starters only.
- (d) Must be separated from 120 Vac and higher wiring.



Customer-Supplied Remote Starter Wiring

Current Transformer and Potential Transformer Wire Sizing

For customer-supplied starter to chiller unit control panel starter module 1A23 these wires must be separated from 120 Vac or higher wiring.

Table 11. Maximum recommended wire length for secondary CT leads in dual CT system

Wire AWG (mm ²)	Maximum Wire Length Secondary CT Leads	
	Feet	Meters
8 (10)	1362.8	415.5
10 (6)	856.9	261.2
12 (4)	538.9	164.3
14 (2.5)	338.9	103.3
16 (1.5)	213.1	65.0
17 (1)	169.1	51.5
18 (0.75)	134.1	40.9
20 (0.5)	84.3	25.7

Note: 1. Wire length is for copper conductors only.

2. Wire length is total one-way distance that the CT can be from the starter module.

Table 12. Maximum recommended total wire length for PTs in a single PT system

Wire Gauge	Maximum Lead Length	
	Feet	Meters
8	5339	1627
10	3357	1023
12	2112	643
14	1328	404
16	835	254
17	662	201
18	525	160
20	330	100
21	262	79
22	207	63

Note: 1. Wire length is for copper conductors only.

2. The above length is maximum round trip wire length. The maximum distance the PT can be located from the starter module is half of the listed value.

Table 13. Max recommended total wire length (to and from) for PT leads in a dual PT system

Wire Gauge	Max Wire Length Primary		Max Wire Length Secondary	
	Feet	Meters	Feet	Meters
8	3061	933	711	217
10	1924	586	447	136
12	1211	369	281	85
14	761	232	177	53
16	478	145	111	33
17	379	115	88	26
18	301	91	70	21
20	189	57	44	13
21	150	45	34	10
22	119	36	27	8

Notes:

1. Wire length is for copper conductors only.

2. The above length is maximum round trip wire length. The maximum distance the PT can be located from the starter module is half of the listed value.



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.

To assure that power supply wiring to the starter panel is properly installed and connected, review and follow the guidelines outlined below.

3-Phase Power Source

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

⚠ NOTICE

Starter Damage!

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

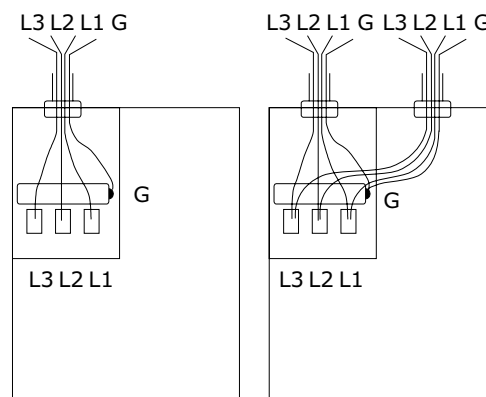
⚠ NOTICE

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 starter enclosure must be cut to provide electrical access, exercise care to prevent debris from falling inside the enclosure.
- Use copper conductors to connect the 3-phase power supply to the remote or unit-mounted starter 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 starter must carry the correct number of conductors to ensure equal phase representation

Note: Connect L1, L2, and L3 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. Assure that the conduit is long enough to simplify any servicing that may be necessary in the future (e.g., starter removal).
- Electrical wire torque specifications - follow starter manufacturer's torque specifications.

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.

Power Factor Correction Capacitors (Optional)

Power factor correction capacitors (PFCCs) are designed to provide power factor correction for the compressor motor. PFCCs are available as an option for unit-mounted starters and remote mounted starters.

Note: Verify PFCC voltage rating is greater than or equal to the compressor voltage rating stamped on the unit nameplate.

Refer to the wiring diagrams that shipped with the unit for specific PFCC wiring information.



Power Supply Wiring

⚠ NOTICE

Motor Damage!

PFCCs must be wired into the starter correctly. Failure to do so could cause misapplication of these capacitors and result in a loss of motor overload protection and subsequently cause motor damage.

PFCCs must be wired one of two ways as shown as shown below.

Rule 1 - PFCCs installed downstream of starter contactor, upstream of current transformers.

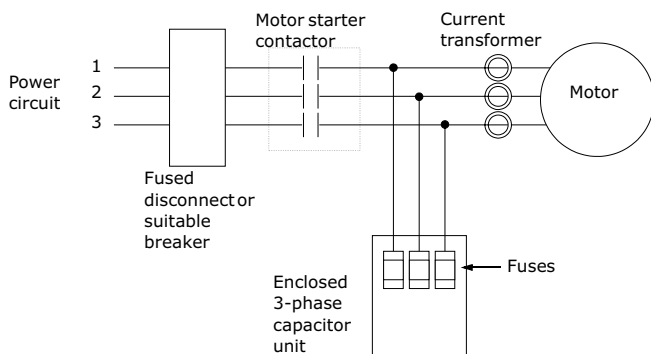
⚠ WARNING

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.

Note: For additional information regarding the safe discharge of capacitors, see PROD-SVB06A-EN or PROD-SVB06A-FR

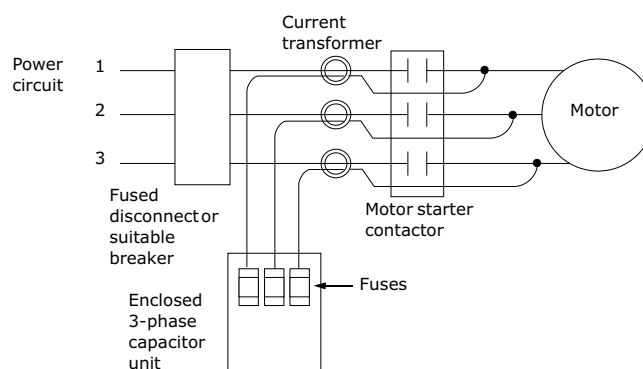
Simultaneously disconnect capacitors and load from line power. If the capacitors are not switched offline when the load is disconnected, they continue to add capacitance to the electrical distribution system. A "leading" power factor—too much capacitance—may eventually develop. This overprotection causes poor voltage regulation, i.e., voltage is high when the circuit is unloaded, then drops as loads are added.



Rule 2 - PFCC wires routed through current transformers.

Size motor overload protection to account for capacitor-supplied current. Overloads are typically set to measure the total current drawn by the motor. When PFCCs are used, they become the source of part of that current.

If the current they provide isn't registered by the overload protectors, potentially damaging amperage can reach the motor. The simplest way to ensure that the overloads "see" all current supplied to the motor is to position the PFCCs upstream of the current transformers as shown in the preceding figure. If the capacitor connection points are downstream of the current transformers, route the PFCC leads through the current transformers as shown in the following figure. This assures that the overloads register both line and capacitor-supplied current.



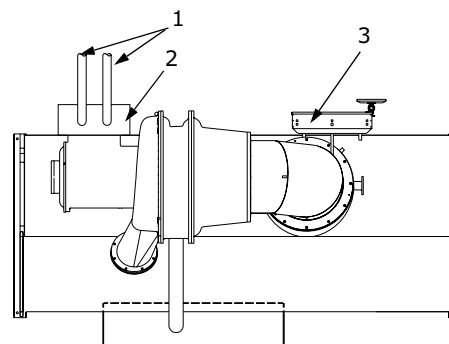
Interconnecting Wiring

Typical equipment room conduit layouts with and without unit mounted starters are shown in [Figure 21](#) and [Figure 22](#).

Important: Keep in mind that the interconnecting wiring between the starter panel, compressor and control panel is factory-installed with unit-mounted starters but must be field-installed when a remote mounted starter is used.

See starter submittal drawing for location of incoming wiring to the starter.

Figure 21. Typical equipment room layout for units with unit-mounted starters

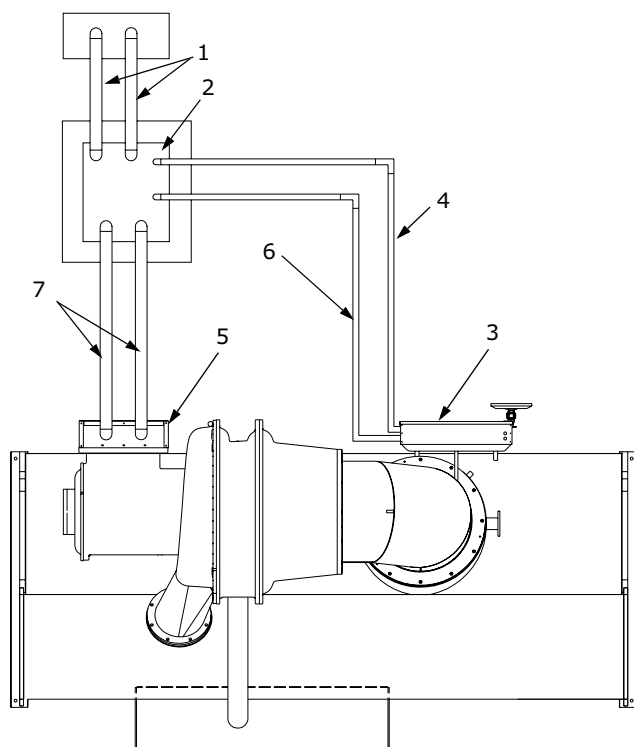


1. Line side power conduits
2. Unit-mounted starter
3. Unit control panel



Power Supply Wiring

Figure 22. Typical equipment room layout for units with remote-mounted starters



1. Line side power conduits
2. Remote-mounted starter
3. Unit control panel
4. IPC Circuit conduit less than 30V

Note: Must enter the low voltage Class 2 portion of the unit control panel (1000 feet max).

5. Motor terminal box
6. 115 V Control conduit

Note: Must enter the higher than 30 Vdc Class 1 portion of the unit control panel.

7. Lead power wiring

Note: Refer to the unit field connection diagram for approximate unit control panel knock out locations.

Note: To prevent damage to the unit control panel components, do not route control conduit into the top of the box.

Starter to Motor Wiring (Remote-Mounted Starters Only)

Ground Wire Terminal Lugs

Ground wire lugs are provided in the motor terminal box and in the starter panel.

Terminal Clamps

Terminal clamps are supplied with the motor terminals to accommodate either bus bars or standard motor terminal wire lugs. Terminal clamps provide additional surface area to minimize the possibility of improper electrical connections.

Wire Terminal Lugs

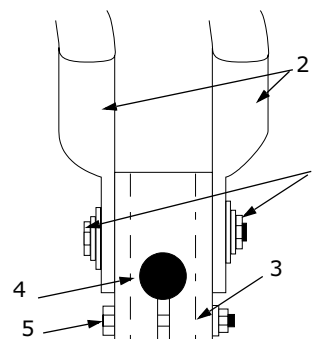
Wire terminal lugs must be field supplied.

- Use field provided crimp type wire terminal lugs properly sized for the application.

Note: Wire size ranges for the starter line and load-side lugs are listed on the starter submittal drawings supplied by the starter manufacturer or Trane. Carefully review the submitted wire lug sizes for compatibility with the conductor sizes specified by the electrical engineer or contractor.

- A terminal clamp with a 3/8" bolt is provided on each motor terminal stud; use the factory supplied Belleville washers on the wire lug connections. The figure below illustrates the juncture between a motor terminal stud and terminal lug.

Figure 23. Terminal stud, clamp and lug assembly



1. Belleville washer
2. Terminal lugs
3. Terminal clamp
4. Motor terminal stud
5. 3/8" bolt

1. Torque for this assembly is 24 ft·lb (32.5 N·m).
2. Install but do not connect the power leads between the starter and compressor motor. (These connections will be completed under supervision of a qualified Trane service engineer after the pre-start inspection.)

⚠ NOTICE

Component Damage!

Ensure the power supply wiring and output to motor wiring are connected to the proper terminals. Failure to do so will cause catastrophic failure of the starter and, or motor.



Power Supply Wiring

Bus Bars

Bus bars and extra nuts are available as a Trane option. Install the bus bars between the motor terminals when using a low-voltage

- across-the-line
- primary reactor/ resistor
- auto transformer
- customer-supplied outside the delta solid-state
- customer-supplied AFD.

Connect T1 to T6, T2 to T4, and T3 to T5.

Note: *Bus bars are not needed in medium-voltage or high-voltage applications since only 3 terminals are used in the motor and starter.*

When attaching starter leads to 6.6 – 7kV motor terminals, the 1/2" – 13 brass jam nuts should be tightened to a maximum torque of 18 to 22 ft·lb (18 to 30 N·m). Always use a second wrench to back-up the assembly and prevent applying excessive torque to the terminal shaft.

Starter to Control Panel Wiring

Field wiring connection diagram and starter to control panel connection diagram showing the electrical connections required between the remote-mounted starter and the control panel are available in the unit submittal.

Note: *Install separate conduit into the low voltage (30 volts) section of the control panel.*

When sizing and installing the electrical conductors for these circuits, follow the guidelines listed. Use 14 ga. wire for 120V control circuits unless otherwise specified.

⚠ NOTICE

Component Damage!

Remove all debris from inside the starter panel. Failure to do so could result in an electrical short and could cause serious starter component damage.

⚠ NOTICE

Electrical Noise!

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 wiring.

1. If the starter enclosure must be cut to provide electrical access, exercise care to prevent debris from falling inside the enclosure. Do not cut AFD enclosure.
2. Use only shielded twisted pair wiring for the Interprocessor Communication (IPC) circuit between the starter and the control panel on remote mounted starters. Recommended wire is Belden Type 8760, 18 AWG for runs up to 1000 feet.

Note: *The polarity of the IPC wiring is critical for proper*

operation.

3. Separate low-voltage (less than 30V) wiring from the 115V wiring by running each in its own conduit.
4. As you route the IPC circuit out of the starter enclosure, make sure that it is at least 6" from all wires carrying a higher voltage.

⚠ WARNING

Grounding Required!

Follow proper local and state electrical code on requirements for grounding. Failure to follow code could result in death or serious injury.

5. The IPC wiring shield should be grounded on one end only at control panel end. The other end should be un-terminated and taped back on the cable sheath to prevent any contact between shield and ground.
6. Oil Pump Interlock - All starters must provide an interlock (normally open) contact with the chiller oil pump connected to the control panel at Terminals 1A7-2-4 and 1A7-J2-2 (14 ga.) The purpose of this interlock is to power the oil pump on the chiller in the event that a starter failure, such as welded contacts, keeps the chiller motor running after the controller interrupts the run signal.



10kV–13.8kV Medium Voltage Installation

⚠ WARNING

Hazardous Voltage!

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.

All electrical circuits shall be treated as energized until all lockout-tagout procedures are in place and the circuit has been tested to verify that it is de-energized. The medium voltage motor terminal box cover must not be removed if power is present, or if there is a possibility that power may be present. Working on energized medium voltage circuits is not an approved practice for normal HVAC maintenance or service.

10kV–13.8kV Medium Voltage Motor

The motor is suitable for remote mounted across-the-line (including circuit breaker starting), primary reactor, autotransformer, or solid-state starting. Refer to the unit nameplate for motor data including RLA, LRA, etc.

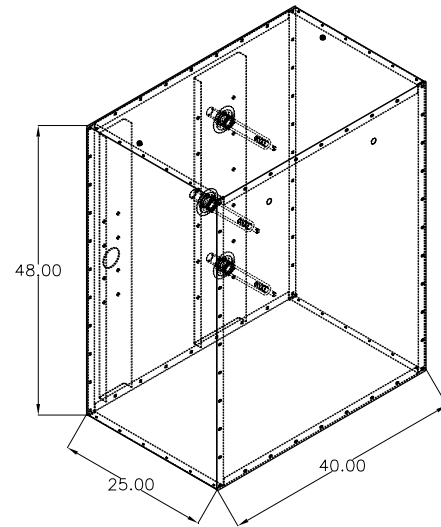
In all cases of non-Trane supplied starters, the Trane Engineering Specification for Symbio800 Starter By Others (available through your local Trane office) must be followed in order to ensure proper function and protection of the chiller. A disconnecting means and short-circuit protection must be installed ahead of the starter, unless they are included as part of the starter. Trane assumes no responsibility for the design, documentation, construction, compatibility, installation, start-up, or long term support of starters provided by others.

Motor Terminal Box

A large steel motor terminal box is provided to allow for the field connection of the motor power supply wire to the motor

- Motor terminal box cover only weight is 55 lb (25 kg)
- Two 7/8" (22 mm) lifting holes are provided in the cover.
- Motor terminal box weight without the cover is 215 lb (98 kg)
- Two 3/8"-16 weld nuts are provided on the top of the terminal box to allow the use of properly rated lifting d-rings if removal is needed for clearance purposes.

Note: If the box is removed for installation purposes, the motor terminals **MUST** be protected against impact or stress damage. Field fabrication of a cover or guard is required.



Note: Dimensions in inches

The motor terminal box is large enough to accommodate the use of stress cones. If conduit is applied a flexible connection of the conduit to the box should be made to allow for unit serviceability and for vibration isolation. The cable should be supported or protected against abrasion and wear on any edges or surfaces. Cable or conduit openings can be cut at any location in the box sides, top, or bottom for cable entry. Always ensure that debris does not remain in the box after cutting cable entry holes.

Motor Supply Wiring

⚠ WARNING

Grounding Required!

Follow proper local and state electrical code on requirements for grounding. Failure to follow code could result in death or serious injury.

Motor circuit wire sizing by the installer must be made in accordance with the National Electric Code or any other applicable codes. All wiring to the CenTraVac motor must be shielded copper, with insulation rated to a minimum of 15kV.

Three terminals are provided on the chiller for the connection of power to the motor from the starter. Power leads to motors must be in multiples of 3, with equal phase representation in all conduits or wire trays. To limit the effects of corona or ionization with cables carrying more than 2000V, Trane requires that the power cable have a metallic shield, unless the cable is specifically listed or approved for non-shielded use. If the cable is shielded, the shielding must be grounded at one end (grounding is typically done at the starter or supply end).

Care must be taken while routing the incoming cables to ensure that cable loads or tensions are not applied to the terminal or premature terminal failure could result.



10kV–13.8kV Medium Voltage Installation

Motor Terminals

Field provided ring type lugs, with no sharp edges or corners, must be used by a qualified installer to connect the power wiring to the motor terminals. Follow all instructions provided with the field provided lugs to ensure proper connections. The use of stress cones is highly recommended to reduce and control longitudinal and radial electrical stresses at the cable ends. Prior to assembly the terminal stud, nuts, and lug should be inspected and cleaned to ensure they are not damaged or contaminated. When attaching starter leads to 2.3–6.6 kV motor terminals, the M14x2 brass jam nuts should be tightened to a maximum torque of 32.5–40.7 N·m (24–30 ft·lb). Always use a second wrench to backup the assembly and prevent applying excessive torque to the terminal shaft.

Note: 6.0kV and 6.6kV motors on 6800 or 6800L frames (see compressor model number for motor frame) use the same motor terminals as the 10kV–13.8kV motors.

The motor terminal has a copper shaft that is threaded 9/16" - 18 UNF2A. Brass nuts are provided on the motor terminals to retain the lugs, and the final connection should be tightened to 22–25 ft·lb (30–34 N·m), using a 7/8" (22 mm) socket on a torque wrench.

⚠ NOTICE

Motor Terminal Damage!

Do not apply torque to the motor terminal when tightening lugs. Always use a second wrench to back-up the assembly and prevent the application of torque to the terminal shaft. Failure to follow this instruction could cause equipment or property-only damage.

Before beginning wiring and torquing, ensure proper motor terminal care and do not apply any excess stress.

Ground Wire Terminal Lug

A ground wire lug is provided in the motor terminal box to allow the field connection of an earth ground. The lug will accept a field supplied ground wire of #8 to #2 AWG size. After the field connection of wiring is complete inspect and clean the motor terminals and motor housing, and remove any debris before reinstalling the motor terminal box cover. The cover must be re-installed onto the motor terminal box and all bolts installed. Do not operate the chiller with the motor terminal box cover removed or with any loose or missing cover bolts.



System Control Circuit Wiring

Table 14. 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	1X1-5 to 1A6-J3-2	Binary Input	Normally Open, closure with flow
Condenser Water Flow Proving Input	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 startup 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
Free Cooling Relay Output	1A11-J2-4 to 6	Binary Output	Normally Open
Standard Low Voltage Circuits (less than 30 Vac)			
	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-J2-1 to 2	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
External Free Cooling Input Enable Input	1A20-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
External Current Limit Setpoint Input	1A16-J2-2 to 3	Analog Input	2–10 Vdc, or 4–20 mA
External Current Limit Setpoint Input	1A16-J2-5 to 6	Analog Input	2–10 Vdc, or 4–20 mA
External Current Limit 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)	
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 3.3°C [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 1X1-6 to 1K27-4 (binary input; normally open, closure with flow). Remove factory jumper when used.



System Control Circuit Wiring

Water Pump Interlock Circuits and Flow Switch Input

⚠ 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.

Note: For additional information regarding the safe discharge of capacitors, see PROD-SVB06A-EN or PROD-SVB06A-FR

Chilled Water Pump.

1. Wire the evaporator water pump contactor (5K1) to a separate 120 volt single phase power supply with 14 AWG, 600 volt copper wire
2. Connect circuit to 1A5-J2-6
3. Use 1A5-J2-4 120 Vac output to allow the control panel to control the evaporator water pump, or wire the 5K1 contactor to operate remotely and independently of the control panel.

Chilled Water Proof of Flow.

When installed properly, this circuit only allows compressor operation if the evaporator pump is running and providing the required minimum water flow.

1. Wire the auxiliary contacts of the evaporator water pump contactor (5K1) in series with the flow switch (5S1) installed in the evaporator supply pipe with 14 AWG, 600-volt copper wire
2. Connect circuit to control panel terminals 1X1-5 to 1A6-J3-2.

Condenser Water Pump.

1. Wire the condenser water pump contactor (5K2) to a separate 120-volt, single phase power supply with 14 AWG, 600-volt copper wire
2. Connect circuit to control panel terminals 1A5-J2-3
3. Use 1A5-J2-1 120 Vac output to allow the control panel to control the condenser pump.

Condenser Water Proof of Flow.

When installed properly, this circuit only allows the compressor to operate if the condenser pump is running and providing the required minimum water flow.

1. Use 14 AWG, 600-volt copper wire to connect the auxiliary contacts of the condenser water pump contactor (5K2) in series with the flow switch (5S2) installed in the condenser supply pipe
2. Connect circuit to control panel terminals 1X1-6 to 1A6-J2-2

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

CWR - Outdoor Option.

The outdoor temperature sensor 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 assures 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, maximum length 1000 feet (305 meters). The module four-wire bus must be connected to the control panel four-wire bus using the Trane-approved connectors provided.

The sensor will be configured (given its identity and become functional) at start-up when the serviceman 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.

⚠ NOTICE

Electrical Noise!

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.



System Control Circuit Wiring

Optional Control and Output Circuits

Install various optional wiring as required by the owner's specifications. Refer to [Table 14, p. 49](#).

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 Comm option is published in the installation and operator's guide that ships with the Tracer.

Unit Start-Up

All phases of initial unit start-up must be conducted under the supervision of a qualified Trane technician. This includes pressure testing, evacuation, electrical checks, refrigerant charging, actual start-up and operator instruction. Advance notification is required to assure that initial start-up is scheduled as close to the requested date as possible.

Starter Module Configuration

The starter module configuration settings will be checked (and configured for Remote Starters) during start-up commissioning. To configure starter modules, and perform other starter checks, it is recommended that the line voltage three phase power be turned off and secured (locked out), and then a separate source control power (115 Vac) be utilized to power up the control circuits. To do this, remove control coil circuit fuse, typically 2F4, and connect separate source power cord to starter terminal block 120 V source connect, and ground.

Use the as-built starter schematic to assure correct fuse and terminals. Verify correct fuse is removed, control circuit connections are correct, then apply the 115 Vac separate source power to service the controls.

Schematic Wiring Drawings

The chart below consist of typical wiring drawings for a CenTraVac chiller available through e-Library. However, please refer to the submittals and drawings that actually shipped with the unit. Additional wiring drawings for CenTraVac chillers are available from your local Trane office.

Field Wiring Layout Drawing	Drawing Number	Maximum Acceleration Time (seconds)
Unit Mounted Wye-Delta Starter (USTR)	2311-0801	27
Unit Mounted Solid-State Starter (USID)	2311-0831	15
Unit Mounted Across-the-Line (UXL)	2311-0834	6
Unit Mounted Adaptive Frequency Drive (UAFD)	2311-0810 & 2311-0811	30
Unit Mounted Auto Transformer Start (UATR)	2311-0832	11
Unit Mounted Primary Transformer (UPIR)	2311-0833	11
Remote Wye-Delta Starter (RSTR)	2311-0802	27
Remote Mounted Solid-State Starter (FSID, WSID)	2311-0804	15
Remote Across-the-Line Starter (RXL)	2311-0808	6
Remote Primary Reactor Starter (RPIR)	2311-0807	11
Remote Auto Transformer Starter (RATR)	2311-0806	11
Customer Supplied Wye-Delta Starter (CSTR)	2311-0457	27
Customer Supplied Primary Reactor or Auto Transformer Starter (CATR, CPIR)	2311-0479	11
Customer Supplied Across-the-Line Starter (CXL)	2311-0493	6
Customer Supplied Solid-State Starter (CSOL)	2311-0461	20
Purge Schematic	2311-0816	
Unit Controls Schematic	2311-0810	
System Controls Schematic	2311-0814	
Optional Control Schematic	2311-0817	
Connection Diagrams		
Standard Connection Diagram Panel with Options	2311-0819	
Field Connection Trane Starter (LV)	2311-0822	
Unit Wiring	2311-0824	

Notes:

1. These are typical drawings only. Refer to specific as-built schematics for actual unit drawings which represent the unit wiring as shipped.
2. Contact your local Trane representative for all other schematics, wiring diagrams and/or connection diagrams not listed.



Operating Principles

General Requirements

Operation and maintenance information for models CVHE, CVHF, CVHG are covered in this section. This includes both 50 and 60 Hz centrifugal chillers equipped with the AdaptiView Symbio800 control system. Please note that information pertains to all chiller types unless differences exist in which case the sections are broken down by chiller type as applicable and discussed separately. 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 qualified service organization 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 first stage variable inlet guide vanes, and into the first stage impeller.

Note: Inlet guide vanes are designed to modulate the flow of gaseous refrigerant to meet system capacity requirements; they also pre-rotate the gas, allowing it to enter the impeller at an optimal angle that maximizes efficiency at all load conditions.

CVHE, CVHG 3-Stage Compressor

Compressed gas from the first-stage impeller flows through the fixed, second-stage inlet vanes and into the second-stage impeller. Here, the refrigerant gas is again compressed, and then discharged through the third-stage variable guide vanes and into the third stage impeller.

Once the gas is compressed a third time, it is 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 passes through 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 three stages of compression (see [Figure 25, p. 52](#)). Notice that some of the liquid refrigerant flashes to a gas because of the pressure drop

created by the orifice plates, thus further cooling the liquid refrigerant. This flash gas is then drawn directly from the first and second stages of the economizer into the third-and second-stage impellers of the compressor, respectively. All remaining liquid refrigerant flows through another orifice plate to the evaporator.

Figure 24. Pressure enthalpy curve 3 stage

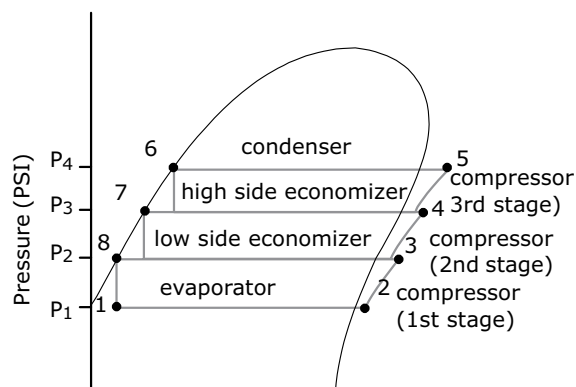
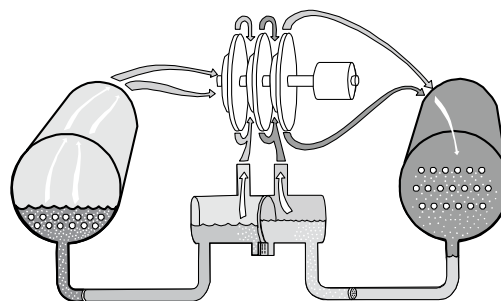


Figure 25. Refrigerant flow 3 stage



CVHF 2-Stage Compressor

Compressed gas from the first-stage impeller is discharged through 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 27, p. 53](#)). 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.



Operating Principles

Figure 26. Pressure enthalpy curve 2 stage

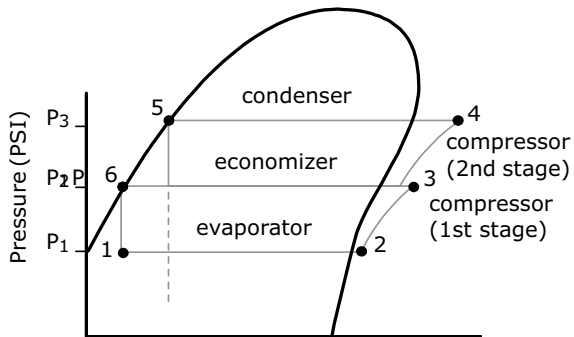


Figure 27. Refrigerant flow 2 stage

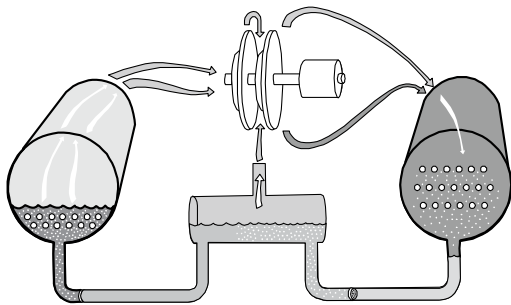
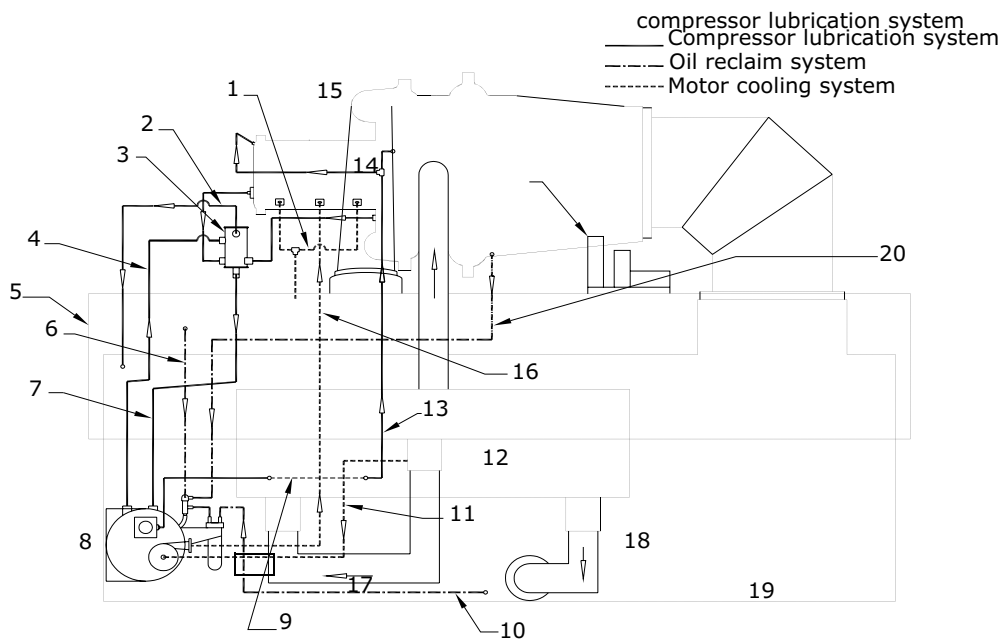


Figure 28. Oil refrigerant pump



- | | |
|---|--|
| 1. Motor coolant return to condenser (2.125 OD) | 10. (0.25 OD) Oil reclaim from evaporator (2nd eductor) |
| 2. Oil tank vent to evaporator | 11. Liquid refrigerant to pump (1.625 OD) |
| 3. Oil separator and tank vent manifold | 12. Economizer |
| 4. Tank vent line | 13. Oil supply to bearings (0.625 OD) |
| 5. Condenser | 14. Purge |
| 6. eductors (0.375 OD) High pressure condenser gas to drive oil reclaim | 15. Compressor |
| 7. Oil return to tank | 16. Liquid refrigerant motor coolant supply (1.125 OD) |
| 8. Oil tank | 17. Liquid refrigerant to economizer |
| 9. except 1820, Oil cooler within economizer (0.625 OD coiled tubing), CVHF1820 use external plate oil cooler | 18. Liquid refrigerant to evaporator |
| | 19. Evaporator |
| | 20. Oil reclaim from suction cover (1st eductor) (0.25 OD) |



Operating Principles

⚠ WARNING

Surface Temperatures!

MAY EXCEED 150°F. Use caution while working on certain areas of the unit, failure to do so could result in death or serious injury.

To ensure proper lubrication and prevent refrigerant from condensing in the oil tank, a 750-watt heater is in a well in the oil tank. The heater is used to warm the oil while the unit is off. With the default settings for R-123, the oil heater is de-energized when the unit starts. With the default settings for R-514A, Running Oil Temperature Control is enabled, and the Running Oil Temperature Setpoint is factory-programmed at 100°F(37.8°C). With either refrigerant, the heater energizes as needed to maintain 140°F to 145°F(60.0°C to 62.8°C) when the chiller is not running.

With R-123 and mineral oil, when the chiller is operating, the temperature of the oil tank is typically 100°F to 160°F (37.8°C to 71.1°C). With R-514A, solid state oil heater control is installed and enabled.

The oil return lines from the thrust and journal bearings, transport oil and some seal leakage refrigerant. The oil return lines are routed into a manifold and separator under the motor. Gas flow exits the top of the manifold and is vented to the evaporator. Oil exits the bottom of the manifold and returns to the tank. Separation of the seal leakage gas in the separator keeps this gas out of the tank.

A dual eductor system is used to reclaim oil from the suction cover and the evaporator, and deposit it back into the oil tank. These eductors use high pressure condenser gas to draw the oil from the suction cover and evaporator to the eductors and then discharged into the oil tank. The evaporator eductor line has a shut off valve mounted by the evaporator and ships closed. During the commissioning process, it is necessary for the designated technicians to open and adjust this valve according to the operating conditions.

Liquid refrigerant is used to cool the oil supply to both the thrust bearing and journal bearings. On refrigerant pump units the oil cooler is located inside the economizer and uses refrigerant passing from the condenser to evaporator to cool the oil. Oil leaves the oil cooler and flows to both the thrust and journal bearings.

CVHF1820 use separate external plate oil cooler, one way liquid from refrigerant pump cool the oil from oil pump, the cooled oil enter thrust bearing and journal bearings.

Motor Cooling System

Compressor motors are cooled with liquid refrigerant (see [Figure 28, p. 53](#)). The refrigerant pump is located on the front of the oil tank (motor inside the oil tank). The refrigerant pump inlet is connected to the well at the bottom of the condenser. The connection is on the side where a weir assures a preferential supply of liquid. Refrigerant is delivered to the motor via the pump. Motor refrigerant drain lines are routed to the condenser.

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. See CTV-SVU01C-EN, Tracer AdaptiView™ Display for Water-Cooled CenTraVac™ Chillers Operations Guide, for more details.

Tracer TU Chiller Service Tool

When servicing a chiller, you need different information—historic and active diagnostics, configuration settings, and custom control algorithms, as well as operation settings.

For the service technician or advanced operator: all chiller status, machine configuration settings, custom limits, and up to 60 active or historic diagnostics are displayed through the service tool interface. A technician can interact with an individual device or a group of devices for advanced troubleshooting. For more information on Tracer TU, visit your local Trane Service company, or Trane's website at www.trane.com.

⚠ WARNING

Every Trane Centrifugal chiller is designed for customer's condition to get best efficiency and performance, so please avoid to run chiller at conditions when chilled water set point is far from TOPSS selected condition, otherwise this may cause reliability risk or trip issue. For more information, please contact local Trane office.



Start-up and Shut Down

Sequence of Operation

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. Adaptive control algorithms can also complicate the exact sequence of operation. This section and its diagrams attempt to illustrate common control sequences.

Software States

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

Stopped

Starting

Running

Stopping

Start-up Sequence of Operation—Wye-Delta

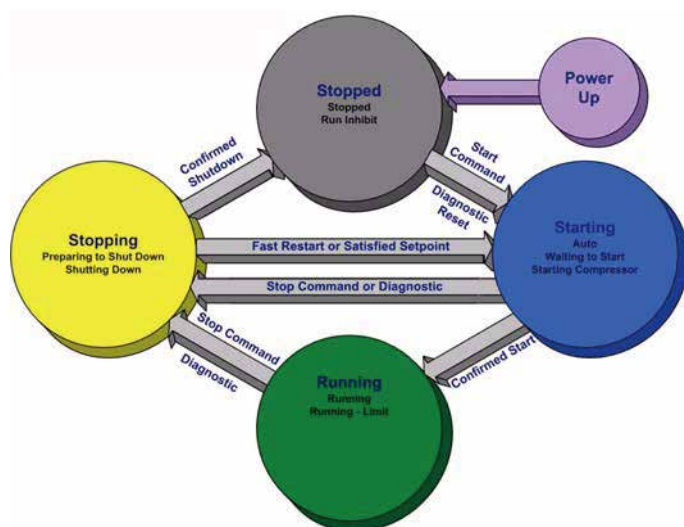
Logic Circuits within the various modules will determine the starting, running, and stopping operation of the chiller. When operation of the chiller is required the chiller mode is set at "Auto." Using customer supplied power, the chilled water pump relay is energized and chilled water flow must be verified within 4 minutes and 15 seconds, at the same time the oil vent line valve is opened. 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.

Based on the Restart Inhibit function and the Differential to Start setpoint, the oil and refrigerant pump is energized, and the oil vent line valve is closed to the minimum position. The oil pressure must be at least 82.7 kPa (12 psid) for 60 continuous seconds and condenser water flow verified within 4 minutes and 15 seconds for the compressor start sequence to be initiated. After the compressor starts, the oil vent line valve begins to open; it can take between 15 and 30 minutes to fully open depending on the chiller running conditions.

The compressor motor starts in the "Wye" configuration and then, after the compressor motor has accelerated and the maximum phase current has dropped below 85 percent of the chiller nameplate RLA for 1.5 seconds, the starter transitions to the "Delta" configuration.

Now that the compressor motor is running in the "Delta" configuration, the inlet guide vanes will modulate, opening and closing to the chiller load variation by operation of the stepper vane motor actuator to satisfy chilled water setpoint. The chiller continues to run in its appropriate mode of operation: Normal, Softload, Limit Mode, and so on. If the oil tank temperature rises above the oil cooler setpoint while the compressor is running, the oil cooler solenoid valve shall be energized to cool the oil. 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 oil and refrigerant pump motor will continue to run for 3 minutes post-lube while the compressor coasts to a stop. The oil vent line valve will then open. 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. illustrates this sequence.



Time Line Text

The large time line cylinder 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 pad, 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 and Shut Down

Figure 29. Sequence of operation: power up to starting

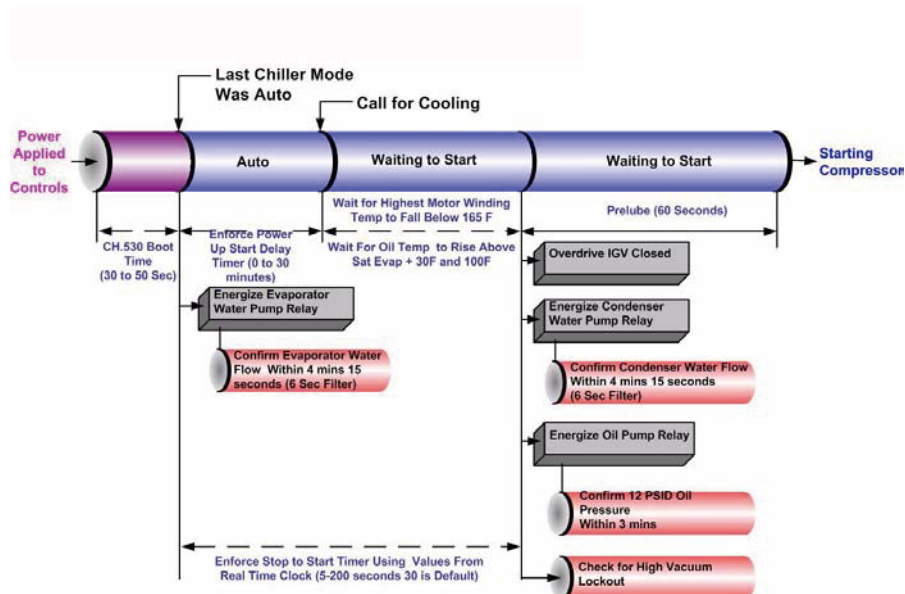
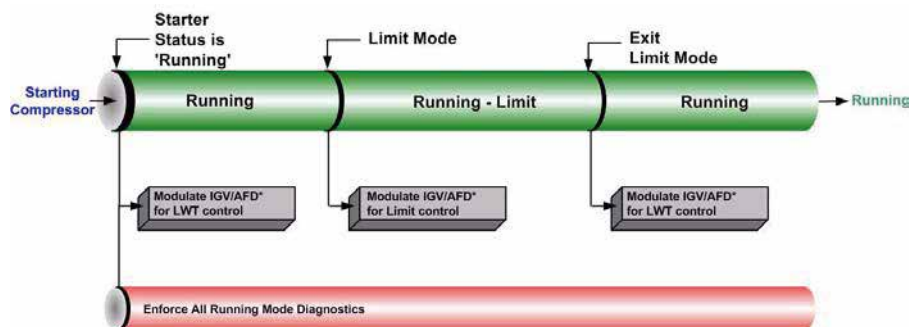
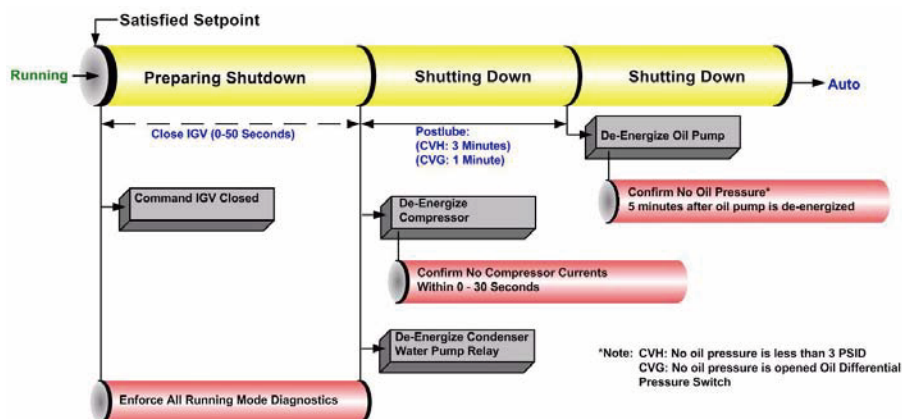


Figure 30. Sequence of operation: running



*Note: AFD applies to CVH Only.

Figure 31. Sequence of operation: satisfied setpoint

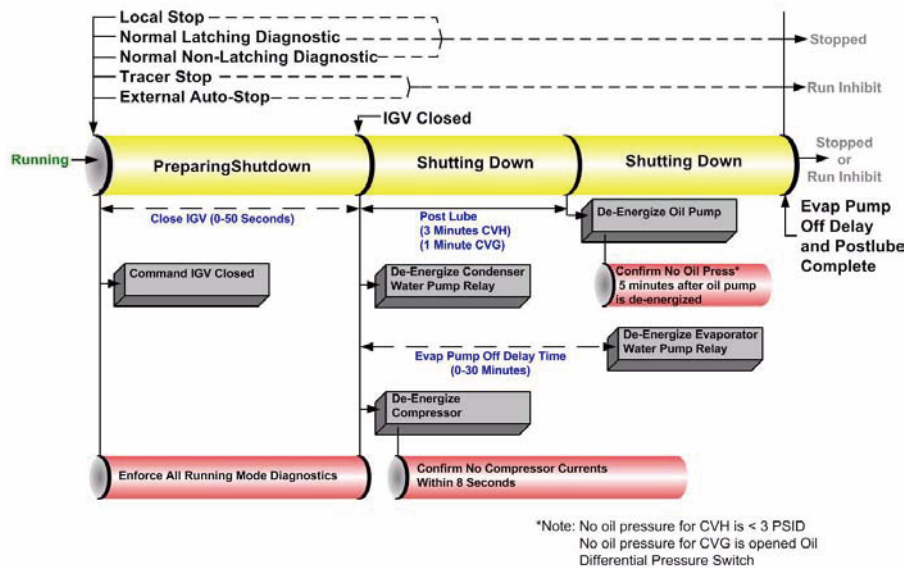


If the STOP key is pressed on the operator interface, the chiller will follow the same stop sequence as above except the chilled water pump relay will also open and stop the chilled water pump after the chilled water pump delay timer has timed out after compressor shut down. If the "Immediate Stop" is 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 32. Sequence of operation: normal shutdown to stopped and run inhibit



Start-up and Shut Down



Power Up Diagram

The Power up chart shows the respective Tracer AdaptiView screens 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.

Software Operation Overview Diagram

The Software Operation Overview is a diagram of the five possible software states. This diagram can be thought of as a State Chart, with the arrows, and arrow text, depicting the transitions between states. The text in the circles 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.

Ice Machine Control

The control panel provides a service level Enable or Disable menu entry for the Ice Building feature when the Ice Building option is installed. Ice Building can be entered from Front Panel, or if hardware is specified the control panel will accept either an isolated contact closure 1A19 Terminals J2-1 and J2-2 (Ground)) or a remote communicated input (BAS) to initiate the ice building mode where the unit runs fully loaded at all times. Ice building will be terminated either by opening the contact or based on entering evaporator fluid temperature. The control panel will not permit the Ice Building mode to be entered again until the unit is switched to the non-ice building mode and back into the ice building mode. It is not acceptable to reset the chilled water setpoint low to achieve a fully loaded compressor. When entering ice building, the compressor will be loaded at its maximum rate and when leaving ice building the compressor will be unloaded at its maximum rate. While loading and unloading the compressor, all surge detection will be ignored. While in the ice building mode, current limit setpoints less than the maximum will be ignored. Ice Building can be terminated by one of the following means:

- Front panel disable.
- Opening the external Ice. Contacts/ Remote communicated input (BAS).
- Satisfying an evaporator entering fluid temperature setpoint. (Default is 27°F)
- Surging for 7 minutes at full open IGV.

Figure 33. Sequence of operation: ice making: running to ice making



Start-up and Shut Down

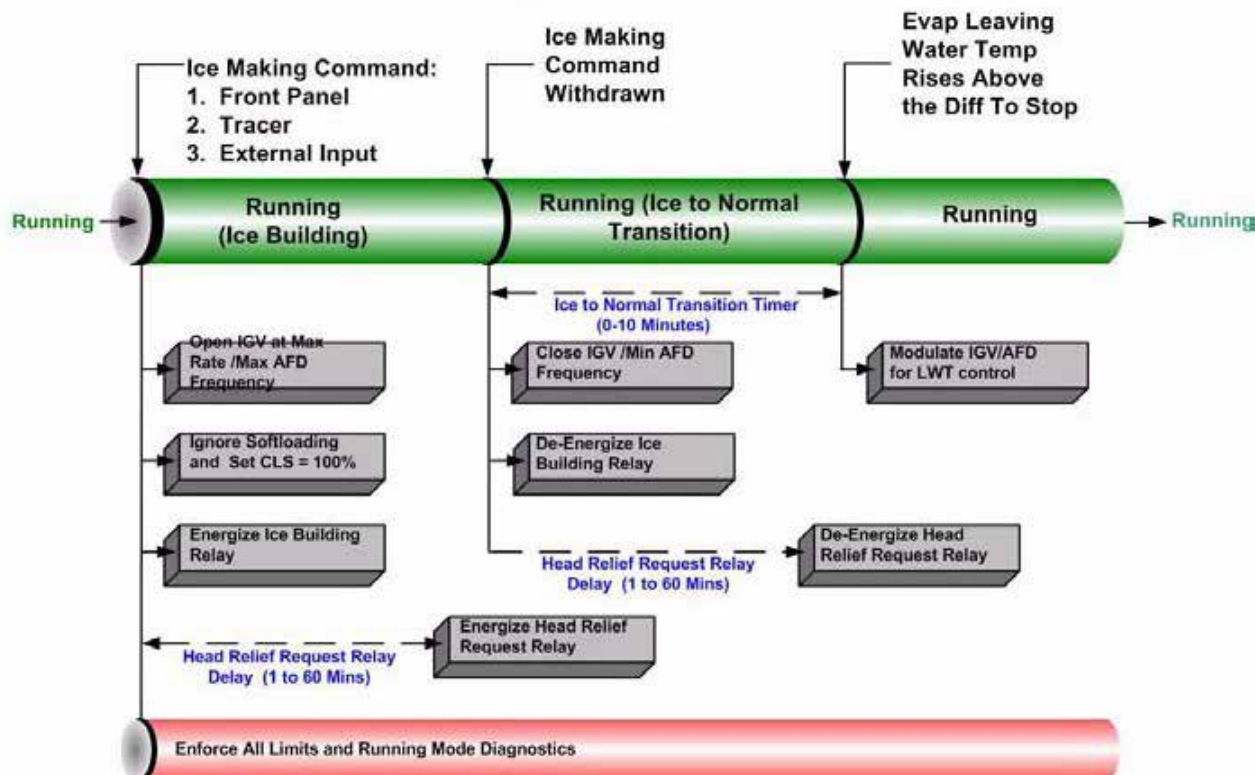
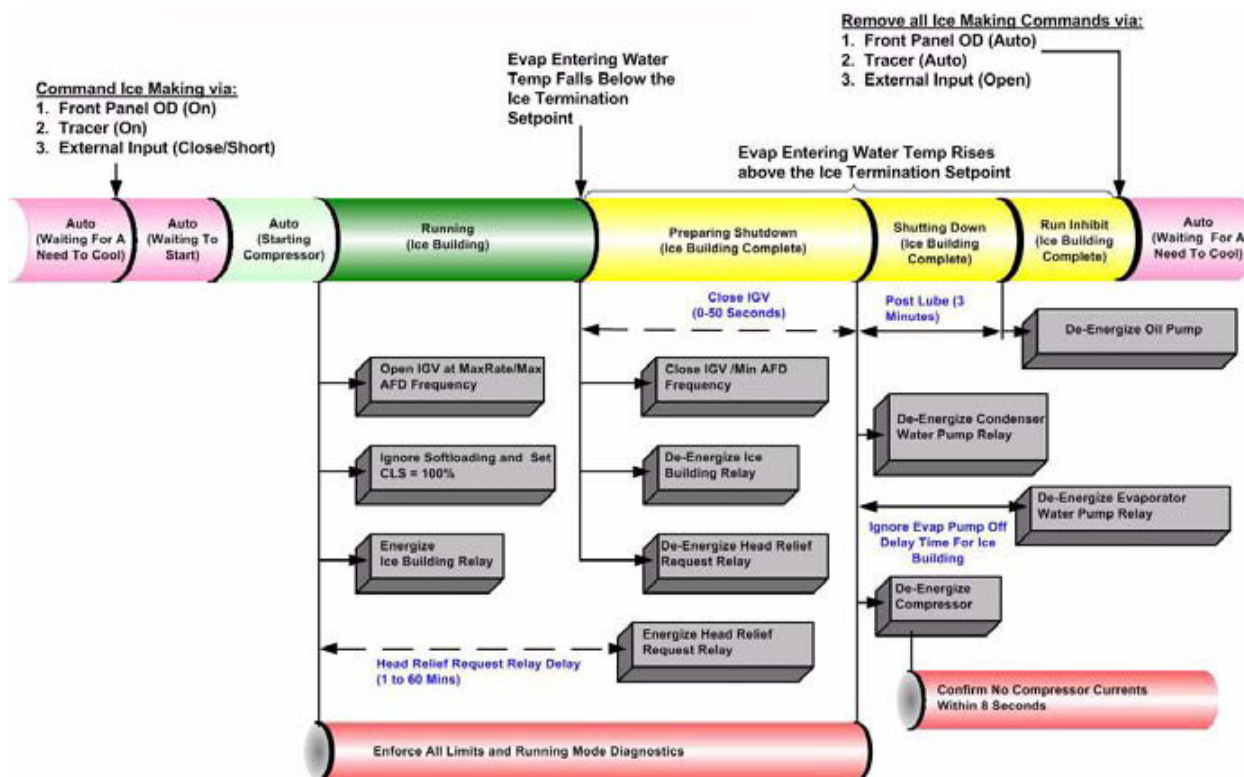


Figure 34. Sequence of operation: ice making: stopped to ice to ice building complete





Start-up and Shut Down

Free Cooling Cycle

Based on the principle that refrigerant migrates to the coldest area in the system, the free cooling option adapts the basic chiller to function as a simple heat exchanger. However, it does not provide control of the leaving chilled water temperature.

If condenser water is available at a temperature lower than the required leaving chilled water temperature, the operator interface must remain in AUTO and the operator starts the free cooling cycle by enabling the Free cooling mode in the Tracer AdaptiView Feature Settings group of the

operator interface, or by means of a BAS request. Several components must be factory-installed or field-installed to equip the unit for free cooling operation:

- a refrigerant gas line, and electrically-actuated shutoff valve, between the evaporator and condenser;
- a valved liquid return line, and electrically-actuated shutoff valve, between the condenser sump and the evaporator;
- a liquid refrigerant storage vessel (larger economizer); and,
- additional refrigerant.

When the chiller is changed over to the free cooling mode, the compressor will shut down if running, the shutoff valves in the liquid and gas lines open; unit control logic prevents the compressor from energizing during free cooling. Liquid refrigerant then drains (by gravity) from the storage tank into the evaporator and floods the tube bundle. Since the temperature and pressure of the refrigerant in the evaporator are higher than in the condenser (i.e., because of the difference in water temperature), the refrigerant in the evaporator vaporizes and travels to the condenser, water causes the refrigerant to condense, and flow (again, by gravity) back to the evaporator.

This compulsory refrigerant cycle is sustained as long as a temperature differential exists between condenser and evaporator water. The actual cooling capacity provided by the free cooling cycle is determined by the difference between these temperatures which, in turn, determines the rate of refrigerant flow between the evaporator and condenser shells.

If the system load exceeds the available free cooling capacity, the operator must manually initiate change-over to the mechanical cooling mode by disabling the free cooling mode of operation. The gas and liquid line valves then close and compressor operation begins (see beginning at Auto mode). Refrigerant gas is drawn out of the evaporator by the compressor, where it is then compressed and discharged to the condenser. Most of the condensed refrigerant initially follows the path of least resistance by flowing into the storage tank. This tank is vented to the economizer sump through a small bleed line; when the storage tank is full, liquid refrigerant

must flow through the bleed line restriction. Because the pressure drop through the bleed line is greater than that of the orifice flow control device, the liquid refrigerant flows normally from the condenser through the orifice system and into the economizer.

Free Cooling (FRCL)

To enable Free Cooling Mode:

1. Free Cooling must first be installed and commissioned.
2. Enable the Free Cooling mode in the Tracer AdaptiView Settings Menu
3. Press AUTO, and if used, close the external binary input switch (connected to 1A20 J2- 1 to 2) while the chiller is in AUTO.

Free Cooling cannot be entered if the chiller is in "STOP".

If the chiller is in AUTO and not running, the condenser water pump will start. After condenser water flow is proven, Relay Module 1A11 will energize operating the Free Cooling Valves 4B12 and 4B13. The Free Cooling Valves End Switches must open within 3 minutes, or an MMR diagnostic will be generated. Once the Free Cooling Valves End Switches open, the unit is in the Free Cooling mode. If the chiller is in AUTO and running powered cooling, the chiller will initiate a friendly shut down first (Run: Unload, Post Lube, and drive vanes closed). After the vanes have been overdriven closed and condenser water flow proven, the Free Cooling relays will be energized. To disable Free Cooling and return to Powered Cooling, either disable the Free Cooling Mode in the Tracer AdaptiView settings menu if used to enable Free Cooling or OPEN the external binary input switch to the 1A20 Module if it was used to enable Free Cooling. Once Free Cooling is disabled, the Free Cooling relays Relay Module 1A11 will de-energize allowing the Free Cooling valves to close. The Free Cooling valves end switches must close within 3 minutes or an MMR diagnostic is generated. Once the end switches close the chiller will return to AUTO and powered cooling will resume if there is a call for cooling based on the differential to start.

Note: *The manual control of the inlet guide vanes is disabled while in the Free Cooling Mode and the compressor is prevented from starting by the control logic.*

Note: *The relay at 1A11-J2-4 to 6 is a FC auxiliary relay and can be used as required.*

Hot Gas Bypass (HGBP)

The hot gas bypass (HGBP) control option is designed to minimize machine cycling by allowing the chiller to operate stably under minimum load conditions. In these situations, the inlet guide vanes are locked at a preset minimum position, and unit capacity is governed by the HGBP valve actuator. Control circuitry is designed to allow both the inlet guide vanes and the HGBP valve to



Start-up and Shut Down

close for unit shutdown. After a chiller starts and is running the inlet guide vanes will pass through the HGBP Cut-In-Vane position as the chiller starts to load. As the chiller catches the load and starts to unload, the inlet guide vanes will close to the HGBP Cut-In Vane position. At this point the movement of the inlet guide vanes is stopped and further loading/unloading of the chiller is controlled by the opening/closing of the HGBP Valve (4M5). When the control algorithm determines the chiller to be shut down, the inlet guide vanes will be driven fully closed, and the HGBP valve will be driven closed. After the inlet guide vanes are fully closed the chiller will shut down in the Friendly mode. Chillers with HGBP have a discharge temperature sensor (4R16) monitoring the discharge gas temperature from the compressor. If this temperature exceeds 200°F, the chiller will shut off on a MAR diagnostic. The chiller will reset automatically when this temperature drops 50°F below the trip-point. HGBP is enabled in the Features menu settings Group of the Tracer AdaptiView Menus by enabling the option. The setting the HGBP Cut-In Vane Position is setup at unit commissioning via the service tool.

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.

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 to 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 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 –J2-1 to J2-3 (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 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 pull-down 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 HGBP, AFD, free cooling, or 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.

Heat Recovery Cycle

Heat recovery is designed to salvage the heat that is normally rejected to the atmosphere through the cooling tower, and put it to beneficial use. For example, a high-rise office building may require simultaneous heating and cooling during the winter months. With the addition of a heat recovery cycle, heat removed from the building cooling load can be transferred to areas of the building that require heat. (Keep in mind that the heat recovery cycle is only possible if a cooling load exists to act as a heat source.)

To provide a heat recovery cycle, a heat-recovery condenser is added to the unit. Though physically identical to the standard cooling condenser, the heat-recovery condenser is piped into a heat circuit rather than to the cooling tower. During the heat recovery cycle, the unit operates just as it does in the cooling only mode except that the cooling load heat is rejected to the heating water circuit rather than to the cooling tower water circuit. When hot water is required, the heating water circuit pumps energize. Water circulated through the heat-recovery (or auxiliary) condenser tube bundle by the pumps absorbs cooling-load from the compressed refrigerant gas discharge by the compressor. The heated water is then used to satisfy heating requirements.

Auxiliary Condensers

Unlike the heat-recovery condenser (which is designed to satisfy comfort heating requirements), the auxiliary condenser serves a preheat function only, and is used in those applications where hot water is needed for use in kitchens, lavatories, etc. While the operation of the auxiliary condenser is physically identical to that of the



Start-up and Shut Down

heat-recovery condenser, it is comparatively smaller in size, and its heating capacity is not controlled. Trane does not recommend operating the auxiliary condenser alone because of its small size.

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's operator interface and main processor is called Tracer AdaptiView and is located on an adjustable arm connected to the base of the control panel (for detailed information about operating Tracer AdaptiView, see CTV-SVU01C-EN, *Tracer AdaptiView™ Display for Water-Cooled CenTraVac™ Chillers Operations Guide*, 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.

Variable Water Flow Through the Evaporator

Varying the water flow reduces the energy consumed by pumps, while requiring no extra energy for the chiller. This strategy can be a significant source of energy savings, depending on the application. With its faster and more intelligent response to changing conditions, the Symbio800 reliably accommodates variable evaporator water flow and its effect on the chilled water temperature. These improvements keep chilled water flowing at a temperature closer to its setpoint.

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 run evaporator water pump longer than 30 minutes after the chiller is shutdown.
- Ensure that the evaporator is isolated from the hot water loop before changeover to heating mode.

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. 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 take appropriate precautions or react properly to a potential hazard could result in death or serious injury.

Unit Start-Up Check

1. Verify the chilled water pump and condenser water pump starter are in ON or AUTO.
2. Verify the cooling tower is in ON or AUTO.
3. Check the oil tank oil level, the level must be visible in the lower sight glass. Also, be sure to check the oil tank temperature; normal oil tank temperature before start-up is 140°F to 145°F (60°C to 63°C).

Note: Each oil heater is energized during the compressor off cycle. During unit operation, the oil tank heater may be de-energized. The oil heater may be energized during unit operation with R-514A.

Note: If the chiller is equipped with the free cooling option, ensure that the free cooling option is disabled in the Chiller Settings menu.

4. Check the chilled water setpoint and readjust it, if necessary, in the Chiller Settings menu.



Start-up and Shut Down

5. If necessary, readjust the current limit setpoint in the Chiller Setpoints menu.
6. Press AUTO.

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

If the control panel determines that the difference between the evaporator leaving water temperature and chilled water setpoint exceeds the start differential setpoint, the unit enters the initiate Start Mode and the oil pump and 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.*

When less than 5 seconds remain on the restart inhibit, the pre-start starter test is conducted on Y-Delta starters. If faults are detected, the unit's compressor will not start, and a diagnostic will be generated. 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

3-minute 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.

Daily Unit Shutdown

Note: *Refer to Start-Run Shutdown sequence in the sequence of operation section.*

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

Seasonal Unit Shutdown

⚠ NOTICE

Oil Sump Heater Operation!

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

1. Open all disconnect switches except the control power disconnect switch.
2. Drain the condenser piping and cooling tower, if used. Rinse with clean water.
3. Remove the drain and vent plugs from the condenser headers to drain the condenser. Air dry bundle of residual water.
4. Once the unit is secured for the season, the maintenance procedures described under Annual Maintenance in the Periodic Maintenance section of this manual should be performed by qualified Trane service technicians.

Note: *During extended shutdown periods, be sure to operate the purge unit for a 2-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 2-hour run time.*



Start-up and Shut Down

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 water boxes.
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 Unit Start-Up Check section.



Maintenance

⚠ NOTICE

Moisture Contamination!

If frequent purging is required, monitor purge pump-out 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.

⚠ WARNING

Hazardous Voltage w/Capacitors!

Disconnect all electric power, including remote disconnects before servicing. Follow proper lock-out/ 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.

Note: For additional information regarding the safe discharge of capacitors, see PROD-SVB06A-EN or PROD-SVB06A-FR.

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 for the EarthWise Purge Operation and Maintenance manual which can be obtained at the nearest Trane office.

For R-123 chillers, recommended purge maintenance procedures are detailed in *Operation and Maintenance Guide: EarthWise™ Purge system with Tracer AdaptiView™ Control for Water-Cooled CenTraVac™ Chillers with R-123 Refrigerant (PRGF-SVX001*-EN)*. For R-514A chillers, recommended purge maintenance procedures are detailed in *Operation and Maintenance Guide: Purge System with Tracer AdaptiView™ Control for Water-Cooled CenTraVac™ Chillers with R-514A Refrigerant (PRGG-SVX001*-EN)*.

Record Keeping Forms

An important aspect of the chiller maintenance program is the regular completion of records. Provided at the end of this manual are 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.

Daily Maintenance and Checks

Operating Characteristic	Normal Reading
Approximate Evaporator Pressure	6 to 9 PSIA / -9 to -6 PSIG
Approximate Condenser Pressure (see Note 1 & Note 2)	17 to 27 PSIA / 2 to 12 PSIG (standard condenser)
Oil Sump Temperature Unit not running	140°F to 176°F (60°C to 80°C)
Oil Sump Temperature Unit running	95°F to 162°F (35°C to 72°C)
Oil Sump Differential Oil Pressure (see Note 3)	18 to 22 psid

Notes:

1. 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.
2. Normal pressure readings for ASME condenser exceed 12 PSIG.
3. Oil tank pressure -9 to -6 psig HG Discharge oil pressure 7 to 15 PSIG



Maintenance

Daily	Every 3 months	Every 6 months	Annual
evaporator and condenser pressures, oil tank pressure, differential oil pressure and discharge oil pressure. Compare the readings with the values provided in the above. Check the oil level in the chiller oil sump using the two sight glasses provided in the oil sump head. When the unit is operating, the oil level should be visible in the lower sight glass. Complete logs on a daily basis.	Clean all water strainers in the water piping system.	Lubricate the vane control linkage bearings, ball joints, and pivot points. See "General Lubrication," p. 84. Lubricate vane operator tang O-rings. See "General Lubrication," p. 84. Lubricate the oil filter shutoff valve O-rings. See Step 7 in "Oil Filter Replacement Procedure," p. 83. 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 "Annual Inspection Checklist". Refer to Operation and Maintenance Guide to perform purge maintenance procedures once a year. Use an ice water bath to verify that the accuracy of the evaporator refrigerant temperature sensor (4R10) is still within tolerance (+ or - 2.0°F at 32°F (1°C at 0°C)). If the evaporator refrigerant temperature displayed on the control panel readout is outside this 4-degree tolerance range, replace the sensor. 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. Submit a sample of the compressor oil to a Trane qualified laboratory for comprehensive analysis. Measure the compressor motor winding resistance to ground; a qualified service technician should conduct this check to ensure that the findings are properly interpreted. Contact a qualified service organization to leak-test the chiller; this procedure is especially important if the system requires frequent purging.
Every 3 years, use a nondestructive tube test to inspect the condenser and evaporator tubes. Note: 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. 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. Note: (a) Chronic air leaks, which can cause acidic conditions in the compressor oil and result in premature bearing wear; and, (b) Evaporator or condenser water tube leaks. Water mixed with the compressor oil can result in bearing pitting, corrosion, or excessive wear			



Maintenance

Compressor Oil Change

⚠ Notice

Equipment Damage!

Mixing refrigerants or oils could result in equipment damage including bearing damage, introduction of acids into the chiller, or continuous purge pump-out in high-head/high ambient applications. CenTraVac chillers are manufactured with different refrigerant/oil systems: R-123 chillers using OIL00372 and R-514A chillers using OIL00371/OIL00373. Verify proper refrigerant and oil for your chiller and do NOT mix refrigerants or oils!

This Installation, Operation, and Maintenance manual applies to CenTraVac chillers with two different refrigerant and oil systems:

- R-123 and OIL00372
- R-514A and OIL00371/OIL00373

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

After the first 6 months or 1000 hours operation, whichever comes first, change the oil and filter. After this oil change, recommendations are to subscribe to an annual oil analysis program rather than automatically change the oil as part of scheduled maintenance.

Change the oil only if indicated by the oil analysis. Use of an oil analysis program will reduce the chillers overall lifetime waste oil generation and minimize refrigerant emissions. The analysis determines system moisture content, acid level and wear metal content of the oil, and can be used as a diagnostic tool. The oil analysis should be performed by a qualified laboratory that is experienced in refrigerant and oil chemistry and in the servicing of Trane centrifugal chillers.

In conjunction with other diagnostics performed by a qualified service technician, oil analyses can provide valuable information on the performance of the chiller to help minimize operating and maintenance costs and maximize its operating life. A drain fitting is installed in the oil filter top, after the oil filter, for obtaining oil samples. If customer have no Trane annual oil analysis program or automatically oil change plan. Recommended to change the oil and filter every six months of accumulated operation or every 1000 hours operation—whichever comes first.

Note: Use only Trane OIL specified. A full oil change is 9 gallons of OIL.

Oil Change Procedure

⚠ NOTICE

Heater Damage!

The oil sump heater must be deenergized before draining the sump. Failure to do so could possibly burn out the oil sump heater.

When oil analysis indicates the need to change compressor oil, use the following procedure for removing oil.

- Draw the oil from the chiller through the oil charging valve on the chiller oil sump into an approved, evacuated tank; or,
- Pump the oil from the chiller through the oil charging valve into an airtight resealable container, using a magnetically-driven auxiliary pump.

Forcing the oil from the oil sump by pressurizing the chiller (by raising chiller temperature or adding nitrogen) is not recommended. Refrigerant dissolved in the oil can be removed and returned to the chiller by using an appropriate deep vacuum recovery unit and heating and agitating the oil container. Follow all Federal, State, and Local regulations with regard to disposal of waste oil.

Oil Filter

Replace oil filter: (1) annually, (2) at each oil change, (3) or if erratic oil pressure is experienced during chiller operation.

Oil Filter Replacement Procedure

Use the following procedure to service the oil filter.

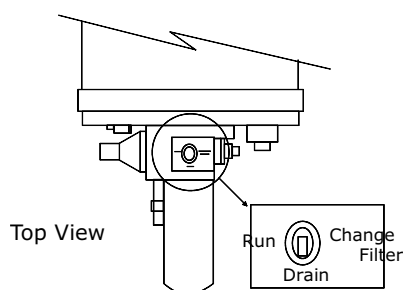
1. Run the oil pump for two to three minutes to ensure that the oil filter is warmed up to the oil sump temperature.
2. Turn the oil pump motor off.
3. Pull the D handle on the rotary valve locking pin out of its detent and rotate the valve to the DRAIN position. An offset pointer is located on top of the valve with wrench flats to allow turning. The spring force on the locking pin should allow the pin to drop into a detent at this position.
4. Allow at least 15 minutes for the oil to drain from the filter back into the oil sump.
5. Pull the D handle to unlock the pin and rotate the valve to the Change Filter position. This isolates the filter from the unit. The locking pin should drop into a detent in this position.
6. Remove and replace the filter as quickly as possible. Tighten filter 2/3 to 3/4 turn per instructions written on the filter. Place the used filter in a reusable container. Follow all local, state and federal regulations to dispose of the filter. Pull the D handle to unlock the pin and rotate the valve to the RUN position. The



Maintenance

locking pin should drop into a detent in this position. The chiller is now ready for operation.

7. The oil filter shut off valve uses dual O-Rings to seal to atmosphere. These should be manually lubricated by removing the pipe plug at the valve lubrication port and placing a few drops of Trane OIL00372 or OIL00371/OIL00373 in the cavity. Be sure to reinstall the pipe plug when lubrication is completed.
8. Purge unit.
9. Check oil pressure 18–22 psi.



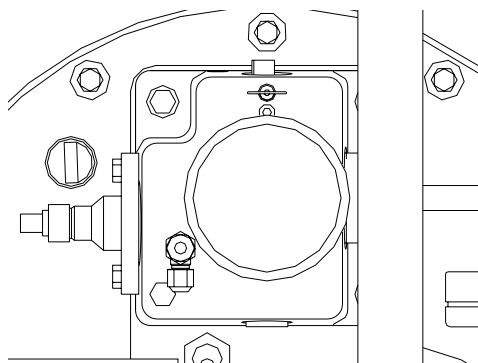
General Lubrication

The only chiller component that requires periodic lubrication is the external vane linkage assembly and Rotary oil valve. Lubricate the vane linkage shaft bearings and rod end bearings as needed with a few drops of light-weight machine oil.

Consider placing a bead of silicon caulk around the top of the oil filter shut off valve if the chiller is located in a wet, dusty or corrosive environment.

The CenTraVac inlet guide vane tang operators should be serviced annually with R-123 and R514A compatible grease. Use only Trane approved R-123 and R514A compatible grease:

LUB00033 (16 oz. standard grease gun cartridge)
LUB00063 (3 oz. mini grease gun cartridge)



Service for the 1st Stage Tang Operator

All Units Except Extended Capacity Chillers with 1470 or 1720 or 1820 Compressors

1. The chiller must be off.

2. Carefully remove any insulation that may have been placed over the two lubrication ports of the tang operator base. This insulation will need to be replaced after the service is complete.
3. Note the position of the tang operator arm, note the placement of spacing washers etc., then disconnect the linkage rod from the tang operator arm. Manually move the tang operator arm and note the amount of effort required to operate the assembly.
4. Loosen but **DO NOT REMOVE** the 1/16" NPT lubrication port plug that is highest on the assembly.
5. Loosen and remove the remaining lower 1/16" NPT plug.
6. Using a grease gun with an appropriate fitting, insert **ONLY** Rheolube grease into the open port until clean grease is seen to appear around the threads of the plug in the opposite port.
7. Tighten the plug that was loosened in [Step 4](#). Tighten the plug to hand tight plus 1/4 to 1/2 turn.
8. Remove the grease fitting, if used.
DO NOT LEAVE GREASE FITTINGS INSTALLED.
If grease fittings have been used for this procedure then they **MUST BE REMOVED** before returning the unit to service. Grease fittings are not vacuum-tight and will become a leak path.
9. Using a clean wooden dowel or other similar tool, remove excess grease from the remaining open lubrication port.
10. Clean and then lightly coat the threads of the plug with Rheolube grease and re-install it into the lubrication port. Tighten the plug to hand tight plus 1/4 to 1/2 turn.
11. Before reconnecting the vane linkage, grasp the tang operator arm and manually operate the vane assembly. If it is now difficult to move, then the tang operator may have become hydraulically locked because of excess grease in the assembly. This situation could cause damage to the O-rings of the assembly. If this occurs then remove one of the lubrication plugs, remove some of the grease, then re-install the plug.
12. Reconnect the linkage to the tang operator arm. Ensure the spacer washers between the linkage and the arm are properly placed and that the assembly does not bind. Re-install any insulation that was cut or removed. The unit may be restarted.

Service for the 1st and 2nd Stage Tang Operators

Extended Capacity Chillers with 1470 or 1720 or 1820 Compressors.

The 1st and 2nd stage rotary inlet guide vane tang operators of the extended capacity chillers also require periodic lubrication, at least annually, with Trane approved R-123 and R514A compatible grease. These actuators



Maintenance

have two 1/8" NPT plugs located 180 degrees apart, with one on the top and the other on the bottom of the operator base. Use the same procedure as described above, except that it will be necessary to temporarily disconnect the vane actuators from the tang operator arms in order to test for a hydraulically locked condition.

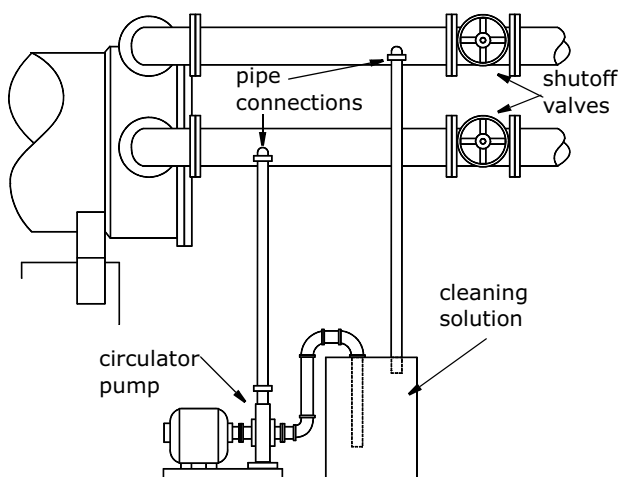
Cleaning the Condenser

⚠ 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.

Figure 35. Typical Chemical Cleaning Setup



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.

1. Follow all instructions in ["Waterbox Removal and Installation" p. 72](#) 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.

⚠ 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.

Cleaning the 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, on open evaporator systems, such as air washers, periodic inspection and cleaning is recommended.

Purge System

Because some sections of the chiller's refrigeration system operate at less-than-atmospheric pressure, the possibility exists that air and moisture may leak into the system. If allowed to

accumulate, these noncondensables become trapped in the condenser; this increases condensing pressure and compressor power requirements, and reduces the chiller's efficiency and cooling capacity.

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 trouble shooting is covered by a separate operation and maintenance manual, which may be obtained from the nearest Trane office.



Maintenance

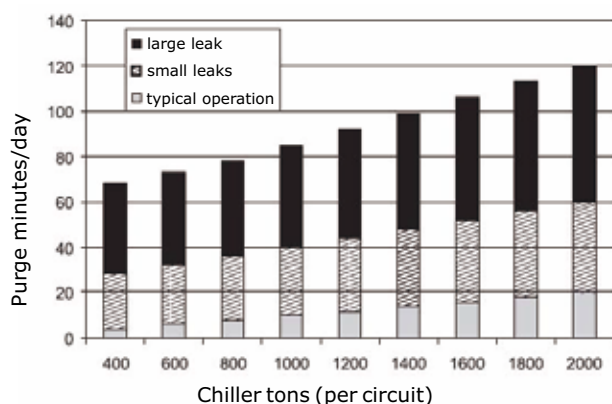
Leak Checking Based on Purge Pump Out Time

A formula has been developed which allows the annual refrigerant leakage rate to be calculated based on the daily purge pump out time and the unit refrigerant charge. This formula is as follows:

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

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

A graph 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 graph 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.



Long Term Unit Storage

This section describes extended storage requirements for chillers to be removed from service in excess of a normal seasonal shutdown.

⚠ 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.

⚠ 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.

Unit Preparation

The following steps are necessary in order to properly prepare a unit for storage.

1. Remove all liquid refrigerant if the unit is charged.
2. After the liquid refrigerant is removed, using a recovery or recycle unit or vacuum pump, pull a vacuum to remove remaining refrigerant vapor from the unit.
3. After all traces of refrigerant are out of the unit, a positive nitrogen charge should be put into the unit (6 to 8 psig). This positive pressure must be checked monthly to ensure that no noncondensables get into the unit. Use a pressure gage on the evaporator shell to verify that the 6 to 8 psig dry nitrogen holding charge is still in the chiller. If this charge has escaped, contact a qualified service organization and the Trane sales engineer that handled the order.
4. The refrigerant charge should be stored in proper refrigerant containers. Due to possible leakage, do not store in used drums.
5. Maintain control power to the control panel. This will maintain oil temperature in the oil sump and the capability of the control panel to present report information. The Chiller Reports should be viewed once a week for normal readings. Any abnormal observation must be reported to the Trane Sales Engineer that handled the order.

⚠ WARNING

Hazardous Voltage w/Capacitors!

Disconnect all electric power, including remote disconnects before servicing. Follow proper lock-out/ 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.

Note: For additional information regarding the safe discharge of capacitors, see PROD-SVB06A-EN or PROD-SVB06A-FR.

6. Remove the factory installed jumper or the field installed wiring on terminals in the unit control panel. This will prevent unwanted chiller operation.
7. Set the purge operating mode to OFF on UCP chillers.
8. The oil can be left in the unit.



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9. The water side should not cause a problem if shut down and drained. There may be slight scaling inside the tubes, but not enough to cause a problem. The customer should inspect and clean tubes before the unit is returned to service.

Note: Do not use untreated or improperly treated water, or equipment damage may occur.

Note: 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.

10. Motor bearings: If the motor sits for a long time the bearings could take a set and cause bearing problems or replacement later. Once every six months the chiller oil pump must be started and the compressor motor bump started to rotate the shaft. Contact a qualified service organization to perform this task. If the compressor motor cannot be bump started, then the shaft must be rotated manually by a qualified service organization.
11. Obtain an oil analysis initially after six months of storage, and once each succeeding year. If no oil breakdown is evident do not change the oil. If breakdown is evident, the oil must be replaced.
12. If the unit is stored for more than five years, and the storage is expected to be indefinite, the unit should be examined for leaks every five years from the initial storage date.
13. When the unit is to be returned to service, the services of a qualified service organization should be obtained to conduct all activities associated with the startup of a new chiller.

Refrigerant Charge

⚠ 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.

⚠ Notice

Equipment Damage!

Mixing refrigerants or oils could result in equipment damage including bearing damage, introduction of acids into the chiller, or continuous purge pump-out in high-head/high ambient applications. CenTraVac chillers are manufactured with different refrigerant/oil systems: R-123 chillers using OIL00372 and R-514A chillers using OIL00371/OIL00373. Verify proper refrigerant and oil for your chiller and do NOT mix refrigerants or oils!

The refrigerant charging procedure for Trane centrifugal chillers is:

1. If water is present in the tubes, break machine vacuum with refrigerant vapor, or circulate water, to avoid tube damage.
2. Always use refrigerant compatible hoses or copper tubing with self-sealing connections or shut-off valves.
3. Transfer the refrigerant using one of the following (listed in order of preference):
 - a. An approved Trane low pressure refrigerant recovery and recycle unit.
 - b. The available pressure differential.
 - c. Gravity. (Use a return vent line to refrigerant drums to equalize pressure.)
4. Do not use dry nitrogen to push refrigerant into the chiller as was common practice in the past. This will contaminate the charge and require excessive purging, which will result in unnecessary release of refrigerant.
5. Weigh in the proper charge.
6. Use recovery and recycle unit or vacuum pump to evacuate hoses; discharge outdoors.
7. If refrigerant is supplied in new returnable cylinders, be sure and refer to General Service Bulletin CVHE-SB-48B for information on returning cylinders. This service bulletin is available at the nearest Trane office.

Depending on the chiller duty, contact a qualified service organization to determine when to conduct a complete



Maintenance

examination of the unit to discern the condition of the compressor and internal components.

Note: *If your chiller is covered by a Trane extended warranty, the terms of that warranty may require that the procedures listed in the Periodic Maintenance section of this manual be followed for your extended warranty to remain in force. The terms may also require that the chiller be inspected by a Trane-authorized warranty agent every four years or 40,000 operating hours, whichever occurs first. This inspection will include, at a minimum, a review of the annual inspection checklists and the daily operating logs, as well as performance of a leak test and a general inspection of the chiller. The owner is then required to follow the recommendations made as a result of this inspection at the owners expense.*

Recovery and Recycle Connections

To facilitate refrigerant removal and replacement, newer-design units are provided with a 3/4-inch vapor fitting with shutoff valve on the chiller suction and with a 3/4-inch liquid connection with shutoff valve at the bottom of the evaporator shell (refer to Refrigerant Handling Guidelines).

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.

To leak-test a chiller containing full refrigerant charge, raise chiller pressure using a controlled hot water or electric-resistance system to a maximum of 8 psig. Do not use nitrogen, which will cause excessive refrigerant discharge by the purge system.



Waterbox Removal and Installation

Important: ONLY QUALIFIED TECHNICIANS SHOULD PERFORM THE INSTALLATION AND SERVICING OF THIS EQUIPMENT.

Discussion

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

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

Procedure

⚠ WARNING

Heavy Objects!

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. Failure to properly lift waterbox could result in death or serious injury.

⚠ WARNING

Eyebolts!

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 (CVH, CVG). Refer to Trane Nameplate located on chiller control panel.

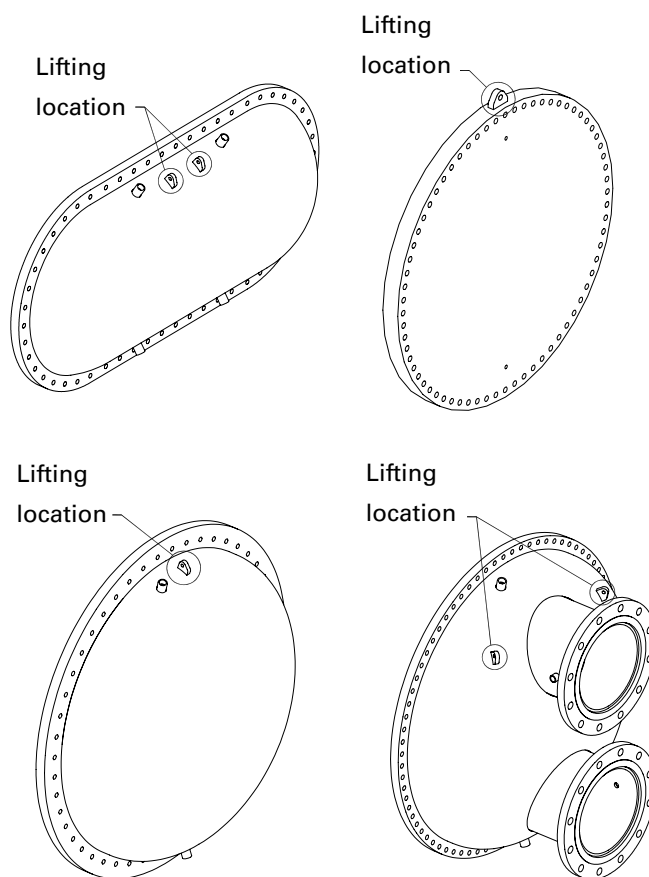
Note: This bulletin contains rigging and lifting information for Trane CTV chillers built in La Crosse only. For Trane CTV chillers built outside the US, refer to literature provided by the applicable manufacturer.

location.

2. Select the proper lift connection device from the Connection Devices table. 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. Example: thread type (course/fine, English/metric). Bolt diameter (English/metric).
4. Properly connect the lift connection device to the waterbox. Refer to [Figure 36, p. 72](#). Ensure 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" threaded connections and 28 ft·lb for 1/2" threaded connections.

Figure 36. Waterbox rigging and lifting - condenser and evaporator connections



5. Disconnect water pipes, if connected.
6. Remove water box 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. 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 in reverse. Use new O-rings or gaskets on all joints after thoroughly cleaning each joint.

9. Torque waterbox bolts. Refer to [Table 15](#).

CenTraVac

Refer to [Table 15](#) for torque and refer to CVHE-SVN02D-EN, *Installation - Piping Information: Water- Cooled CenTraVac with Symbio800*, or the most recent version for CVHE torquing procedure.

Table 15. 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)



Forms

CenTraVac Commissioning Checklist

Job Name _____ Location _____
 Model # _____ Serial # _____
 Sales Order # _____ Start-up Date _____

Note: The Unit Installation, Operation and Maintenance Manuals including Warning and Cautions, Applicable Service Alerts and Bulletins, Submittals, and Design Specifications must be used in conjunction with this checklist.

I. PRE-COMMISSIONING PROCEDURES

A. Obtain Pre-commissioning Check Sheet

This must be prepared by installer for a particular unit, verifying the unit is ready for commissioning.

B. Obtain Design (order) Specification Data

This indicates the design criteria of the particular unit. A unit cannot be properly commissioned unless this data is known. It is the responsibility of the selling office to furnish this data.

C. Obtain Wiring Diagrams

The "as-wired" electrical diagram should be compatible with the recommended Trane submittals and diagrams. Are customer added external/remote control circuits compatible? ☐ Yes ☐ No

D. General Installation Observations

- ☐ 1. Is there any apparent shipping or rigging damage? ☐ Yes ☐ No
- ☐ 2. Record the unit pressure upon receipt: _____ psig. If there is no pressure, a leak test will have to be done before the unit can be evacuated and charged.
- ☐ 3. Is the water piping correctly installed?
- | | | | | | |
|-------------------|------------------------------|-----------------------------|-----------------------|------------------------------|-----------------------------|
| Flow Switches | ☐ Yes | ☐ No | Pressure Gauges | ☐ Yes | ☐ No |
| Isolations Valves | ☐ Yes | ☐ No | Flow Balancing Valves | ☐ Yes | ☐ No |
| Thermometer Wells | ☐ Yes | ☐ No | Vent Cocks and Drains | ☐ Yes | ☐ No |
- ☐ 4. Have proper clearances around the unit been maintained per submittal and/or Installation? Are there Manual guidelines available ☐ Yes ☐ No
- ☐ 5. Is power wiring of adequate ampacity and correct voltage? ☐ Yes ☐ No
- ☐ 6. Is the unit base acceptable, level, and is the unit on isolators (rubber as supplied by Trane or spring type)? ☐ Yes ☐ No
- ☐ 7. Have the low voltage circuits been properly isolated from the higher voltage control and power circuits? ☐ Yes ☐ No

E. Comments _____



Forms

II. COMMISSIONING PROCEDURES

A. Pre-start Operations

1. Holding Charge

☐ _____ psig. Must be positive pressure or leak test must be done.

2. Before relieving the holding charge, calibrate the H.P.C. high-pressure control

This is a check of pressure to the H.P.C. as well as calibration of the control.

Disconnect and cap the flare. Calibrate H.P.C. and reconnect flare.

☐ Relieve the holding charge.

☐ Check and if necessary, tighten all connections per proper specs.

3. Megohm the Motor (500 volt Meggar for low voltage, 2500volt Meggar for mid and high voltage)

☐ Compressor motor Megohms - refer to temp/resistance chart for acceptable values. Remove surge suppressors before Megging. Never Meg test with the unit in a vacuum.

T1 to Earth _____	T4 to Earth _____	T1 to T2 _____	T1 to T4 _____
T2 to Earth _____	T5 to Earth _____	T1 to T3 _____	T2 to T5 _____
T3 to Earth _____	T6 to Earth _____	T2 to T3 _____	T3 to T6 _____

4. Evacuation

Connect the vacuum pump to start evacuation. Use a 2-stage pump with at least 5 CFM capacity. Connect to the evaporator-charging valve with a hose no smaller than 3/4 inch ID.

a. For the IT Cutler-Hammer Solid State Starter it is necessary to shut off all power to the unit prior to evacuating the chiller. The IT starter has terminals 4, 5, & 6 hot when the unit is off. Failure to shut off power to the chiller, with the vacuum pump hook up, will cause a motor failure.

5. Condenser

☐ Isolation and flow valves installed

☐ Calibrated thermometers and pressure gauges installed in/out condenser on machine side of any valve or elbow.

☐ If condenser pump controlled by control panel, is field wiring correct and complete?

☐ Condenser pump(s) run, system and strainers properly cleaned and/or flushed.

☐ Condenser water strainer in close proximity to entering connection of condenser.

☐ Provisions installed to properly maintain water treatment additives.

☐ Initial water treatment added to system

☐ Flow or differential pressure switch installed and where possible, wired in series with auxiliary of pump motor starter. Verify correct operation of flow proving circuit.

☐ Condenser water flow balance.

PSID design _____ GPM design _____

PSID actual _____ GPM actual _____

6. Evaporator

☐ _____ psig. Must be positive pressure or leak test must be done.

☐ Calibrated thermometers and pressure gauges installed in/out of evaporator on machine side of any valve or elbow.

☐ If the evaporator pump controlled by the control panel, is field wiring correct and complete?

☐ Evaporator pump(s) run 24 hrs. System and strainers properly cleaned and/or flushed.

☐ Evaporator water strainer in close proximity to entering connection of evaporator.

☐ Provisions installed to properly maintain water treatment additives.

☐ Initial water treatment added to system.

☐ Flow or differential pressure switch installed and where possible, wired in series with auxiliary of pump motor



Forms

tor starter. Verify correct operation of flow proving circuit.

- ☐ Evaporator water flow balanced.

PSID design _____ GPM design _____

PSID actual _____ GPM actual _____

7. Electrical and Controls

a. Motor Starter Panel

- ☐ All terminals tightened.
- ☐ Wiring free from abrasion, kinks, and sharp corners. Contactors and relays have freedom of movement.
- ☐ All contacts are free of corrosion or dirt. Panel is free of dust, debris etc.
- ☐ Check the ratio of the current transformers. Record the part numbers on the start-up log.
- ☐ Use only twisted shielded pair for the IPC circuit between the starter and the control panel on remote starters. Recommended wire is Belden 8760, 18 AWG. Polarity is critical.
- ☐ The low voltage IPC link (___30 volts) must be in separate conduit from the 115-volt wiring.
- ☐ IPC link routing within the starter panel must stay a minimum of 6 inches from higher voltages.
- ☐ Remote starter to control panel connections are complete and comply with Trane requirements. Verify oil pump interlock circuit to 1A7J2-4 and J2-2.
- ☐ Check the correctness of the power connections from the starter to the motor.
- ☐ Check the wiring to the starter for size, voltage and correct phase rotation (A-L1, B-L2, & C-L3)
- ☐ Check the equal phase representation in each power-wiring conduit.

b. Control Panel

- ☐ All terminals tightened.
- ☐ Wiring free from abrasion, kinks, and sharp corners.
- ☐ Low voltage wires are isolated from high voltage wires.
- ☐ Panel is free of dust, debris etc.
- ☐ "Power Up" the control panel. (Non-AFD Starters)
 1. Starter disconnect locked open.
 2. Fuse 2F4 must be removed from the starter.
 3. Connect auxiliary 115VAC-power cord to Terminals 1X1-5(L1) and 1X1-17(L2) in the starter panel. MAKE SURE OF THE POLARITY. THE 'HOT' SIDE MUST BE CONNECTED TO TERMINAL 1X1-5(L1) AND THE 'NEUTRAL' SIDE TO 1X1-17(L2).
 4. Plug in cord to 115VAC-power source. Control panel is now energized.
- ☐ Record the configuration and setpoints of the Symbio800 control system, using Service Tool (Tracer TU). Check "on-line" to be sure your Service Tool is current.
- ☐ Using Tracer TU equipment utility configuration, check the Symbio800 firmware version and upgrade if available.
- ☐ Using the unit nameplate data and the order specification, double check and reset, if required, the settings of RLA & CTMS, using Service Tool.
If Evaporator and condenser water pumps are controlled by the control panel, use the AdaptiView manual override menu to manually start and test the control of the pumps.
- ☐ Check the setting of the oil pressure-regulating valve.
 1. Use the AdaptiView manual override of the control panel to manually start the oil pump.
 2. Proceed to the Compressor Report menu and observe the Differential Oil Pressure.
 3. Adjust the oil pressure-regulating valve to maintain 23~27psid. After oil pump run 10mins, check the oil temperature increase of the before and after bearing, if no increase, have to find the reason. The oil pressure-regulating valve may require adjustment as the unit is started to make sure the pressure diff is 18~22psid.



Forms

4. This procedure also checks to ensure correct sensing of oil pressure. The Oil Pressure Cutout setting is adjustable within via the Symbio800 Service Tool.
5. Return Oil Pump control to 'Auto' from within the AdaptiView.
- ☐ Check vane operator and vanes (Service Tool).
 1. Use the Service Tool manual override menu to manually override the vane control.
 2. Enter targets from 0% to 100% and observe vane operation. At minimum and maximum travel the operator should not exert any force on the vane assembly, adjust as required.
 3. Vane movement is smooth to open/close.
 4. Vane movement is reported back to the control panel.
 5. Return Vane control to 'Auto'.
- ☐ Dry run the starter (Service Tool).
 1. Make sure the starter disconnect is safety locked open.
 2. Use the Service Tool menu of the control panel to initiate the Starter Dry Run.
 3. Observe correct operation of starter contactors.
 4. Observe correct operation of transition complete signal (if required).
 5. Disable Starter Dry Run when complete.
- ☐ Remove Power
- ☐ Disconnect and remove temporary power cord.

B. Preparation for Start-up.

1. Evacuation and charging

- ☐ Evacuation leak test. When vacuum has been drawn down to 500 microns to 1000 microns, secure the vacuum pump. Wait for 12 hours for a valid vacuum leak test. If the rise in vacuum is less than 500 microns per 12 hours start-up may proceed.
- ☐ Charge refrigerant. MAKE SURE THE CHILLED WATER IS FLOWING THROUGH THE EVAPORATOR. Charge the prescribed amount of refrigerant through the liquid charging valve at the liquid inlet to the evaporator. Check that all drums contain a full amount of refrigerant. Amount charged lgs and kg.

2. Electrical

- ☐ Disconnect all temporary power cords, replace all fuses, connect motor leads, make final electrical inspection.
- ☐ Power up the motor starter. Check for control voltage at control panel terminals 1X1-1 and 1X1-17.
_____ Volts
- ☐ Check current to the oil sump heater.
_____ Amperes
- ☐ As the oil heats up, finish any operations not yet completed in preparation for starting the unit.

C. Chiller Start-up

1. Make all preliminary checks.

Oil temp, oil level, chilled water flow, chilled water load available (cooling units on) etc.

2. Start the unit

- ☐ If the phase rotation of the electrical power has not been positively confirmed, the actual rotation of the motor must be checked. Observe the rotation of the motor shaft through the sight glass on the end of the motor at the moment of start-up. Rotation must be CLOCKWISE. If the phase sequence is incorrect, confirmed by observation of the Phase Reversal diagnostic on the control panel, then the incoming power leads to the stator must be adjusted by authorized personnel.
- ☐ As the unit starts and runs, observe closely all operating conditions. Adjust the oil pressure regulator if necessary to 18 to 22 psi net.
- ☐ In the AdaptiView Purge Settings menu of the control panel, place the Purge Operating Mode to 'on' to al-



Forms

low the removal of non-condensables. It may also be necessary to disable the Purge Pumpout Limit timer found in the Purge Settings menu.

- ☐ After the unit has the system down to design leaving chilled water temp and is under control, and the purge is no longer relieving non-condensables, begin taking the start-up test log. Log the unit a minimum of 3 times at 15-minute intervals.
- ☐ In the AdaptiView Purge Settings menu of the control panel, return the purge-operating mode to 'Adaptive'.
- ☐ Restart the chiller and carefully observed the starting and loading sequence.

3. Instructions to the Chiller Operator.

- ☐ Instructions for starting, operating, and shutting down.
- ☐ Instructions for logging the unit.
- ☐ Instructions for periodic maintenance.

D. After 2 weeks of operation (International Units Only)

1. Remove the water box covers on both the evaporator and condenser. Mechanically brush clean all the tubes. This is to assure there is no debris blocking any of the tubes. A piece of debris partially blocking a tube may cause that tube to fail prematurely.

2. Replace the oil filter with the spare oil filter included in the control panel at time of shipment.

E. Comments and/or Recommendations:

Service Technician

Signature

Date



Forms

CenTraVac® Pre-commissioning Checksheet and Request for Serviceman

To: _____ Trane Service Company _____

S.O. No.: _____ Serial #s: _____

Job/Project Name: _____

Address: _____

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

Check boxes if the task is complete or if the answer is "yes"

1. CenTraVac

In place and piped. Do not insulate CenTraVac or adjacent piping. 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 _____ ☐**3. Flow Balancing Valves Installed**Leaving chilled water _____ ☐Leaving condenser water _____ ☐Heat recovery condenser leaving water _____ ☐**4. Gauges, Thermometers and Air Vents**Installed on both sides of evaporator _____ ☐

Installed on both sides of condenser and heat

recover condenser (as applicable) _____ ☐**5. Wiring**Compressor motor starter has been furnished by or approved by Trane La Crosse, WI _____ ☐Full Power available _____ ☐Interconnecting wiring, starter to panel (as req'd) _____ ☐External interlocks (flow swtch, pumps aux, etc) _____ ☐Chiller motor connection (remote starters)* _____ ☐Chilled water pump (connected and tested) _____ ☐Condenser water pump (connected and tested) _____ ☐Cooling tower fan rotation checked _____ ☐

Heat recovery condenser water

pump (as applicable) _____ ☐Power available for Service tools 115 VAC _____ ☐All controls installed and connected _____ ☐All magnetic starters installed and connected _____ ☐

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

6. TestingDry nitrogen available for pressure testing _____ ☐Trace gas amounts of Refrigerant-22 or R-134a available for leak testing, if necessary _____ ☐**7. Refrigerant On Job Site** _____ ☐**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 installation have properly placed and operating audible and visual refrigerant

alarms? _____ ☐



Forms

10. Equipment Room (continued)

- Does the equipment room have proper mechanical ventilation? ☐
- If it is required by local code, is a self-contained breathing apparatus available? ☐

11. Owner Awareness

- Has the owner been fully instructed on the proper use of refrigerant HCFC-123/HFC-514? ☐
- Does the owner have a copy of the MSDS for refrigerant HCFC-123/HFC-514? ☐
- 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 of the installation, will be invoiced at prevailing rates.

This is to certify that the CenTraVac chiller(s) has/have been properly and completely installed, and that the applicable items listed above have been satisfactorily completed.

Checklist Completed By _____

Signed: _____ **Date:** _____

In accordance with your quotation and our purchase order number _____, we will therefore require the presence of Trane service on the site, for the purpose of start-up and commissioning, by: Date: _____

Note: Advance notification is required to allow scheduling of the start-up as close as possible to the requested date.

Additional Comments/Instructions _____

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.



Annual Inspection Checklist (typical)

Follow the Annual Maintenance Instructions provided in the text of this manual, including but not limited to:

Compressor Motor

- ☐ Motor continuity
- ☐ Motor meg test (record results)
- ☐ Check and tighten motor terminals
- ☐ Clean motor terminal board
- ☐ Check control RLA settings

Starter or AFD

- ☐ Check condition of starter contacts
- ☐ Check/tighten all connections per manufacturer's specification.
- ☐ Follow all manufacture's recommendations for starter or AFD maintenance.
- ☐ Inspect/clean/service the AFD cooling system (water or air cooled AFD).
- ☐ Record all applicable starter or starter component settings.

Oil Sump

- ☐ Change oil only if recommended by oil analysis. (9 gal cap)
- ☐ Change oil filter.
- ☐ Lubricate oil filter valve.
- ☐ Check/clean Refrigerant/Oil pump motor terminals, start relay, and capacitor connections.
- ☐ Refrigerant/Oil pump motor ground/continuity check.
- ☐ Run oil pump and check net oil pressure.

Condenser

- ☐ Visually inspect for scaling and fouling in tubes. Note findings and make recommendations for cleaning.

Evaporator

- ☐ Once every 3 years on a closed loop, visually inspect for scaling and fouling in tubes. This may be needed annually if on an open system or if performance issues are noted.

Controls

- ☐ Check low refrigerant temp cutout setpoint. Check accuracy of sensor in ice water.
- ☐ Check evap leaving water temp low temp cutout setpoint. Check accuracy of sensor in ice water.
- ☐ Ensure sensors are properly seated in wells with thermo-paste installed.
- ☐ Check all electrical connections.
- ☐ Check the condenser high pressure switch. Note trip point.
- ☐ Check adjustment and operation of the IGV actuator.
- ☐ Note number of starts and operating hours.
- ☐ Check and record the chiller unit controls configuration and setpoints.
- ☐ Check service bulletins and alerts to determine if any updates are required or recommended.



Forms

Leak Test Chiller

- ☐ Check purge times and unit performance logs. Pressure leak test if warranted or every 3 years.
- ☐ Refrigerant and oil analysis for acid content.
- ☐ Inspect unit for any signs of refrigerant or oil leakage.
- ☐ Check unit for any loose bolts on flanges, volutes, or casings.

Purge

- ☐ Review the purge operation and maintenance manual and perform all maintenance items identified.
- ☐ Replace the filter drier on the purge return line.

Exterior

- ☐ Clean and touch-up painted surfaces as needed.
- ☐ Repair deteriorated, torn, or missing insulation.
- ☐ Lubricate linkages and tang operators.

Interview customer and review any operating data from the cooling season.

Comments: _____

Recommendations: _____



Forms

**STARTUP Test Log Water Cooled CenTraVac
With Symbio800 Controller**

AdaptiView Reports - log sheet	Log 1	Log 2	Log 3
Evaporator			
Entering			
Leaving			
Saturated			
Refrig. Press			
Approach			
Flow Sw Status			
Condenser			
Entering			
Leaving			
Saturated			
Refrig. Press			
Approach			
Flow Sw Status			
Compressor			
Starts			
Running Time			
Oil Tank Press			
Oil Discharge Press			
Oil Diff Press			
Oil Tank Temp			
IGV Position %			
IGV Steps			
Motor			
% RLA L1, L2, L3			
Amps L1, L2, L3			
Volts AB, BC, CA			
Power KW			
Load PF			
Winding # 1 Temp			
Winding # 2 Temp			
Winding # 3 Temp			
with AFD only			
AFD Freq			
AFD Speed			
AFD Transistor Temp			
Purge			
Time Until Next Purge Run			
Daily Pumpout - 24 hrs			
Avg. Daily Pumpout - 7 days			
Daily Pumpout Limit/Alarm			
Chiller On 7 days			
Pumpout Chiller On 7 days			
Pumpout Chiller Off 7 days			
Pumpout - Life			
Purge Rfgt Cprsr Suction Temp.			
Purge Liquid Temp.			
Carbon Tank Temp.(if present)			

Date:

Technician:

Owner:



Forms

STARTUP Chiller Report – Water Cooled CenTraVac With Symbio800 Controller Service Tool Records

Configuration

Unit Information

Unit Name _____
 Unit Model Number _____
 Unit Sales Order Number _____
 Unit Serial Number _____
 Application Firmware _____
 Boot Firmware _____
 Build Part Number _____
 Date/Time _____

Chiller Configuration

Main

_____ Unit Type (MODL)

Symbio800

_____ Unit Capacity(PTON)
 _____ Compressor Size(NTON)
 _____ Manufacturing Location
 _____ Starter Type
 _____ Condenser High Pressure Cutout
 _____ Impeller Diameter

Options

_____ Line Voltage Sensing
 _____ Free Cooling
 _____ Hot Gas Bypass
 _____ Second Condenser
 _____ Hot Water Control
 _____ Outdoor Air Temp Sensor
 _____ External Chilled Water Setpoint
 _____ External Current Limit Setpoint
 _____ Hardware Ice Building
 _____ Refrigerant Monitor Type
 _____ Condenser Pressure Sensor
 _____ Evap Differential Wtr Press
 _____ Condenser Differential Water Pressure
 _____ Enhanced Oil Temperature Protection
 _____ Chiller Running Oil Temperature Control
 _____ Compressor Refrigerant Discharge Temperature Sensor
 _____ Bearing Temperature Sensors
 _____ IGV Actuators



Forms

☐ Operating Status Programmable Relays
☐ LonTalk (Comm5) BAS Interface
☐ Purge Control
☐ % RLA and Condenser Rfgt Pressure Output
☐ Max Capacity Relay Filter Time
☐ Head Relief Relay Filter Time
☐ Base Loading

Options Setup

☐ ECWS Minimum Temperature
☐ ECWS Maximum Temperature
☐ Rfgt Pressure Output Type
☐ Min Delta Rfgt Pressure Output
☐ Max Delta Rfgt Pressure Output
☐ Evaporator Differential Water Pressure Range

Starter (non AFD)

☐ Stop Delay Time (Contactor Interrupt Failure)
☐ Unit Line Voltage
☐ Voltage Transformer Ratio
☐ Rated Load Amps
☐ CT Meter Scale
☐ Current Unbalance Trip Point
☐ Current Unbalance Grace Period
☐ Maximum Acceleration Setting
☐ Acceleration Time Out Action
☐ Overload Type
☐ Phase Reversal Protection
☐ Contactor Integrity Test
☐ Phase Reversal Grace Period
☐ Surge Protection
☐ Momentary Power Loss Protection
☐ Restart Inhibit Stop to Start Time
☐ Surge Sensitivity
☐ Power Loss Reset Time
☐ RTD Type

Starter (AFD)

☐ Restart Inhibit Stop to Start Time
☐ Surge Protection
☐ Surge Sensitivity
☐ Power Loss Reset Time
☐ Unit Line Voltage
☐ Motor NP FLA (TVA)
☐ Motor NP RLA
☐ Motor NP Power
☐ Motor NP Hertz
☐ Motor NP RPM



Forms

_____	Stator Resistance
_____	Flux Current Reference
_____	Acceleration Time
_____	Deceleration Time
_____	Starter Current Limit
_____	Current Limit Gain
_____	Power Loss Mode
_____	Power Loss Time
_____	Flying Start
_____	Flying Start Gain
_____	Use Trane Defaults
_____	RTD Type



Forms

STARTUP Chiller Report – Water Cooled CenTraVac With Symbio800 Controller Service Tool Records

Setpoints

Chiller Service Setpoints

Chiller Setpoints

_____ Front Panel Chilled Water Setpt
 _____ Front Panel Current Limit Setpoint
 _____ Front Panel Ice Building Command
 _____ Differential to Start
 _____ Differential to Stop
 _____ Setpoint Source
 _____ Evaporator Water Flow Point 1
 _____ Evaporator Pressure Drop Point 1
 _____ Evaporator Water Flow Point 2
 _____ Evaporator Pressure Drop Point 2
 _____ Evaporator Fluid Specific Gravity
 _____ Evaporator Fluid Specific Heat
 _____ Evap Low Water Flow Warning Setpoint
 _____ Low Differential Oil Pressure Cutout Setpoint
 _____ Check Oil Filter Diagnostic
 _____ Check Oil Filter Setpoint
 _____ Restart Inhibit Diagnostic
 _____ Minimum Capacity Limit
 _____ Maximum Capacity Limit

Compressor Setpoints

_____ Motor Winding Temp Diagnostic Severity

Adjustable Frequency Drive Setpoints

_____ AF Control
 _____ Re-Optimization Sensitivity

Chiller Field Startup Settings

Feature Settings

_____ Chilled Water Reset Type
 _____ Return Reset Ratio
 _____ Return Start Reset
 _____ Return Maximum Reset
 _____ Outdoor Reset Ratio
 _____ Outdoor Start Reset
 _____ Outdoor Maximum Reset
 _____ Ext Chilled Wtr Setpt
 _____ Front Panel Ice Termn Setpt
 _____ Evaporator Design Delta Temp



Forms

☐ Evaporator Leaving Water Temp Cutout
☐ Inlet Guide Vane Max Steps First Stage
☐ Low Refrigerant Temp Cutout
☐ Condenser Limit Setpt
☐ Restart Inhibit Free Starts
☐ Local Atmospheric Pressure
☐ High Evaporator Water Temperature Cutout
☐ High Evaporator Refrigerant Temperature Warning
☐ Ice Building Feature
☐ Current Limit Softload Start Point
☐ Phase Unbalance Limit Protection
☐ Over/Under Voltage Protection
☐ Minimum Capacity Timer
☐ Control Algorithm Flow Compensation

Manual Settings

☐ Clear Energy Consumption
☐ Purge Regen Cycle
☐ Purge Exhaust Circuit Test
☐ Clear Restart Inhibit Timer
☐ Exhaust Circuit Pressure Test
☐ Exhaust Circuit Vacuum Test

Adjustable Frequency Drive

☐ Maximum Frequency
☐ Minimum Frequency
☐ AFD Surge Capacity Increase

Timers

☐ Ice to Normal Cooling Timer Setpoint
☐ Maximum Time at Minimum Capacity
☐ Power-Up Start Delay
☐ Condenser Water Pump Off Delay
☐ Evaporator Water Pump Off Delay
☐ Restart Inhibit Start to Start
☐ Capacity Control Softload Time
☐ Current Limit Control Softload Time
☐ Starter Power Demand Time Period
☐ Re-Optimization Timer
☐ Daily Pumpout Limit
☐ Disable Daily Pumpout Limit

Chiller Purge Purge

☐ Purge Mode
☐ Purge Liquid Temp Inhibit
☐ Purge Liquid Temperature Limit



Forms**LLID List**

Create a list of all installed LLIDs.

Manual Entries

Refrigerant Level _____

Addition of Refrigerant _____

Oil Level _____

Vibration Levels _____

Addition of Oil _____

Signed _____

Date _____



Forms

AdaptiView Display Customer Training Checklist

- ☐ Equipment Description, including how to use the touch screen
 - ☐ Screen Overview
 - ☐ Chiller Status Area
 - ☐ Main Display Area/Home Screen
 - ☐ Component Screens
 - ☐ Main Menu Area
- ☐ Stopping/Restarting Chiller Operation
- ☐ Alarms
 - ☐ Viewing the Alarms Screen
 - ☐ Understanding Alarm Icons
 - ☐ Viewing Active and Historic Alarms
 - ☐ Sorting Alarms
 - ☐ Resetting Alarms
 - ☐ The Two Other Alarm Indicators on the display
- ☐ Reports
 - ☐ Viewing the Reports Screen
 - ☐ Viewing the Log Sheet
 - ☐ Viewing the ASHRAE Chiller Log
 - ☐ Creating and Viewing a Custom Report
 - ☐ Editing a Custom Report
 - ☐ Viewing Unit Information (About This Chiller)
 - ☐ Viewing Chiller Operating Modes
 - ☐ Viewing Purge Operating Modes
- ☐ Data Graphs
 - ☐ Viewing the Data Graphs Screen
 - ☐ Viewing Data Graphs
 - ☐ Changing the Scales on Data Graphs
 - ☐ Creating Custom Data Graphs
 - ☐ Editing Custom Data Graphs
 - ☐ Deleting a Custom Data Graph
- ☐ Equipment Settings
 - ☐ Viewing the Settings Screen
 - ☐ Viewing and Changing Equipment Settings
 - ☐ Chiller Settings
 - ☐ Setpoint Sources
 - ☐ Setpoint Source Arbitration
 - ☐ Changing the Setpoint Source
 - ☐ Feature Settings
 - ☐ Chilled Water Reset
 - ☐ Purge Settings
 - ☐ Manual Control Settings
- ☐ Display Settings
 - ☐ Viewing the Settings Screen
 - ☐ Viewing and Changing Display Preferences
 - ☐ Viewing and Changing the Language Preference
 - ☐ Viewing and Changing Date and Time Preferences
 - ☐ Cleaning the Display
- ☐ Security Settings
 - ☐ Viewing the Settings Screen
 - ☐ Logging In
 - ☐ Logging Out
 - ☐ Disabling/Enabling Security
- ☐ Troubleshooting

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