Installation, Operation, and Maintenance

Commercial Self-Contained Units SWUD

R-454B – 20 to 110 Tons

SWUD – 20 to 110 Tons

⚠ 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.

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PKG-SVX029B-EN

Introduction

Read this manual thoroughly before operating or servicing this unit.

Warnings, Cautions, and Notices

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

The three types of advisories are defined as follows:

⚠ WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
⚠ CAUTION	Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It could also be used to alert against unsafe practices.
NOTICE	Indicates a situation that could result in equipment or property-damage only accidents.

Important Environmental Concerns

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

Important Responsible Refrigerant Practices

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

⚠ WARNING

Proper Field Wiring and Grounding Required!

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

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

⚠ WARNING

Personal Protective Equipment (PPE) Required!

Failure to wear proper PPE for the job being undertaken could result in death or serious injury.

Technicians, in order to protect themselves from potential electrical, mechanical, and chemical hazards, MUST follow precautions in this manual and on the tags, stickers, and labels, as well as the instructions below:

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

⚠ WARNING

Follow EHS Policies!

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

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

⚠ WARNING

R-454B Flammable A2L Refrigerant!

Failure to use proper equipment or components as described below could result in equipment failure, and possibly fire, which could result in death, serious injury, or equipment damage.

The equipment described in this manual uses R-454B refrigerant which is flammable (A2L). Use ONLY R-454B rated service equipment and components. For specific handling concerns with R-454B, contact your local representative.

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Agency Listing

Unit is listed with ETL as a modular/cassette product and ships as such. Individual assemblies are tested and meet the requirements as such, but is not tested as a completed unit.

Important: *Installer is responsible for proper installation and for properly following assembly instructions found in this IOM.*

Revision History

- Updated Digit 16 and Digit 37 in Model Number Description chapter.
- Added R-454B Detection and Mitigation topic in the Operating Principles chapter.

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Overview

Note: *One copy of this document ships inside the control panel of each unit and is customer property. It must be retained by the unit maintenance personnel.*

This manual describes proper installation, operation, and maintenance procedures for water cooled systems. By carefully reviewing the information within this manual and following the instructions, the risk of improper operation and/or component damage will be minimized. It is important that periodic maintenance be performed to help support trouble free operation. A maintenance schedule is provided at the end of this manual. Should equipment failure occur, contact a qualified service organization with qualified, experienced HVAC technicians to properly diagnose and repair this equipment.

R-454B Compressors

- Use crankcase heaters which must be energized 24 hours prior to compressor start.

  Note: *This unit is equipped with stator heating capabilities that eliminates the need for a crankcase heater on the variable speed compressor only. All fixed speeds must utilize a crankcase heater.*

- Contains POE oil which readily absorbs potentially damaging moisture from air.
- Control box includes a phase monitor to detect phase loss, line voltage imbalance, and reversal.

SWUD Components

SWUDs are complete HVAC systems used in floor-by-floor applications.

- A single piece cabinet design to target new constructions.
- Left hand power connections.
- Left or right hand water connections.
- Factory installed options.

The hermetically sealed scroll compressor motors utilize internal motor protection and time delays to prevent excessive cycling.

Units utilize two refrigerant circuits and ship with a R-454B charge and full oil charge. Each circuit includes filter drier, pressure relief valve, moisture indicating sight glass, thermostatic expansion valve with sensing bulb and externally equalized, and high pressure cutout. The water cooled condensers are shell and tube. It is recommended to clean the condenser mechanically, but the condenser can be cleaned chemically.

Fan array consists of 1-7 direct drive plenum fans with each fan equipped with ECM motors.

Figure 1. SWUD components

Standard Controls

Standard controls supplied with the unit include Symbio™ 500 unit controls and the TD-7 touch screen display. All basic setup parameters are preset from the factory.

TD-7 Touch Screen Display

- TD-7 is unit mounted and accessible without opening the unit front panel.
- Use the TD-7 touch screen for easy setpoint adjustment.
- The TD-7 displays all unit operating parameters and conditions in a backlit color screen.

Symbio 500 Unit Controller

The Symbio™ 500 provides smart unit control with safety features and control relays for external devices. The Symbio 500 utilizes BACnet® MSTP to communicate to a front end Building Automation System (BAS).

The SWUD self-contained unit is controlled by a microelectronic programmable control system programmed from the factory specifically for the application. If additional input or output points are needed, expansion modules can be used.

For more detailed information on the control points provided, see the Owners section of this manual.

Optional Controls

Optional controls include a disconnect switch, dirty filter switch, water flow switch, supply air temperature reset, or external setpoint inputs. Morning warm-up operation is available on all units with heat or with downstream VAV boxes with heat.

Note: *A water flow switch is required for the installation, either supplied from the factory or field-provided.*

The static pressure probe, supply air temperature reset sensor options ship separate, but with the unit for field

installation. For more detailed unit control options, see the Owners section of this manual.

Unit Nameplate

The unit nameplate identifies the unit model number. It is located on the door of the starter panel.

Model Number Description

Digit 1, 2, 3, 4 — Unit Model

SWUD = Self-Contained Water-Cooled Unitary Device

Digit 5 — Refrigerant

5 = R-454B

Digit 6, 7, 8 — Capacity

020 = 20 Tons
025 = 25 Tons
030 = 30 Tons
035 = 35 Tons
040 = 40 Tons
045 = 45 Tons
050 = 50 Tons
055 = 55 Tons
060 = 60 Tons
065 = 65 Tons
070 = 70 Tons
075 = 75 Tons
085 = 85 Tons
090 = 90 Tons
100 = 100 Tons
110 = 110 Tons

Digit 9 — Unit Voltage

F = 208–230/60/3
4 = 460/60/3
5 = 575/60/3

Digit 10, 11 — Design Sequence

**

Digit 12 — Fan Type

1 = 1 Fan
2 = 2 Fans
3 = 3 Fans
4 = 4 Fans
5 = 5 Fans
6 = 6 Fans
7 = 7 Fans

Digit 13 — Compressor Technology

F = Fixed Speed

Digit 14 — Control Valves

0 = None
H = Head Pressure Control Valves

Digit 15 — Future Use

0 = None

Digit 16 — Economizer

0 = No Economizer
W = With Water Side Economizer
H = 2-Position Damper Ventilation Interface
J = Airside Economizer Interface
K = Airside Economizer Interface W/Comparative Enthalpy

Digit 17 — Water Connections

L = Left Hand Connections with Flow Switch
R = Right Hand Connections with Flow Switch

Digit 18 — Unit Water Connections

1 = Victaulic

Digit 19 — Air Discharge

H = Horizontal Discharge
V = Vertical Discharge

Digit 20 — Electrical Connections

L = Left Hand Connections

Digit 21 — Unit Electrical Connections

1 = Disconnect Switch
2 = Terminal Block

Digit 22 — Drain Pan

G = Galvanized Drain Pan
S = Stainless Steel Drain Pan

Digit 23 — Future Use

0 = None

Digit 24 – Filter Type

A = 2 inch - MERV 8
B = 4 inch - MERV 8
C = 2 inch - Pre-MERV 8, 4 inch, Post-MERV 13
D = 2 inch - MERV 13
E = 4 inch - MERV 13
F = 6 inch - MERV 15

Digit 25 — Heater

4 = Hydronic Remote
5 = Electric Remote (3 stages max, on/off)
6 = Electric Remote SCR
7 = Gas Remote
8 = Steam Remote

Digit 26 — Shipping Method

S = Single Piece

Digit 27— Unit Isolators

0 = None
A = Isopads

Digit 28 — Air Volume/Temp Control

A = VAV Control Scheme (Fixed DA Temp)
B = VAV Control Scheme (Return Air Reset)
C = VAV Control Scheme (Space Temp Reset)
D = CV Control Scheme (Fixed DA Temp)

Digit 29 — Agency Listing

0 = None
E = ETL listing

Digit 30 — Options

0 = None
2 = Compressor Service Valves

Digit 31 — Space Sensor Options

0 = None
1 = Space Sensor Only

Digit 32 — Future Use

0 = None

Digit 33 — Industrial Options

0 = None
A = Protective Coating Evaporator Coil
B = Protective Coating Evaporator Coil + WSE

Digit 34 — Discharge Plenum

0 = None
S = Standard Plenum with Field-Cut Holes

Digit 35 — Future Use

0 = None

Digit 36 — Future Use

0 = None

Digit 37 — Controller

3 = Symbio™ 500 - BACnet® MSTP
4 = Symbio 500 - Air Fi
5 = Symbio 500 - BACnet/IP

Digit 38 — Future Use

0 = None

Digit 39 — Major Design Version

A = 1.0

Digit 40 — Design Special

0 = None
S = Design Special

General Data

Table 1. SWUD water-cooled self-contained

Tonnage	20	25	30	35	40	45	50	55	60	65	70	75	85	90	100	110
Compressor Data																
Quantity	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Nominal Ton/Comp	5	6.25	7.5	8.75	10	11.25	12.5	13.75	15	16.25	17.5	18.75	21.25	22.5	25	27.5
Circuits	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Evaporator Coil Data																
Rows	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Sq. Ft.	28.65	28.65	28.65	28.65	35.42	37.5	39.58	40.63	40.63	50	51.11	52.78	52.78	68.33	68.33	68.33
Fins/in	12.0	12.0	12.0	12.0	12	12	12	12	12	12	12	12	12	12	12	12
Number of Coils	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Condenser Data																
Minimumum GPM w/o Econ [a]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Minimum GPM w/ Econ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Maximum GPM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Evaporator Fan Data																
Quantity	1	1	2	2	2	2	3	3	4	4	4	4	5	5	6	7
Diameter	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
Power consumption kW	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Minimum Design cfm[b]	4000	5000	6000	7000	7400	8600	10000	10800	12000	13000	13600	15200	16600	18000	20400	22600
Maximum Design cfm	7600	9500	11400	13300	14060	16340	19000	20520	22800	24700	25840	28880	31540	34200	38760	42940
Refrigerant Charge, lbs. R-454B[c]																
Circuit A	10.0	12.5	15.0	17.5	20.0	22.5	25.0	27.5	30.0	32.5	35.0	37.5	42.5	45.0	50.0	55.0
Circuit B	10.0	12.5	15.0	17.5	20.0	22.5	25.0	27.5	30.0	32.5	35.0	37.5	42.5	45.0	50.0	55.0
Total	20.0	25.0	30.0	35.0	40.0	45.0	50.0	55.0	60.0	65.0	70.0	75.0	85.0	90.0	100.0	110.0
Filter Data, Water-Cooled Units																
Number - Size (in.)	9-20"x24"				12-20"x24"					15-20"x24"				21-20"x24"		
Number of Compressor Tandems																
8T Fixed Speed Tandem	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10T Fixed Speed Tandem	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13T Fixed Speed Tandem	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0
15T Fized Speed Tandem	0	0	0	1	2	1	0	0	0	0	0	0	0	0	0	0
20T Fixed Speed Tandem	0	0	0	0	0	1	2	1	0	0	0	0	0	0	0	0
23T Fixed Speed Tandem	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
26T Fixed Speed Tandem	0	0	0	0	0	0	0	0	1	2	1	1	0	0	0	0
30T Fixed Speed Tandem	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0
37T Fixed Speed Tandem	0	0	0	0	0	0	0	0	0	0	0	1	1	2	1	0
45T Fixed Speed Tandem	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
Number of Fans/Unit																
No. of fans	1		2				3		4				5		6	7

Note: All performance data is provided in the Performance Selection Program. Contact Trane Sales at 770-988-8338 for more information.

[a] All performance data is provided in the Performance Selection Program. Contact MJC Sales at 770-988-8338 for more information.

[b] Minimum air flow at part load is 35% of full load design CFM.

[c] Refrigerant charge shown is a general guideline, charge to sub-cooling as described in IOM. Note that occasionally a TXV adjustment may need to be made but only after adequate sub-cooling has been reached.

Table 2. EER/IEER ratings

Tonnage	Model Number	EER	IEER	AHRI Net Cooling Capacity (MBH)
20	SWUD5020	18.7	21.3	252
25	SWUD5025	16.7	19.9	292
30	SWUD5030	17.9	22.6	387
35	SWUD5035	18.2	22.0	411
40	SWUD5040	18.2	21.9	458
45	SWUD5045	17.9	22.1	536
50	SWUD5050	18.8	22.8	625
55	SWUD5055	18.3	22.1	665
60	SWUD5060	18.2	21.7	743
65	SWUD5065	17.7	21.2	775
70	SWUD5070	17.3	21.7	839
75	SWUD5075	16.5	20.4	920
85	SWUD5085	16.6	20.6	987
90	SWUD590F	16.4	20.1	1096
100	SWUD5100	16.5	20.3	1234
110	SWUD5110	16.2	19.6	1371

Notes:

1. Cooling only.
2. Cooling performance is rated at 80F EDB/67F EWB with 85 EWT for water-cooled performance and 95F Ambient for air-cooled performance.
3. EER, IEER, and AHRI Net Cooling Capacity are tested in accordance with the AHRI 340/360 (I-P) and certified to 10 CFR Part 431 from the US Department of Energy.

Pre-Installation

Receiving

Receiving Checklist

Complete the following checklist immediately after receiving unit shipment to detect possible shipping damage:

- Inspect individual cartons before accepting. Check for rattles, bent carton corners, or other visible indications of shipping damage.
- If a unit appears damaged, inspect it immediately before accepting the shipment. Make specific notations concerning the damage on the freight bill. Do not refuse delivery.
- Inspect the unit for concealed damage before it is stored and as soon as possible after delivery. Report concealed damage to the freight line within the allotted time after delivery. Check with the carrier for their allotted time to submit a claim.
- Do not move damaged material from the receiving location. It is the receivers responsibility to provide reasonable evidence that concealed damage did not occur after delivery.
- Do not continue unpacking the shipment if it appears damaged. Retain all internal packing, cartons, and crate. Take photos of damaged material if possible.
- Notify the carrier of the damage immediately by phone and mail. Request an immediate joint inspection of the damage by the carrier and consignee.

  Note: *Notify your Trane representative of the damage and arrange for repair. Have the carrier inspect the damage before making any repairs to the unit.*

Ship-Separate Accessories

Field installed components ship separately inside cassette labeled **Ship-With Components** or on individual pallet.

Contractor Installation Responsibilities

Complete the following checklist before beginning final unit installation:

- Verify the unit size and tagging with the unit nameplate.
- Make certain the floor or foundation is level, solid, and sufficient to support the unit and accessory weights. Level or repair the floor before positioning the unit if necessary.
- Allow minimum recommended clearances for routine maintenance and service. Allow space at end of the unit for servicing. Refer to the unit submittals for dimensions. See also the “Service Clearances,” p. 17 section in the “Dimensional Data,” p. 14.
- Electrical connection knockouts are on the top, of the starter panel.
- Allow adequate space for piping access and panel removal. Locate and properly identify condenser water piping, refrigerant piping, and condensate drain connections depending upon your application.

  Note: *Unit height and connection locations will change if using vibration isolators.*
- Electrical supply power must meet specific balance and voltage requirements as described in “Installation – Mechanical,” p. 25.
- The installer is responsible for providing a condenser main, standby water pump, cooling tower, pressure gauges, and all components for waterside piping.

Unit Inspection

To protect against loss due to damage incurred in transit, perform inspection immediately upon receipt of the unit.

Exterior Inspection

If the job site inspection reveals damage or material shortages, file a claim with the carrier immediately. Specify the type and extent of the damage on the bill of lading before signing. Notify the appropriate sales representative.

Important: *Do not proceed with installation of a damaged unit without sales representative approval.*

- Visually inspect the complete exterior for signs of shipping damages to unit or packing material.
- Verify the nameplate data matches the sales order and bill of lading.
- Verify the unit is properly equipped and there are no material shortages.
- Verify the power supply complies with the unit nameplate specifications.

Inspection for Concealed Damage

Visually inspect the components for concealed damage as soon as possible after delivery and before it is stored.

If concealed damage is discovered:

- Notify the carriers terminal of the damage immediately by phone and by mail.
- Concealed damage must be reported within 15 days.
- Request an immediate, joint inspection of the damage with the carrier and consignee.
- Stop unpacking the unit.
- Do not remove damaged material from receiving location.
- Take photos of the damage, if possible.
- The owner must provide reasonable evidence that the damage did not occur after delivery.

Repair

Notify the appropriate sales representative before arranging unit installation or repair.

Important: *Do not repair unit until the damage has been inspected by the carrier's representative.*

Unpacking

SWUD units ship fully assembled in a single piece. Some accessories are shipped inside an additional box.

Dimensional Data

Figure 2. Unit dimensions (in inches)

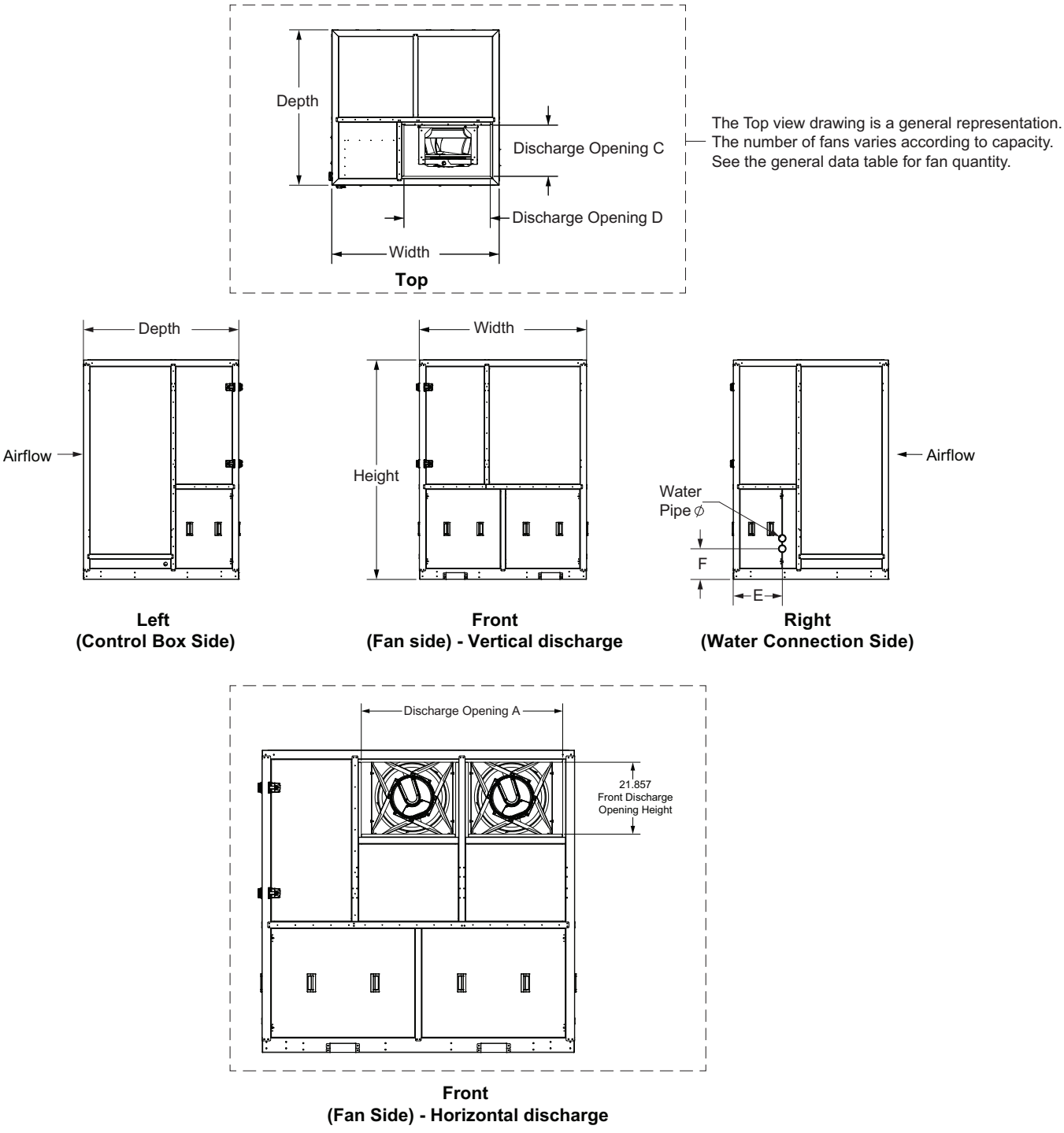
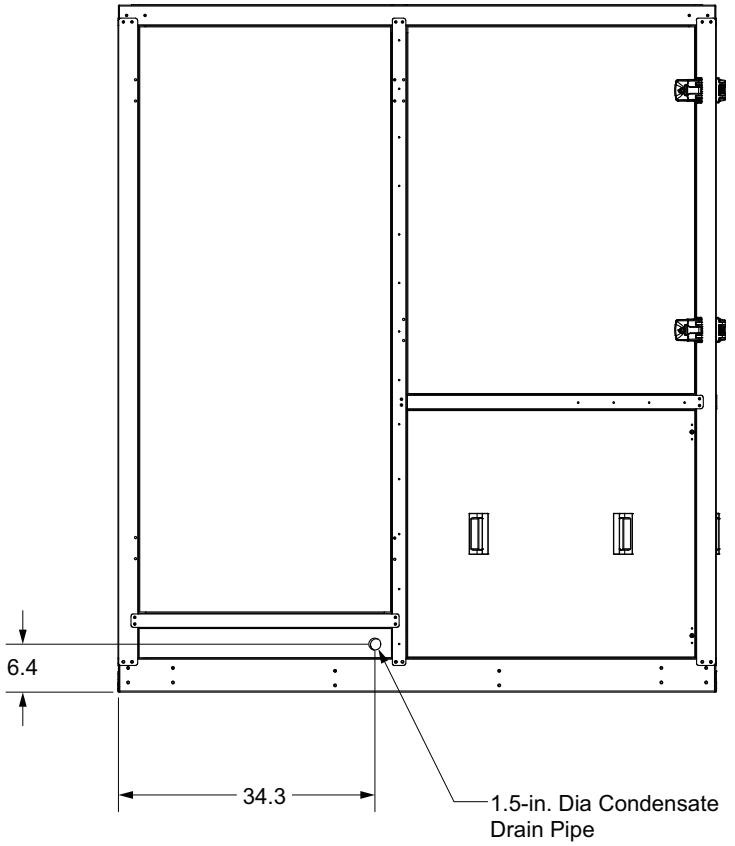


Table 3. Unit dimensions (in inches)

	Unit Size			
Dimension	**20, 25, 30, and 35T**	**40, 45, 50, 55, and 60T**	**65, 70, 75, and 85T**	**90, 100, and 110T**
Width (in.)	70.00	95.00	111.00	140.00
Depth (in.)	65.00	80.00	80.00	80.00
Height (in.)	92.00	92.00	92.00	92.00
Discharge Opening - Vertical discharge				
Discharge Opening C (in.)	21.42	36.50	36.50	36.50
Discharge Opening D (in.)	36.17	61.22	77.16	106.00
Discharge Opening - Horizontal discharge				
Discharge Opening A (in.)	36.24	61.24	79.09	107.96

	Unit Size				
Dimension	**20, 25, 30, and 35T**	**40T**	**45, 50, 55, 60, and 65T**	**70T**	**75, 85, 90, 100, and 110T**
Water Pipe Ø	2.50 NPT	2.50 NPT	3.00 NPT	3.00 NPT	4.00 NPT
E	20.60	30.00	30.00	30.00	30.00
F	12.83	12.87	11.76	13.73	14.82

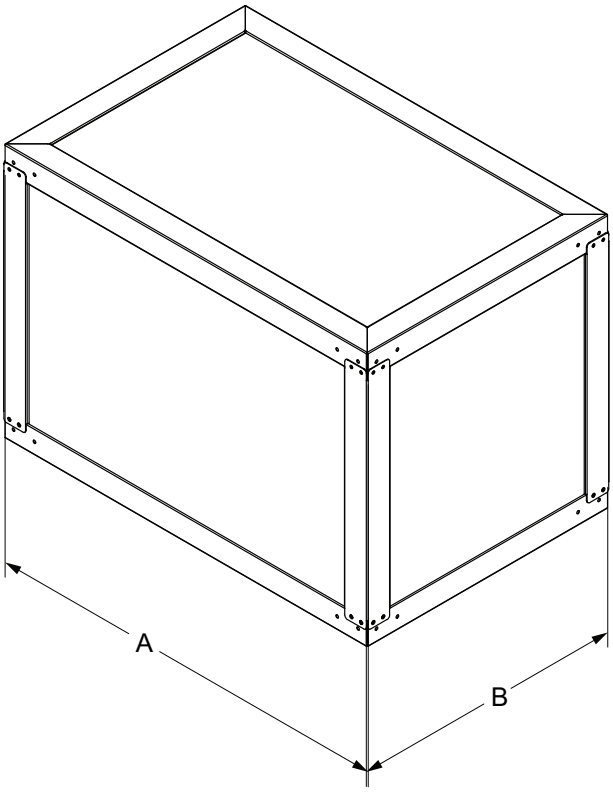
Figure 3. Condensate drain pipe location



Left
(Control Box Side)

Note: *Condensate drain connection always on the LEFT (Control Box) side.*

Figure 4. Standard plenum (option)



Note: *Custom height plenums available upon request.*

Table 4. Standard plenum (option)

Unit Size	Dim A (in.)	Dim B (in.)	Height (in.)
20, 25, 30, and 35T	42.92	28.55	30.00
40, 45, 50, 55, and 60T	67.77	43.40	30.00
65, 70, 75, and 85T	83.77	43.40	30.00
90, 100, and 110T	112.63	43.40	30.00

Service Clearances

Figure 5. Service clearance

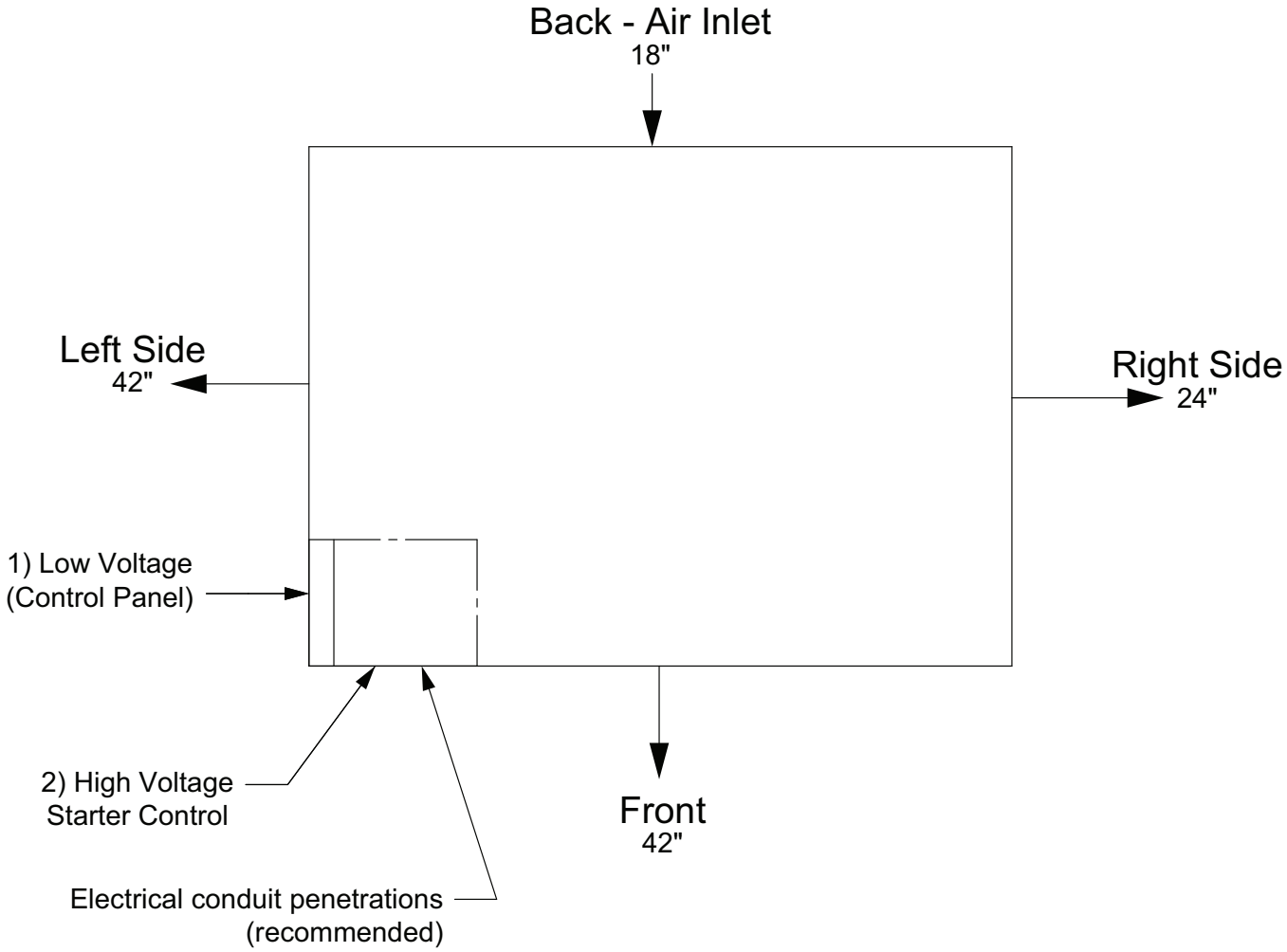


Table 5. Service/code clearance requirements

Side	Distance - in. (mm)	Purpose
Front	42	NEC Code Requirements; Fan, Compressor, Condenser, Service/Removal
Left	42	NEC Code Requirements
Right	24	Door Clearance
Back	18	Provides Uniform Airflow

Weights

Table 6. Unit weights

Unit Size	Base Weight	Waterside Economizer
	(lbs)	(lbs)
20	2763	459
25	2813	459
30	2915	459
35	2965	468
40	3423	578
45	3489	602
50	3654	626
55	3734	638
60	3904	649
65	4231	679
70	4240	777
75	4367	796
85	4466	796
90	5137	1055
100	5237	1055
110	5336	1055

A2L Information

A2L Work Procedures

⚠ WARNING

Risk of Fire — Flammable Refrigerant!

Failure to follow instructions below could result in death or serious injury, and equipment damage.

- **To be repaired only by trained service personnel.**
- **Do not puncture refrigerant tubing.**
- **Dispose of properly in accordance with federal or local regulations.**
- **The equipment shall be stored in a room without continuously operating ignition sources.**

⚠ WARNING

Refrigerant under High Pressure!

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

⚠ WARNING

Hazardous Voltage!

Failure to disconnect power before servicing could result in death or serious injury.
Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.

The units described in this manual use R-454B refrigerant. Use ONLY R-454B rated service equipment or components with these units. For specific handling concerns with R-454B, contact your local Trane representative.

Installation, repair, removal, or disposal should be performed by trained service personnel.

At all times, Trane's maintenance and service guidelines shall be followed. If in doubt, contact Trane technical support for assistance.

Servicing

Prior to initiating work on equipment, check the area with an appropriate refrigerant detector. Ensure the service personnel are properly trained regarding work in potentially toxic or flammable atmospheres. Ensure that the leak detection equipment being used is suitable for use with all applicable refrigerants, i.e. non-sparking, adequately sealed, or intrinsically safe. Be aware that the refrigerant does not contain an odor.

If any hot work is to be conducted on the refrigerating equipment or any associated parts, appropriate fire extinguishing equipment shall be available on hand. A dry powder or CO_2 fire extinguisher should be located adjacent to the charging area.

At all times, Trane's maintenance and service guidelines shall be followed. If in doubt, contact Trane technical support for assistance.

All maintenance staff and others working in the local area shall be instructed on the nature of the work being carried out. Work in confined spaces shall be avoided.

Ignition Source Mitigation

Do not use any sources of ignition when working on the refrigeration system.

Keep all ignition sources, including cigarette smoking, away from the site of installation, repair, removal or disposal, during which refrigerant can potentially be released to the surrounding space.

Survey the area around the equipment before initiating work to ensure no flammable hazards or ignition risks are present.

"No Smoking" signs shall be displayed.

Do not use devices that can be a source of ignition to accelerate defrosting of components. Use only defrost and cleaning procedures recommended by Trane. Do not pierce or burn.

Ventilation

Ensure that the area is in the open or that it is adequately ventilated before breaking into the system or conducting any hot work. A degree of ventilation shall continue during the period that the work is carried out. The ventilation should safely disperse any released refrigerant and preferably expel it externally into the atmosphere. If present, check that the ventilation system, including outlets, are operating adequately and are not obstructed.

Refrigerating Equipment

Refrigerant piping or components should not be installed in locations where substances which may corrode them are present.

Check that equipment hazard markings are visible and legible. Replace them if they are not.

For equipment using secondary fluids, like water or glycol, check that refrigerant is not present in the secondary fluid loop before conducting any hot work.

Electrical Devices

Do not apply power to the circuit if a fault exists which compromises safety. If the fault cannot be corrected immediately, but it is necessary to continue operation, an adequate temporary solution shall be used. This shall be reported to the owner of the equipment, so all parties are advised.

Initial safety checks shall include:

- Cabling is not subject to wear, corrosion, excessive pressure, vibration, sharp edges, or any other adverse environmental effects. Account for the effects of aging or continual vibration from sources such as compressors or fans.
- Capacitors are discharged. This shall be done in a safe manner to avoid possibility of sparking.
- No live electrical components and wiring are exposed while charging, recovering, or purging the system.
- Verify continuity of earth bonding.
- Replace electrical components with Trane replacement parts, or those meeting the same ratings and qualified for flame arrest protection, UL LZGH2 category.

Leak Detection

Never use an open flame to detect leaks. A halide torch should not be used. Use only approved leak detection methods per this instruction manual.

The following leak detection methods are deemed acceptable for all refrigerant systems.

Electronic leak detectors may be used to detect refrigerant leaks but, in the case of flammable refrigerants, the sensitivity may not be adequate, or may need re-calibration. (Detection equipment shall be calibrated in a refrigerant-free area.) Ensure that the detector is not a potential source of ignition and is suitable for the refrigerant used. Leak detection equipment shall be set at a percentage of the LFL gas (25% maximum) is confirmed.

Leak detection fluids are also suitable for use with most refrigerants but the use of detergents containing chlorine shall be avoided as the chlorine may react with the refrigerant and corrode the copper pipe-work.

Examples of leak detection fluids are:

- Bubble method
- Fluorescent method agents

If a leak is suspected, all naked flames shall be removed/ extinguished.

If a refrigerant leak is found which requires brazing, all refrigerant shall be recovered from the system, or isolated (by means of shut off valves) in a part of the system remote from the leak.

Refrigerant Removal and Evacuation

Ensure that the correct number of cylinders for holding the total system charge is available. All cylinders to be used are designated for the recovered refrigerant and labeled for that refrigerant (special cylinders for the recovery of refrigerant, for example). Cylinders shall be complete with pressure-relief valve and associated shut-off valves in good working order. Empty recovery cylinders are evacuated and, if possible, cooled before recovery occurs.

When breaking into the refrigerant circuit to make repairs – or for any other purpose – conventional procedures shall be used. However, for flammable refrigerants it is important that best practice be followed, since flammability is a consideration.

The following procedure shall be adhered to:

1. Safely remove refrigerant following local and national regulations.
2. Evacuate.
3. Purge the circuit with inert gas.
4. Evacuate (optional for A2L).
5. Continuously flush or purge with inert gas when using flame to open circuit.
6. Open the circuit.

Prior to refrigerant removal, open all appropriate valves, including solenoid and electronic expansion valves (EXVs). Use control settings, where available. When not available, manually open all electronically controlled valves using acceptable service procedures.

The recovery equipment shall be in good working order with instructions available. Equipment shall be suitable for the recovery of the flammable refrigerant. For specific handling concerns, contact the manufacturer. Ensure all hose connections are checked for tightness to avoid refrigerant leaks.

In addition, a set of calibrated weighing scales shall be available and in good working order.

The refrigerant shall be recovered into the correct recovery cylinders if venting is not allowed by local and national codes. Do not mix refrigerants in recovery unit and especially not in cylinders.

Refrigerant recovery unit should be purged with an inert gas after each use or before using with a different refrigerant Class – for example, A2L to A1.

If compressors or compressor oils are to be removed, ensure that they have been evacuated to an acceptable level to make certain that flammable refrigerant does not remain within the lubricant. The compressor body shall not be heated by an open flame or other ignition sources to accelerate this process. When oil is drained from a system, it shall be carried out safely.

The system shall be purged with oxygen-free nitrogen to render the appliance safe for flammable refrigerants. This process might need to be repeated several times. Compressed air or oxygen shall not be used for purging refrigerant systems.

The system shall be vented down to atmospheric pressure to enable work to take place.

The outlet for the vacuum pump shall not be close to any potential ignition sources, and ventilation shall be available.

Refrigerant Charging

In addition to conventional charging procedures, the following requirements shall be followed.

- Ensure that contamination of different refrigerants does not occur when using charging equipment.
- Hoses or lines shall be as short as possible to minimize the amount of refrigerant contained in them.
- Cylinders shall be kept in an appropriate position according to the instructions.
- Ensure that the refrigerating system is earthed prior to charging the system with refrigerant.
- Label the system when charging is complete (if not already).
- Extreme care shall be taken not to overfill the refrigerating system.

Prior to recharging the system, it shall be pressure-tested with the appropriate purging gas. The system shall be leak-tested on completion of charging but prior to commissioning. A follow up leak test shall be carried out prior to leaving the site.

Prior to refrigerant charging, open all appropriate valves, including solenoid and electronic expansion valves (EXVs). Use control settings, where available. When not available, manually open all electronically controlled valves using acceptable service procedures.

Verify the equipment refrigerant charge is in accordance with the room area limitation as described in Minimum Room Area Limits section.

Decommissioning

Before carrying out the decommissioning procedure, it is essential that the trained service personnel is completely familiar with the equipment and all its details. It is recommended good practice that all refrigerants are recovered safely. Prior to the task being carried out, an oil and refrigerant sample shall be taken in case analysis is required prior to re-use of recovered refrigerant. It is essential that electrical power is available before the task is commenced.

1. Become familiar with the equipment and its operation.
2. Isolate system electrically.
3. Before attempting the procedure, ensure that:
    a. Mechanical handling equipment is available, if required, for handling refrigerant cylinders.
    b. All personal protective equipment is available and being used correctly.
    c. The recovery process is supervised at all times by a competent person.
    d. Recovery equipment and cylinders conform to the appropriate standards.
4. Pump down refrigerant system, if possible.
5. If a vacuum is not possible, make a manifold so that refrigerant can be removed from various parts of the system.
6. Make sure that cylinder is situated on the scales before recovery takes place.
7. Start the recovery machine and operate in accordance with instructions.
8. Do not overfill cylinders (no more than 80% volume liquid charge).
9. Do not exceed the maximum working pressure of the cylinder, even temporarily.
10. When the cylinders have been filled correctly and the process completed, make sure that the cylinders and the equipment are removed from site promptly and all isolation valves on the equipment are closed off.
11. Recovered refrigerant shall not be charged into another refrigerating system unless it has been cleaned and checked.
12. When equipment has been decommissioned, attach a signed and dated label stating it has been decommissioned and emptied of refrigerant.
13. Ensure that there are labels on the equipment stating it contains flammable refrigerant.

A2L Application Considerations

This product is listed to UL standard 60335-2-40, Household and Similar Electrical Appliances – Safety – Part 2-40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers, which defines safe design and use strategies for equipment using A2L refrigerants. This standard limits the refrigerant concentration in a space in the event of a refrigerant leak. To meet the requirements, the UL standard defines minimum room area, refrigerant charge limit, minimum circulation airflow and/or ventilation airflow requirements, and limits the use of ignition sources in spaces. The standard may require a unit refrigerant leak detection system.

For equipment with R-454B and charge amounts less than or equal to 3.91 lbs per circuit, this UL standard does not prescribe a room area limit and does not require a refrigerant leak detection system or any circulation airflow or ventilation airflow mitigation strategies. However, ignition sources in ductwork must be evaluated.

Depending on the application, a specific requirement of ANSI/ASHRAE Standard 15, Safety Standard for Refrigeration Systems, could be more stringent than UL 60335-2-40 requirements. See *Refrigeration Systems and Machinery Rooms Application Considerations for Compliance with ASHRAE® Standard 15-2022 Application Engineering Manual* (APP-APM001*-EN) for more information.

Ignition Sources in Ductwork

Do not install open flames in the ductwork. Hot surfaces exceeding 700°C (1290°F) should not be installed in the ductwork unless the average airflow velocity is not less than 1.0 m\s (200 ft\min) across the heater and proof of airflow is verified before system is energized.

Electric heaters can exceed the surface temperature limit if airflow distribution is poor, or insufficient airflow is provided over the heater.

Surface temperatures of most gas heaters do not exceed the surface temperature limits due to ANSI construction requirements.

Ignition Sources in Unit

This unit does not contain any ignition sources. All potential ignition sources, (including factory or field installed accessory electric heaters, gas heaters, relays, and contactors) were evaluated during product UL listing.

Minimum Room Area Limits (Refrigerant charge greater than 3.91 lb per circuit)

Equipment with R–454B charge amounts greater than 3.91 lb per circuit may require additional circulation or ventilation airflow mitigation strategies. In this case, two minimum room area (A_{min}) thresholds:

- The first threshold defines when equipment serving a single room is required to provide circulation airflow, either continuous or activated by a leak detection system. A ducted system requires circulation airflow unless the smallest room it serves is larger than the adjusted A_{min} threshold. This product contains a leak detection system if a circuit charge is greater than 3.91 lbs. As a result, no further leak detection system evaluation is required.
- The second threshold defines when additional ventilation airflow is required. If the room area, A or TA, is below the adjusted A_{min} or TA_{min} threshold, additional ventilation is required to remove refrigerant in the event of a leak. Refer to UL 60335-2-40 Clause GG.8 and ANSI\ASHRAE Standard 15 Section 7 for natural and mechanical ventilation requirements.

Table 7. Minimum room area

		Minimum Room Area[a]	
Tonnage	Eff	m2	ft2
20	S	40	427
20	H	42	450
20	V	42	457
25	S	46	491
25	H	49	532
25	V	47	510
30	S	50	536
30	H	57	611
30	V	50	543
40	S	71	765
40	H	73	791
40	V	73	787
50	S	84	900
50	H	100	1072
50	V	101	1083
55	S	81	873
55	H	96	1038
55	V	99	1061
60	S	100	1072
60	H	115	1233
60	V	116	1248
70	S	104	1121
70	H	133	1428
70	V	139	1499
75	S	130	1398
75	H	127	1372
75	V	126	1361
90	S	158	1705
90	H	194	2091
105	S	178	1919
115	S	187	2009
130	S	169	1822

[a] Based on 2.5m ceiling height.

Minimum Room Area (A_{min}) Adjustments

Use equation below to adjust the minimum room area, as applicable, based on the unit's installation height, altitude, and occupancy level it serves.

$$A_{min.adj} = \text{Nameplate } A_{min} \times \text{Altitude Adj} \times \text{Height Adj} \times F_{occ}$$

Multiply the altitude adjustment factor in the table below by A_{min} listed on the unit nameplate or in the Installation, Operation, and Maintenance (IOM) manual.

Table 8. Altitude adjustment factor

Altitude (ft)	Sea Level to 2000	2001 to 4000	4001 to 6000	6001 to 8000	8001 to 10000	10001 to 12000	12001 to 14000	14001 to 15000	Over 15000
A_{min} Adjustment	1	1.05	1.11	1.17	1.24	1.32	1.41	1.51	1.57

In addition, A_{min} can be adjusted if the unit is installed in a room at a height that is higher than the minimum height shown on the unit. To adjust A_{min}, multiply by the ratio of the unit minimum release height (in meters) / actual release height (in meters). Use 0.6 m in the ratio for unit minimum installation heights less than or equal to 0.6 m.

For institutional occupancies, ASHRAE Standard 15 applies an additional adjustment factor F_{occ} to the amount of a charge allowed in a space. To calculate the adjusted A_{min} for institutional occupancies, multiply the A_{min} on the nameplate by two.

EXAMPLE 1: 20 Ton Packaged Rooftop Multi-Zone VAV System Serving an Institutional Occupancy Space

The packaged unit serves 7600 ft² of a nursing home located at an attitude of 4000 ft. The unit has two equally charged 10 ton refrigeration circuits. Each circuit has 12 lbs of refrigerant with a minimum room area requirement of 180 ft² with a 2.2 m release height.

$$TA_{min.adj} = 180\ ft^2 \times 1.05 \times 2 = 378\ ft^2$$

No additional ventilation is required.

EXAMPLE 2: 10 Ton Split System Serving a Single Commercial Occupancy Space

The split system serves a 1500 ft² manufacturing space at 5000 ft altitude. The final installed charge of the single circuit 10 ton unit is 20 lb. The unit has an open return with a release height of 1 m and ducted supply air. The unit A_{min} is 660 ft².

$$A_{min.adj} = 660\ ft^2 \times 1.11 = 733\ ft^2$$

No additional ventilation is required.

Determining Room Area (A or TA)

The room area (A) is the room area enclosed by the projection to the floor of the walls, partitions, and doors of the space that the equipment serves. For ducted systems, total room area (TA) of all rooms connected by ducts, may be used instead of A.

Rooms connected by drop ceilings only are not considered a single room.

Rooms on the same floor of the building, and connected by an open passageway, can be considered part of the same room if the passageway is a permanent opening, extends to the floor and is intended for people to walk through.

Adjacent rooms on the same floor of the building and connected by permanent openings in the walls and/or doors between rooms (including gaps between the wall and the floor), can be considered part of the same room if the openings meet the following criteria.

- The opening is permanent and cannot be closed.
- Openings extending to the floor, such as door gaps, need to be at least 20 mm above the floor covering surface.
- Natural ventilations opening areas must meet the requirements of ANSI\ASHRAE Standard 15-2022, Section 7.2.3.2.

Rooms that are connected by a mechanical ventilation system can be considered a single room area if the mechanical ventilation system meets the requirements of ANSI\ASHRAE Standard 15-2022, Section 7.6.4.

Leak Detection System (Refrigerant charge greater than 3.91 lb per circuit)

The leak detection system consists of one or more refrigerant detection sensors. When the system detects a leak, the following mitigation actions will be initiated until refrigerant has not been detected for at least 5 minutes:

- Energize the supply fan(s) to deliver a required minimum amount of circulation airflow.
- Disable compressor operation.
- Provide an output signal that can be used to fully open zone dampers and/or VAV boxes and disable electric heat in VAV boxes.
- Provide an output signal that can be used to energize additional mechanical ventilation (if needed).
- Units without airflow proving will disable electric heat sources.

Building fire and smoke systems may override this function.

If the refrigerant sensor has a fault, is at the end of its life, or is disconnected, the unit will initiate the mitigation actions. Mitigation actions may be verified by disconnecting the sensor.

The refrigerant sensors do not need service. Use only manufacturer-approved sensors when replacement is required.

A2L Mitigation Airflow

Table 9. A2L mitigation airflow

Unit Tonnage	Total Refrigerant Charge (kg)	Min Airflow (m3h)
20	9.08	899
25	11.34	1123
30	13.6	1347
35	15.88	1572
40	18.14	1796
45	20.4	2020
50	22.68	2246
55	24.94	2469

Table 9. A2L mitigation airflow (continued)

Unit Tonnage	Total Refrigerant Charge (kg)	Min Airflow (m3h)
60	27.2	2693
65	29.48	2919
70	31.76	3145
75	34	3366
85	38.46	3808
90	40.82	4042
100	45.36	4491
110	49.9	4941

Installation – Mechanical

Unit Handling

⚠ WARNING

Improper Unit Lift!

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

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

- Use spreader bars to avoid unit damage.
- Spreader bar must be a minimum of 11 feet for 20 to 85 ton units and 12 feet for 90 to 110 tons. Chains must not bear on top of unit.
- Run straps through fork pockets to connect to the spreader bar. See detail in Figure 6, p. 25 and Figure 8, p. 26.
- Lift using overhead crane only. Adjust rigging for unit center of gravity.
- Unit center of gravity will fall within center of gravity block at various locations depending on unit options.
- See unit nameplate for unit weights.
- Unit has built-in fork pockets for easy forklift maneuverability.
- Do not stack units.

Figure 6. Detail of how to run straps through fork pockets to connect spreader bar on self-contained

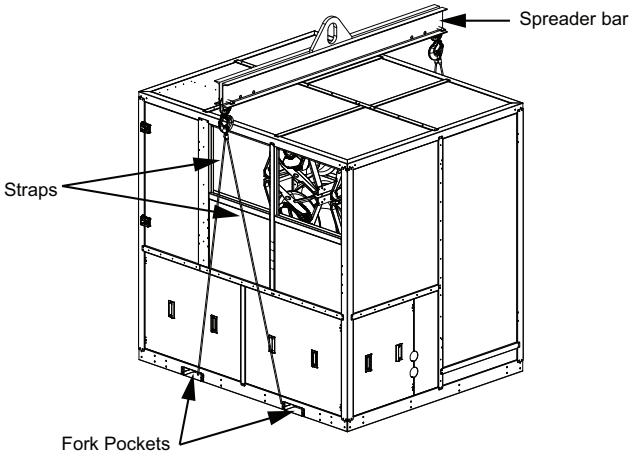


Table 10. Gravity block dimensions 20 to 80 tons, in.

Unit Size (Tons)	Dim A	Dim B	Dim C	Dim D	Dim E
20 to 35	26.8	36.2	34.8	65.0	70.0
40 to 60	34.8	35.9	47.5	80.0	95.0
65 to 85	35.4	35.7	53.9	80.0	111.0
90 to 110	35.3	36.7	70.6	80.0	140.0

Figure 7. Gravity Block Dimensions 20 to 80 tons, in.

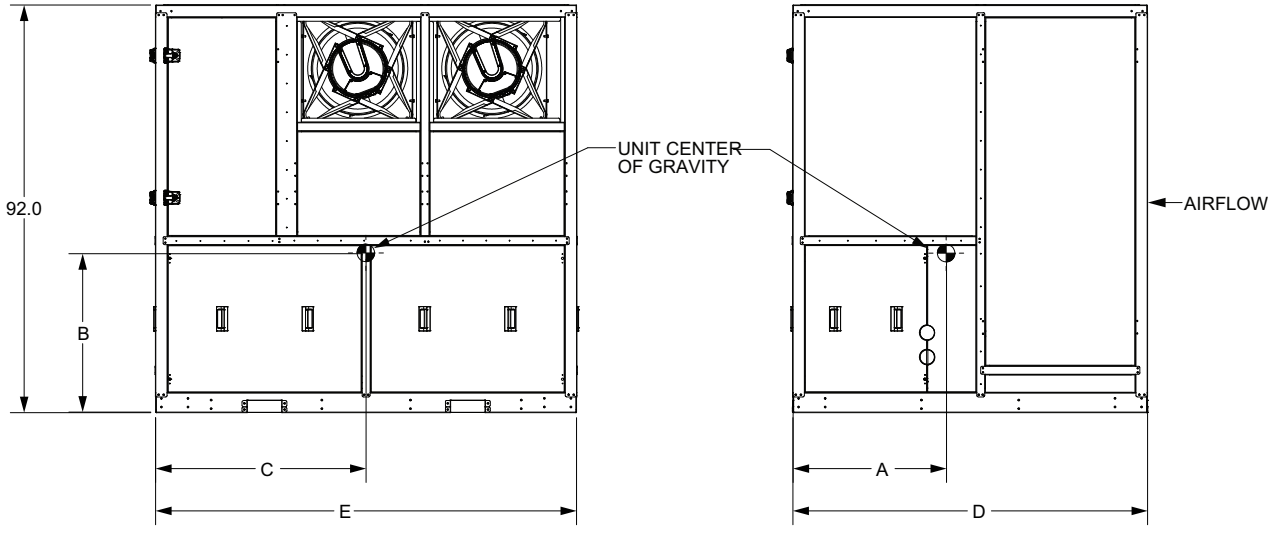
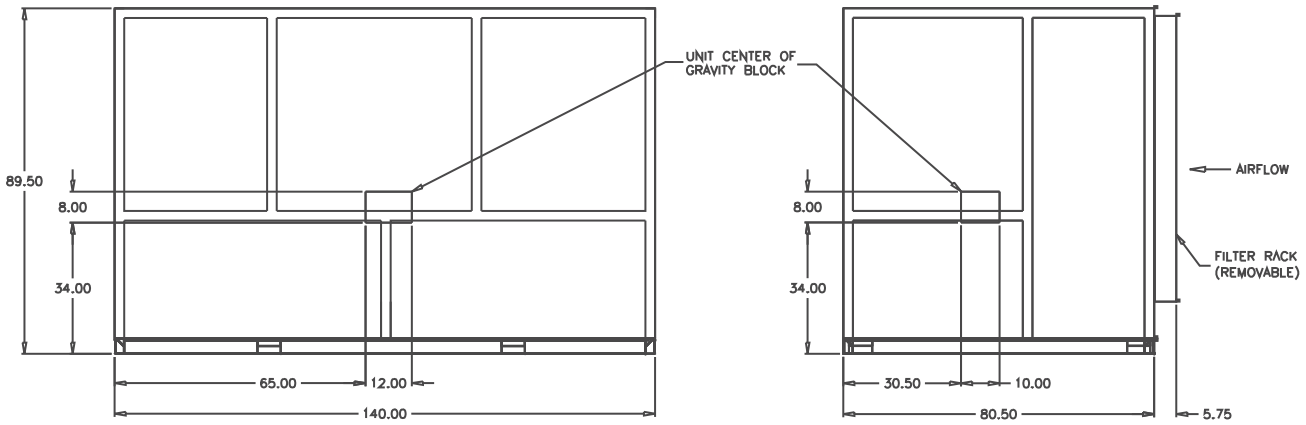


Figure 8. Gravity block location and dimensions for 90 to 110 ton units



Installation Preparation

Before installing the unit, perform the following procedures to confirm proper unit operation.

1. Position the unit and pallet in its final location.
2. Test lift the unit to determine exact unit balance and stability before hoisting it to the installation location. See "Unit Handling," p. 25 for proper rigging procedures and cautions.
3. Remove the protective shipping covers from the unit.

Unit Vibration Isolator Option

Important: *Vibration isolation is not necessary for the unit since the factory internally isolates the fan and compressor, thus creating double isolation. Trane strongly recommends consulting a vibration specialist when considering double isolation. Trane does not recommend double-isolation.*

Unit Isolator Installation Procedure

Use the following procedure to install isolators:

1. Position the isolators under the unit base referring to the isolator placement sheet that ships with the unit isolators. Lift one end of the unit at a time to position the isolators.
2. Shim as required to level the unit. It must be less than 1/8-inch per foot difference.

Note: *The unit is equipped with a positively sloped drain pan to help indoor air quality (IAQ) and does not require one corner of the unit to be pitched.*

Duct Connections

Return air enters the rear of the unit and conditioned supply air discharges through the top.

Notes:

- *Attach supply air ductwork directly to the unit top panel, around the fan discharge opening. A duct collar is not provided.*
- *Units equipped with flexible horizontal discharge plenum option may include a duct collar when holes are factory cut.*

Install all air ducts according to the National Fire Protection Association standards for the Installation of Air Conditioning and Ventilation Systems other than Residence Type (NFPA 90A) and Residence Type Warm Air Heating and Air Conditioning Systems (NFPA 90B).

Make duct connections to the unit with a flexible material such as heavy canvas. If a fire hazard exists, Trane recommends using Flexweave 1000, type FW30 or equivalent canvas. Use 3 inches for return duct and 3 inches for discharge duct. Keep material loose to absorb fan vibration.

- If using return ductwork to the unit, secure it with 3 inches of flexible duct connector.
- Extend discharge duct upward without change in size or direction for at least three fan diameters.
- Use 3-inch flexible duct connection on discharge ductwork.

Note: *Compressors and fan assembly are internally isolated. External isolation devices (spring mounting isolators) are at discretion of a vibration specialist consulted by building or HVAC system designer.*

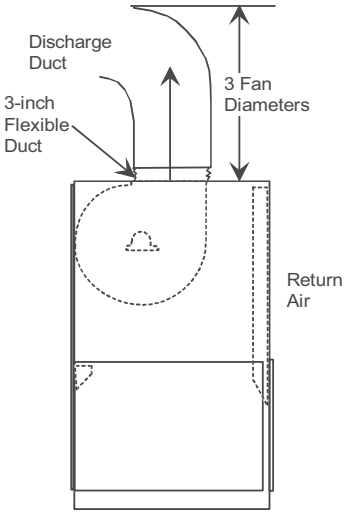
Run the ductwork straight from the opening for a minimum of three fan diameters. See Figure 9, p. 27. Extend remaining ductwork as far as possible without changing size or direction. Do not make abrupt turns or transitions near the unit due to increased noise and excessive static losses. Use elbows with splitters or turning vanes to minimize static losses.

Poorly constructed turning vanes may cause airflow generated noise. Align the fan outlet properly with the ductwork to decrease noise levels in the duct and to increase fan performance. To complete trunk ductwork to the VAV terminal units, refer to the VAV box manuals for

specific requirements. Check total external static pressures against fan characteristics to be sure the required airflow is available throughout the ductwork.

To achieve maximum acoustical performance, minimize the duct static pressure setpoint.

Figure 9. Duct connection recommendations



Water Piping

Condenser Connections

⚠ WARNING

High Pressure Water!

Failure to follow instructions below could result in death or serious injury, and equipment damage.

Provide relief valve on system water piping to prevent instantaneous release of high pressure water.

NOTICE

Proper Water Treatment Required!

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

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

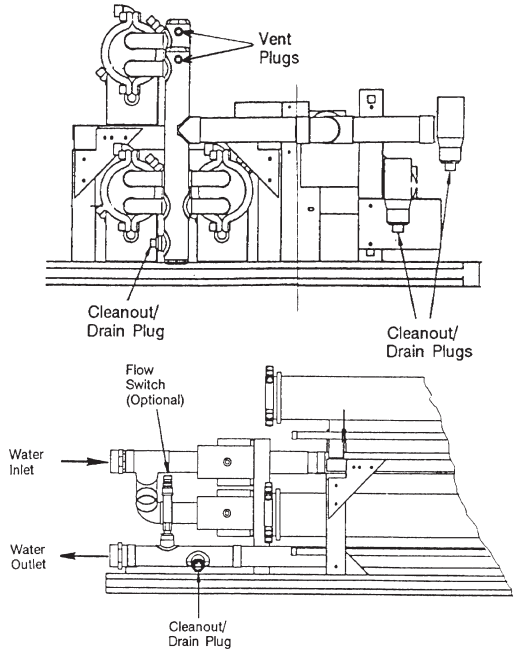
All field-installed piping must conform to applicable local, state, and federal codes. To complete condenser water connections follow the procedure below.

Note: *Four (4) condenser waterline drain plugs ship in a bag in the left end of the unit. The installer must field install these four plugs using pipe thread sealer. An additional plug is provided for units with a waterside economizer.*

1. Install the vent plugs in the economizer coil headers and condenser manifolds. See Figure 10, p. 27. These plugs ship in a bag with the condenser drain plugs.
2. Attach the water supply line to the inlet connection, and the return line to the outlet connection. Entering and leaving water connections for all condensers are factory manifolded and require only single connections for entering and leaving water. If the unit has a waterside economizer and/or control valves, the factory pipes between these components.
3. If using a cooling tower, refer to Figure 11, p. 28 for a typical piping circuit from the unit.
4. Confirm the water pressure to the unit does not exceed 150 psig.

Note: *To prevent water pump damage, design system piping to provide relief when using energy saving waterside economizer valves.*

Figure 10. Economizer coil vent and condenser cleanout/drain plugs



Condensate Drain Connections

Note: *Unit is not internally trapped. Installer will need to provide an external trap for unit to operate properly.*

Locate condensate drain on the unit. Connect condensate drain piping to the 1-1/4-inch NPT internal fitting, using at least 7/8-inch OD copper or 3/4-inch OD iron pipe. Pitch the condensate line downward a minimum of 1/2-inch for each 10–feet of horizontal run, away from the unit. Be sure to install the condensate drain p–trap drain plug. Before starting the unit, fill the trap with water to prevent negative pressure in the fan section from impeding condensate flow.

To facilitate drain pipe cleaning, install plugged tees in place of 90° elbows.

General Waterside Recommendations for Cooling Towers

Cooling tower control affects the unit cycle rates. Condenser water temperature swings from 10°F to15°F may cause excessive compressor, water valve, and unit cycling. Set the tower controls to minimize compressor/unit cycling.

Waterside Piping Arrangements

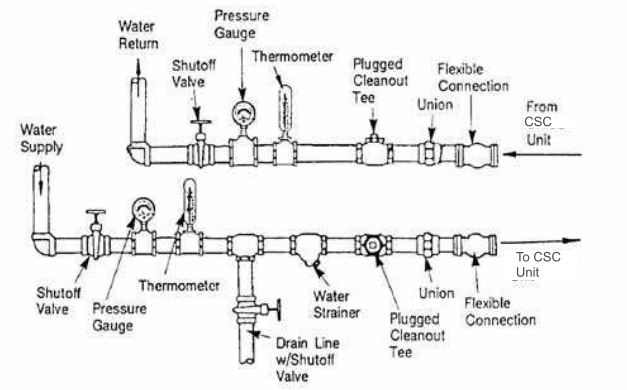
Install a condenser water pump between the cooling tower (either open or closed) and the self-contained unit. Lay out the remainder of the system condenser piping in reverse returns. This helps balance the system by equalizing the length of supply and return pipes. Multi-story buildings may use a direct return system with balancing valves at each floor.

Install the supply riser and its return in close proximity. Furnish both with permanent thermometers to check the waterside balance during start-up and routine maintenance checks.

Include strainers at each pump inlet and unit. Install drain valves at the riser base to allow drainage points for system flushing during start-up and routine maintenance. For condenser draining and header removal, include a shutoff/ balancing valve on the entering and leaving waterside pipes, drain tees, and unions of each unit.

Note: *Unit does not have floor drains.*

Figure 11. Condenser water piping components for cooling tower system



Water Temperature Requirements

Do not allow the entering water temperature to go below 54°F (12.2°C) on units with constant water flow (basic piping).This will cause the compressors to shutdown and the mechanical cooling function will lockout. The economizer (if enabled) will continue to function. The compressors will reset when the entering water temperature reaches 58°F (15°C).

Units with variable water flow (intermediate piping) have a modulating condensing pressure control valve that allows compressor operation down to entering water temperatures of 37°F (3°C).

Note: *Units with a waterside economizer can be set from the human interface panel for variable or constant water flow.*

Water Piping Verification

- Make return and supply water connections to the unit and/or waterside economizer piping package with recommended valves and piping components.
- Install unions to allow waterside maintenance.
- Install cooling tower and standby pumps.
- Treat water to prevent algae, slime, and corrosion.
- Prevent refrigerant piping from rubbing against other objects.

Installating the Hydronic Coil

Refrigerant System

Trane Water Cooled Commercial Self-Contained units ship factory charged with R-454B refrigerant.

Installation - Electrical

Unit Wiring Diagrams

Specific unit wiring diagrams are provided on the inside of the control panel door. Use these diagrams for connections or trouble analysis.

Supply Power Wiring

It is the responsibility of the installer to provide power supply wiring to the unit terminal block or the non-fused disconnect switch option. Wiring should conform to NEC and all applicable code requirements.

Bring the supply wiring through the top of the starter panel. The hole will be field cut at the electrician's discretion. Connect the three phase wires to the power terminal block or the non-fused disconnect switch in the control box terminals. Refer to specific wiring diagrams and fuse information in the control panel.

⚠ WARNING

Hazardous Service Procedures!

Failure to follow all precautions in this manual and on the tags, stickers, and labels could result in death or serious injury.

Technicians, in order to protect themselves from potential electrical, mechanical, and chemical hazards, MUST follow precautions in this manual and on the tags, stickers, and labels, as well as the following instructions: Unless specified otherwise, disconnect all electrical power including remote disconnect and discharge all energy storing devices such as capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. When necessary to work with live electrical components, have a qualified licensed electrician or other individual who has been trained in handling live electrical components perform these tasks.

NOTICE

Use Copper Conductors Only!

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

NOTICE

Motor Damage!

Correct phase sequence is critical. If phase sequence of the incoming line voltage is not correct, it could result in motor damage.

Voltage Range

Voltages must be within ±10% the nameplate voltage. Confirm the unit voltage is balanced by measuring at the compressor terminals. Voltage imbalance on three phase systems can cause motor overheating and premature failure. Maximum allowable imbalance is 2.0 percent.

Voltage Imbalance

Read the voltage at the compressor terminals to determine if it is balanced. Voltage imbalance on three phase systems can cause motor overheating and premature failure. The maximum allowable imbalance is 2.0 percent. Voltage imbalance is defined as 100 times the sum of the deviation of the three voltages from the average (without regard to sign) divided by the average voltage. For example, if the three measured voltages are 221, 230, and 227, the average voltage would be:

(221 + 230 + 227) / 3 = 226 volts

The percentage of voltage imbalance is then:
100 x (226 – 221) / 226 = 2.2%

Phase Monitor

Unit is equipped with a phase monitor in the control box. The phase monitor will protect against phase loss, imbalance and reversal of line voltage. If a fault occurs, the unit will be locked out until the phase is corrected.

Control Power

NOTICE

Component Damage!

Failure to follow instructions below could result in immediate or premature component failures.

Unit transformers are sized to provide power to the unit only. Do not use these transformers to supply power to field equipment.

In this example, 2.2 percent imbalance is not acceptable. When a voltage imbalance of more than 2.0 percent exists, check the voltage at the unit disconnect switch. If the imbalance at the unit disconnect switch does not exceed 2.0 percent, faulty unit wiring is causing the imbalance. Conduct a thorough inspection of the unit electrical wiring connections to locate the fault, and make any repairs necessary.

Access the connection terminal block through the control panel on the upper left side of the unit. All wiring should conform to NEC and applicable local code requirements.

Confirm all wiring connections are secure. Reference the unit specific diagrams inside the control panel.

Note: *Unit transformers IT1, IT3, IT4 and IT5 are sized to provide power to the unit only.*

Selection Procedures

- RLA = Rated Load Amps
- Compressor LRA = Locked Rotor Amps
- Fan Motor LRA = Locked Rotor Amps, N.E.C. Table 430 -150
- FLA = Full Load Amps, N.E.C. Table 430 -150
- Voltage utilization range is ±10%

Determine Minimum Circuit Ampacity (MCA)

MCA = 1.25 x largest motor amps/VFD amps (FLA or RLA) + the sum of the remaining motor amps.

Determine Max Fuse (MFS) and Max Circuit Breaker (MCB) Sizes

MFS and MCB = 2.25 x largest motor amps (FLA or RLA) + the sum of the remaining motor amps.

For units with the dual power option, there are two electrical circuits that need calculations using the previous formulas:

- Circuit #1 – fans
- Circuit #2 – compressors

If the rating value determined does not equal a standard current rating of over current protective device, use the next lower standard rating for the marked maximum rating.

Table 11. Electrical service sizing data — motors

Digit 9 - Unit Voltage	Digit 9	Tonnage	Comp 1	Comp 2	Comp 3	Comp 4	Fan FLA	Qty Fans	Misc	MCA	MOP
460/60/3	4	20	7.1	7.1	7.1	7.1	7.1	1.00	1.00	38	45
460/60/3	4	25	9.1	9.1	9.1	9.1	7.1	1.00	1.00	47	56
460/60/3	4	30	11.9	11.9	11.9	11.9	7.1	2.00	1.00	66	77
460/60/3	4	35	12.4	12.4	11.9	11.9	7.1	2.00	1.00	67	79
460/60/3	4	40	12.4	12.4	12.4	12.4	7.1	2.00	1.00	68	80
460/60/3	4	45	15.4	15.4	12.4	12.4	7.1	2.00	1.00	75	90
460/60/3	4	50	15.4	15.4	15.4	15.4	7.1	3.00	1.00	88	103
460/60/3	4	55	19.4	19.4	15.4	15.4	7.1	3.00	1.00	97	116
460/60/3	4	60	20.6	20.6	19.4	19.4	7.1	4.00	1.00	115	135
460/60/3	4	65	20.6	20.6	20.6	20.6	7.1	4.00	1.00	117	137
460/60/3	4	70	24.0	24.0	20.6	20.6	7.1	4.00	1.00	124	148
460/60/3	4	75	32.8	32.8	20.6	20.6	7.1	4.00	1.00	144	177
460/60/3	4	85	32.8	32.8	24.0	24.0	7.1	5.00	1.00	158	191
460/60/3	4	90	32.8	32.8	32.8	32.8	7.1	5.00	1.00	176	208
460/60/3	4	100	38.5	38.5	32.8	32.8	7.1	6.00	1.00	196	234
460/60/3	4	110	38.5	38.5	38.5	38.5	7.1	7.00	1.00	214	253
208-230/60/3	F	20	16.0	16.0	16.0	16.0	13.5	1.00	2.00	84	100
208-230/60/3	F	25	21.2	21.2	21.2	21.2	13.5	1.00	2.00	105	127
208-230/60/3	F	30	24.4	24.4	24.4	24.4	13.5	2.00	2.00	133	157
208-230/60/3	F	35	28.7	28.7	24.4	24.4	13.5	2.00	2.00	142	171
208-230/60/3	F	40	28.7	28.7	28.7	28.7	13.5	2.00	2.00	151	179
208-230/60/3	F	45	33.3	33.3	28.7	28.7	13.5	2.00	2.00	161	195
208-230/60/3	F	50	33.3	33.3	33.3	33.3	13.5	3.00	2.00	184	218
208-230/60/3	F	55	40.8	40.8	33.3	33.3	13.5	3.00	2.00	201	242
208-230/60/3	F	60	45.9	45.9	40.8	40.8	13.5	4.00	2.00	241	287
208-230/60/3	F	65	45.9	45.9	45.9	45.9	13.5	4.00	2.00	251	297
208-230/60/3	F	70	49.0	49.0	45.9	45.9	13.5	4.00	2.00	258	307
208-230/60/3	F	75	62.1	62.1	45.9	45.9	13.5	4.00	2.00	287	349
208-230/60/3	F	85	62.1	62.1	49.0	49.0	13.5	5.00	2.00	307	369
208-230/60/3	F	90	62.1	62.1	62.1	62.1	13.5	5.00	2.00	333	395

Table 11. Electrical service sizing data — motors (continued)

Digit 9 - Unit Voltage	Digit 9	Tonnage	Comp 1	Comp 2	Comp 3	Comp 4	Fan FLA	Qty Fans	Misc	MCA	MOP
208-230/60/3	F	100	83.1	83.1	62.1	62.1	13.5	6.00	2.00	394	477
208-230/60/3	F	110	83.1	83.1	83.1	83.1	13.5	7.00	2.00	450	533
575/60/3	5	20	6.4	6.4	6.4	6.4	5.7	1.00	0.75	34	40
575/60/3	5	25	7.7	7.7	7.7	7.7	5.7	1.00	0.75	39	47
575/60/3	5	30	9.4	9.4	9.4	9.4	5.7	2.00	0.75	52	61
575/60/3	5	35	9.0	9.0	9.4	9.4	5.7	2.00	0.75	51	60
575/60/3	5	40	9.0	9.0	9.0	9.0	5.7	2.00	0.75	50	59
575/60/3	5	45	12.9	12.9	9.0	9.0	5.7	2.00	0.75	59	72
575/60/3	5	50	12.9	12.9	12.9	12.9	5.7	3.00	0.75	73	86
575/60/3	5	55	13.7	13.7	12.9	12.9	5.7	3.00	0.75	75	88
575/60/3	5	60	14.5	14.5	13.7	13.7	5.7	4.00	0.75	84	98
575/60/3	5	65	14.5	14.5	14.5	14.5	5.7	4.00	0.75	85	100
575/60/3	5	70	19.2	19.2	14.5	14.5	5.7	4.00	0.75	96	115
575/60/3	5	75	24.0	24.0	14.5	14.5	5.7	4.00	0.75	107	131
575/60/3	5	85	24.0	24.0	19.2	19.2	5.7	5.00	0.75	122	146
575/60/3	5	90	24.0	24.0	24.0	24.0	5.7	5.00	0.75	131	155
575/60/3	5	100	27.1	27.1	24.0	24.0	5.7	6.00	0.75	144	171
575/60/3	5	110	27.1	27.1	27.1	27.1	5.7	7.00	0.75	156	183

Notes:

1. MCA: Minimum Circuit Ampacity is 125 percent of the largest compressor RLA or Drive input current, plus 100 percent of the other compressor (s) RLA, plus the sum of the condenser fan RLA, plus any other load rated at 1 AMP or more.
2. Maximum Breaker Overcurrent Protection (MOP): 225 percent of the largest compressor RLA or VSD drive Input, plus 100% of the other compressor(s) RLA, plus the sum of the condenser fan Motor/Drive FLA, plus any other load rated at 1 AMP or more.
3. Recommended disconnect switch: 110 percent to 115 percent of the sum of the RLA of the compressors, VSD drive input, fan motor/drive, and controls FLA.
4. RLA: Rated in accordance with UL standard 1995.
5. Local codes may take precedence.
6. Fix speed compressor are across the line starting, the VSD compressors are controlled by VSD drive. Compressors will never start simultaneously.
7. Voltage utilization range is ±10 percent.

Static Pressure Transducer Installation (VAV Units Only)

Supply air static pressure controls the ECM fans. A static pressure bulkhead connector ships separate in control panel for field installation in the supply air duct work. Installer is responsible for providing pneumatic tubing.

Transducer Inlet Location

Place bulkhead connector in an area of ductwork that will provide an average and evenly distributed airflow pattern. Use the following guidelines to determine an appropriate installation location.

1. Locate static bulkhead connector approximately 2/3 to 3/4 the way down longest duct run, in an area approximately 10 duct diameters downstream and 2 duct diameters upstream of major interferences, turns, or changes in duct diameter.
2. When installing pneumatic tubing between head assembly and transducer in control panel, do not exceed 250 feet for 1/4-inch OD tubing or 500 feet for 3/8-inch OD tubing.

Installing the Transducer

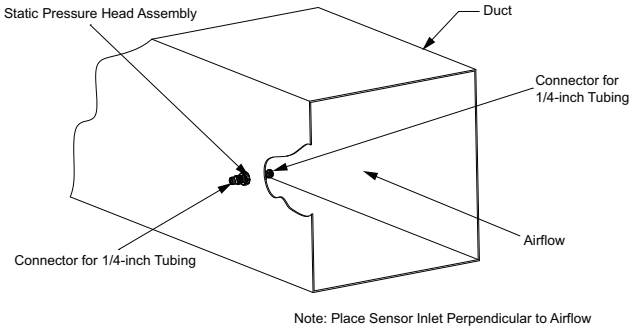
Use the following procedure to properly install the static pressure transducer:

1. Connect the pneumatic tubing from the sensing head to the push-on tubing connection in the control panel. Use a plastic static pickup tubing. Do not exceed 250 feet for 1/4-inch OD tubing or 500 feet for 3/8-inch OD tubing.

Transducer inside control panel picks up low side or reference pressure.

Note: *If plastic tubing pulls away from a connection, trim it back before replacing it on the fitting. Stretched tubing may leak and cause faulty control.*

Figure 12. Static pressure sensor installation



Zone Sensor Option used for Discharge Air Reset by Space Temperature

Zone Temperature Sensor, BAYSENS077 (Optional Item)

Figure 13. Zone temperature sensor

This zone sensor includes an internal thermistor and should be mounted in the zone, Model Number Digit 31=1. This sensor is available for use with all zone sensor options to provide remote sensing capabilities.

Zone Sensor Installation

⚠ WARNING

Hazardous Voltage w/Capacitors!

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

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

NOTICE

Use Copper Conductors Only!

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

Note: *For additional information regarding the safe discharge of capacitors, see Discharging Capacitors in HVAC Systems Service Bulletin (PROD-SVB06*-EN).*

All sensor options ship in the main control panel and are field installed. Programmable option installation procedures.

Mounting Location

Mount the sensor on the wall in an area with good air circulation at an average temperature. Avoid mounting space temperature sensor is areas subject to the following conditions:

- Drafts or dead spots behind doors or in corners
- Hot or cold air from ducts
- Radiant heat from the sun or appliances
- Concealed pipes and chimneys
- Unheated or non-cooled surfaces behind the sensor, such as outside walls
- Airflows from adjacent zones or other units

To mount the sensors, remove the dust cover and mount the base on a flat surface or 2-inch x 4-inch junction box. Sensors ship with mounting screws.

Mounting the Subbase

Remove the zone sensor cover from subbase, and mount subbase on the wall or on a 2-inch x 4-inch junction box. Route wires through the wire access hole in the subbase. See Figure 14, p. 33. Seal the hole in the wall behind the subbase.

Notes:

- *Guidelines for wire sizes and lengths are shown in Table 12, p. 33. The total resistance of these low voltage wires must not exceed 2.5 ohms per conductor. Any resistance greater than 2.5 ohms may cause the control to malfunction due to excessive voltage drop.*
- *Do not run low-voltage control wiring in same conduit with high-voltage power wiring.*

Wiring

1. Run wires between the unit control panel and the zone sensor subbase. To determine the number of wires required, refer to the unit wiring diagrams.
2. Connect the wiring to the appropriate terminals at the unit control panel and at the zone sensor subbase. In general, zone sensor connections to the unit use the

convention of connecting zone sensor terminals to like numbered unit terminals (1 to 1, 2 to 2).The connection detail is shown on the unit wiring diagrams located in the unit control panel.

3. Replace the zone sensor cover back on the subbase and snap securely into place.

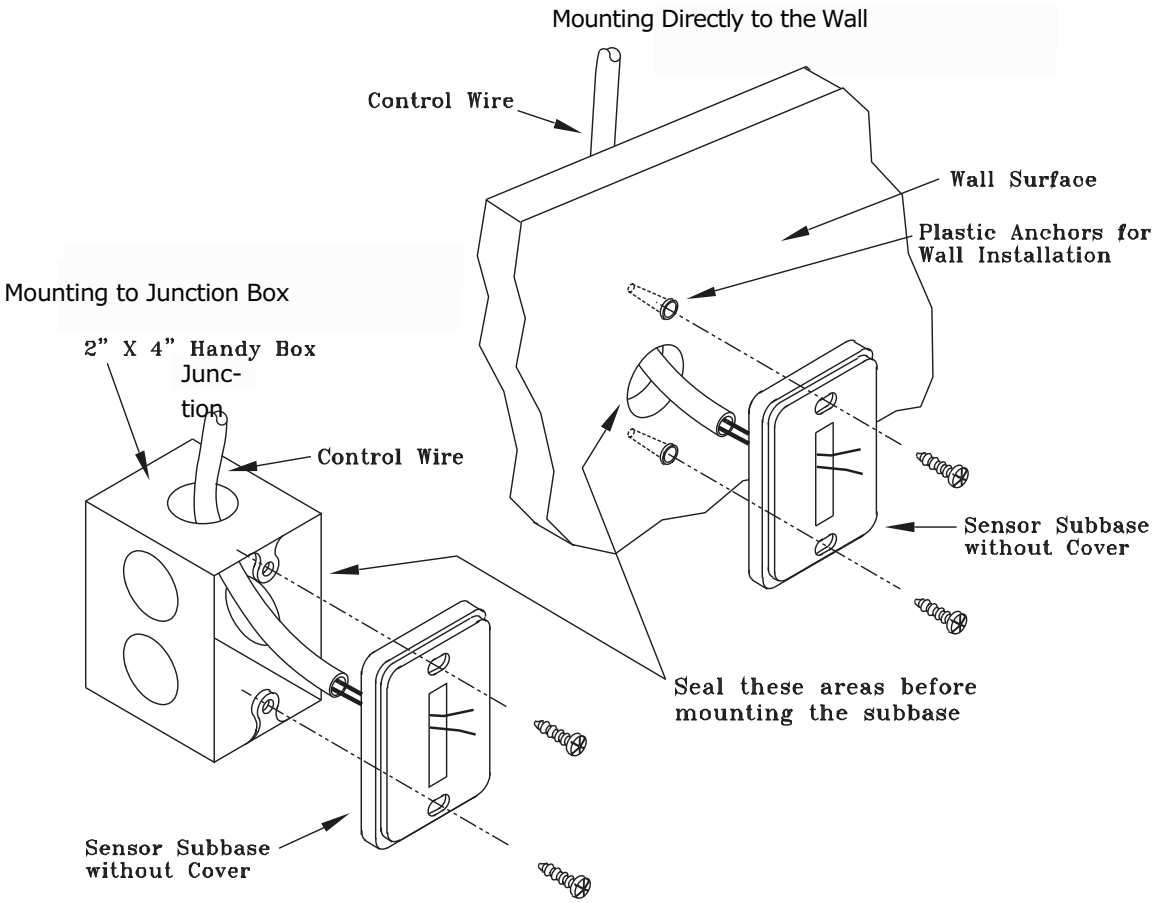
Standard Remote Sensor (BAYSENS077)

When using the remote sensor, BAYSENS077, mount it in the space that is to be controlled. Wire according to the interconnecting wiring diagrams on the unit.

Table 12. Zone sensor maximum lengths and wire size

Distance from Unit to Controller	Recommended Wiring Size
0-150 feet	22 gauge
151-240 feet	20 gauge
241-385 feet	18 gauge
386-610 feet	16 gauge
611-970 feet	14 gauge

Figure 14. Typical zone sensor installation



Control Sequences of Operation

General Support Sequences

Occupied/Unoccupied Switching

There are many sources and types of occupancy. These have an effect on the operation of the unit. All sources are arbitrated (prioritized) into a final occupancy status. Only one method can be used.

Sources of occupancy:

- Occupancy Request is a communicated value from a Building Automation System (BAS) schedule.
- Occupancy Input is locally wired to the Symbio™ 500 which uses a closed contact for Occupied and an open contact for Unoccupied. Use the field terminal block (2TB3) to land the dry contact to the unit.
- Using the Symbio 500 UI a schedule can be created to control unit occupancy locally. This should only be done when there is no BAS front-end, or the occupancy input is not used. The user would create a Multistate Schedule and place the Occupancy Request multistate value in the schedule.

Occupied Status Definition

- **Occupied Operation**: The unit is running in a normal mode providing temperature and ventilation control to the normal occupied setpoints and comfort demands of the occupants.
- **Unoccupied Operation**: The unit is typically shut down and is not providing temperature control to the normal occupied setpoints. No ventilation is required or provided. Temperature control is determined by energy conservation and building protection thresholds.
- **Occupied Bypass Operation**: The unit is temporarily in an Occupied state for some period of time and will automatically return to unoccupied operation when the bypass timer expires. The Occupied Bypass Timer is a user-adjustable field. However, setting the timer to 0 minutes effectively disables Timed Override at the equipment controller.
- **Occupied Standby Operation**: Standby does not apply to a discharge air controller. These units treat Standby as Occupied. Space temperature control units in an Occupied-Standby state are controlling to occupied standby temperature setpoints. Normal operation will resume when Occupancy Status goes to an Occupied state.

Power-Up Start Delay

Anytime power is applied to the unit or the controller is reset, and the unit is able to run, an internal Power-Up Start Delay of 75 seconds is enforced to allow all sensors and timers to get to their starting states.

Normal Unit Starting

When Front Panel Auto Stop, Stop modes, overrides, and diagnostic shutdowns are removed, the controller will start unit operation. The supply fan starts and increases to the minimum Hz setting and must prove On. Unit mode fan only is displayed on the user interface. The supply fan will run for 5 minutes before transitioning into an active heat or cool mode.

External Auto/Stop Input

A normally closed (N.C.) switch wired to the customer connection (2TB3) may be used to shut down all unit operations. When opened, a controlled shutdown will occur on the unit and an Auto reset alarm will be generated. The switch must be rated for 12 ma @ 24 VDC minimum.

Front Panel Auto Stop

The Front Panel Auto Stop binary value is located in the upper left-hand corner of the TD7 display when on the home screen. Place it into Auto to run the unit normally or Stop to shut the unit down in a controlled manner.

Supply Fan Support Sequences

Multiple identical fans are arranged in the fan cabinet to meet the customer airflow and static requirements. Each fan assembly has its own motor with an electronically commutated motor (ECM). The fan speed, start/stop command, and fault status are controlled and monitored individually by the unit controller.

Occupied Fan Operation (VAV Units Only)

When the unit is occupied and no alarms are present that prohibit the fan(s) to run, all fans that are available will start up and operate at 30% speed for 45 seconds. The fans will then modulate to maintain the Duct Static Pressure at the Duct Static Pressure Setpoint. The fans are commanded off during the unoccupied mode.

Supply Air Static Pressure High Limit (VAV Units Only)

During normal operation, the Supply Air Static is monitored. If at any time the static pressure exceeds the software high static limit (defaulted at 2.0 inches from the factory) the unit will immediately shut down and generate a diagnostic.

For the unit to resume operation, the Alarm Reset must be toggled from the TD7. The software high static limit can be user adjusted at the TD7.

Occupied Fan Operation (CV Units Only)

When the unit is occupied and no alarms are present that prohibit the fan(s) to run, all fans that are available will start up and operate at 30% speed for 45 seconds. The fans will

then maintain the fan speed at the fan speed setpoint. The fans are commanded off during the unoccupied mode.

Harmonic Offset

The fan wall at certain frequencies may produce a harmonic which can produce a noise. A Harmonic offset is included in the setpoint menu on the TD7. From the factory this is set to -2%, which will run the even numbered fans 2% less than the odd number fans to avoid this harmonic from developing. This value is adjustable in the TD7 in the event that -2% is not enough based on the final installation of the unit

Temperature Control Support Sequences

Heat/Cool Mode (VAV Units Only)

The unit is in Cooling mode by default. The front-end Building Automation System (BAS) will switch the Heat/Cool Mode request multistate value between the Heating and Cooling modes to get the desired control.

Heat/Cool Mode (CV Units Only)

The unit will automatically switch between Heat and Cool mode based on the conditions of the space temperature. If the space temperature is above the Occupied Cooling Setpoint the unit will transition to cooling mode. If the space temperature is below the Occupied Heating Setpoint the unit will transition to heating mode.

Discharge Air Temperature Control

After the startup delay has completed, indicating the fans have status and the unit is ready to enter normal operations, the unit controller will begin to control the discharge air temperature at its setpoint. This is accomplished by staging the DX compressors and Water side economizer in the Cool mode and the heating source in Heat mode.

Discharge Air Fixed Setpoint (VAV Units Only)

When the units is ordered with the Fixed Setpoint option, the controller will maintain the fixed discharge air setpoint. This setpoint can be adjusted in the TD7 under the setpoints section.

Discharge Air Reset Return Air Temperature (VAV Units Only)

When the unit is ordered with the Return Air Reset option the unit will calculate the discharge air setpoint based on the return air temperature compared against the return air setpoint. The return air setpoint is adjusted in the TD7 under the setpoints section. This option is also available when the unit is ordered as a Fixed Setpoint unit and can be changed in the TD7 under the unit setup menu.

Discharge Air Reset Space Temperature (VAV and CV Units Only)

When the unit is ordered with the Space Temperature Reset option the unit will calculate the discharge air setpoint based on the space temperature compared against the space temperature setpoint. The space temperature setpoint is adjusted in the TD7 under the setpoints section This option requires either a hardwired space temperature sensor to the customer terminal strip (1TB3) or a BACnet® communicated value to the Space Temperature BAS analog value. The unit can also be configured as a fixed setpoint discharge air control in the setup menu.

Cooling/Waterside Economizer

During occupied cooling mode, the waterside economizer option and mechanical cooling are used to control the supply air temperature. The supply air temperature setpoint is user defined at the human interface panel.

After the fans run for 5 minutes, and a call for cooling is calculated, the Cooling Tower/Pump Command is turned on. After the Condenser Water flow switch closes proving flow, the compressors and/or economizer will be allowed to start.

Waterside economizing enables when the unit's entering water temperature is less than the entering mixed air temperature. This is set at Waterside Economizer Enable Offset setpoint. The factory default is 7°F, but can be adjusted by the user at the TD7 or via BACnet®.

The economizer acts as the first stage of cooling. If the economizer is unable to maintain the supply air setpoint, the compressor module will bring on the compressors as required to meet the setpoint. If the unit does not include an economizer, only mechanical cooling will satisfy cooling requirements.

Compressor Control Support Sequences

NOTICE

Compressor Damage!

Do not operate with water loops with less than five minutes circulation time as it could result in poor superheat control and compressor damage.

The MSC uses a combination of one variable speed compressor (VS) and one, two, or three fixed speed compressors (FS), and a tandem set of two compressors for mechanical cooling. The VS compressor is always the first compressor on and last compressor off, except in the event of a VS Compressor or Circuit lockout. A balanced starts routine is used by the Unit Controller when starting FS compressors.

High Pressure Cutout Switch (HPC)

Each VS and FS compressor has an HPC installed in its discharge line. The switch is set to open at 553 psi +/- 15 and re-close at 424 +/-30.

Important: *The HPC is wired into each compressors Enable circuit, and the VS and FS compressor enable circuit are unique. The FS compressor enable circuit uses 24 Vac power sourced from the Control Power Transformer, where the VS compressor enable circuit uses 24 Vdc power sourced from the VS compressor drive. Inadvertently applying 24 Vac to the VS drive terminal block will permanently damage the drive.*

On the fixed speed compressors, if an HPC opens, the 24 Vac power that energizes the compressor start contactor is interrupted and the compressor will turn off. The Unit Controller will detect this and lock the circuit out on a High-Pressure Cutout.

On the variable speed compressor, a 24 Vdc signal originates from terminal number 14 on the 1U1 and is routed through the NC contact of the VS compressor HPC. That signals return must be sensed on terminal #3 of the 1U1. If that signal is lost due to an HPC or Emergency Stop input, the compressor will immediately shut down. The Unit Controller will detect HPC trip and lock the circuit out on a High-Pressure Cutout.

Compressor Input/Output Module

Each compressor has a dedicated XM30 input/output module that communicates digitally with the Unit Controller (XM30.8, 9, 10, and 11 for compressors A, B, C, and D, respectively). The XM30 module is used to sense its respective suction and discharge pressure sensor, suction temperature sensor, and control the condenser water regulating valve via a 0-10 Vdc output.

Compressor Pressure Sensors

Each compressor has its own set of suction and discharge pressure sensors. The sensors are powered by the 5 Vdc power supply 2U1. Their range is 0-600 psig and their voltage output is linearly proportional to the sensed pressure.

The discharge pressure sensor is used by the Unit Controller to do the following:

- Control the optional WRV (if equipped)
- Compute compressor differential pressure
- Warn the user if a high discharge pressure condition occurs
- Activate the VS compressor Limit Condition control function

The suction pressure sensor is used by the Unit Controller to do the following:

- Detect low suction pressures
- Compute compressor suction superheat
- Compute compressor differential pressure
- Activate the VS compressor Limit Condition control function

Compressor Suction Temperature

Each compressor has its own suction temperature thermistor. It is used to compute compressor suction superheat. If superheat is less than 4 degrees for 5 minutes, or more than 25 degrees for 10 minutes, the circuit is locked out on a fault and a diagnostic is annunciated.

Fixed Speed Compressor (FS)

Each FS compressor has two 24 Vac, 30W crankcase heaters. The power for these heaters is routed through a NC auxiliary contact on it's respective start contactor. This way the heater is energized whenever the compressor is Off.

In each FS compressor motor junction box is a 24 Vac powered CoreSense™ compressor protection module (MCSP). This module displays compressor status and diagnostics and provides the following protections:

- Motor temperature protection
- Missing phase protection
- Reverse phase protection
- Low control circuit voltage protection
- Short cycling detection and alert

If the CoreSense module detects a fault condition it opens a dry contact on the module interrupting power to that compressors run contactor coil. The power interruption is detected by the Unit Controller, which disables the compressor and annunciates a Compressor Safety Circuit diagnostic. After the cause of the fault is remedied, a

latching fault can be cleared by cycling 24 Vac module power.

Compressor Safety Circuit

Each fixed speed compressor has a Compressor Safety Circuit intended to protect the circuit from a variety of fault conditions and to distinguish those failures from HPC trips.

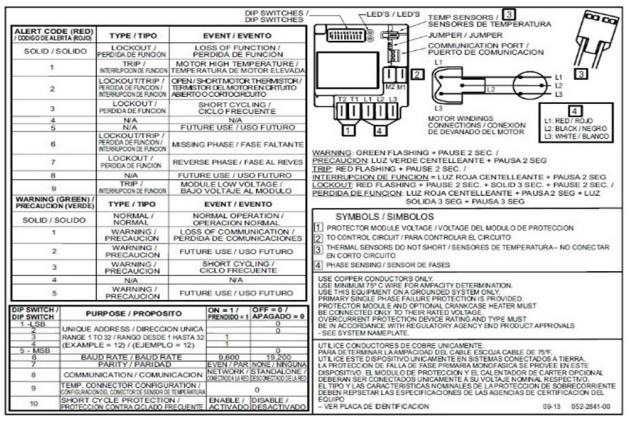
For each FS compressor, 24 Vac power is routed in order from the control power transformer (CPT) through its respective:

1. HPC
2. Phase Monitor dry contact
3. Delayed 'ON' timer relay
4. MCSP dry contact
5. Circuit breaker auxiliary-1CB1, 1CB2, or 1CB3
6. Start/Stop NO contact on the XM32 binary output module
7. Compressor start contactor coil-1K1, 1K2 or 1K3
8. From the compressor start contactor coil, the same 24 Vac signal is routed through the contactor NO auxiliary to an isolating relay-2K2, 2K4 or 2K8

If any of these devices contacts should open, 24 Vac is interrupted from the compressor start contactor and the compressor will shut off.

The Unit Controller can distinguish between an HPC switch opening and any of the other devices in the circuit opening. It will annunciate either High Pressure Cutout Compressor X or Compressor Safety Circuit X.

Figure 15. Fixed speed compressor protection module (MCSP)



ALERT CODE (RED) / CODIGO DE ALERTA (ROJO)	TYPE / TIPO	EVENT / EVENTO
SOLID / SOLIDO	LOCKOUT / PERDIDA DE FUNCION	LOSS OF FUNCTION / PERDIDA DE FUNCION
1	TRIP / INTERRUPCION DE FUNCION	MOTOR HIGH TEMPERATURE / TEMPERATURA DE MOTOR ELEVADA
2	LOCKOUT/TRIP / PERDIDA DE FUNCION / INTERRUPCION DE FUNCION	OPEN/SHORT MOTOR THERMISTOR / TERMISTOR DEL MOTOR EN CIRTUITO ABIERTO O CORTOCIRCUITO
3	LOCKOUT / PERDIDA DE FUNCION	SHORT CYCLING / CICLO FRECUENTE
4	N/A	N/A
5	N/A	FUTURE USE / USO FUTURO
6	LOCKOUT/TRIP / PERDIDA DE FUNCION / INTERRUPCION DE FUNCION	MISSING PHASE / FASE FALTANTE
7	LOCKOUT / PERDIDA DE FUNCION	REVERSE PHASE / FASE AL REVES
8	N/A	FUTURE USE / USO FUTURO
9	TRIP / INTERRUPCION DE FUNCION	MODULE LOW VOLTAGE / BAJO VOLTAJE AL MODULO
WARNING (GREEN) / PRECAUCION (VERDE)	**TYPE / TIPO**	**EVENT / EVENTO**
SOLID / SOLIDO	NORMAL / NORMAL	NORMAL OPERATION / OPERACION NORMAL
1	WARNING / PRECAUCION	LOSS OF COMMUNICATION / PERDIDA DE COMUNICACIONES
2	WARNING / PRECAUCION	FUTURE USE / USO FUTURO
3	WARNING / PRECAUCION	SHORT CYCLING / CICLO FRECUENTE
4	N/A	N/A
5	WARNING / PRECAUCION	FUTURE USE / USO FUTURO

DIP SWITCH / DIP SWITCH	PURPOSE / PROPOSITO		ON = 1 / PRENDIDO = 1	OFF = 0 / APAGADO = 0
1 - LSB	UNIQUE ADDRESS / DIRECCION UNICA			0
2	RANGE 1 TO 32 / RANGO DESDE 1 HASTA 32		1	0
3	(EXAMPLE = 12) / (EJEMPLO = 12)		1	0
4 - MSB			1	0
5	BAUD RATE / BAUD RATE		9,600	19,200
6	PARITY / PARIDAD		EVEN / PAR	NONE / NINGUNA
7	COMMUNICATION / COMUNICACION		NETWORK / STANDALONE / DIRECCION LAN / DESCONECTADO (LAN)	
8	TEMP. CONNECTOR CONFIGURATION / CONFIGURACION DEL CONECTOR DE SENSOR DE TEMPERATURA		0	
9				
10	SHORT CYCLE PROTECTION / PROTECCION CONTRA CICLADO FRECUENTE		ENABLE / ACTIVADO	DISABLE / DESACTIVADO

Variable Speed Compressor (VS)

The VS compressor does not have an external crankcase heater (like FS compressors). Instead, whenever the VS compressor is off, a voltage is applied to the compressor motor stator such that the compressor does not rotate but heats the oil. The power for these heaters is routed through a N.C. auxiliary contact on its start contactor.

The VS drive, 1U1, has its own software to control and protect the VS compressor.

The drive receives the following signals from the Unit Controller:

- Controlled Start/Stop
- Speed signal
- Drive Reset
- Stator Heat Enable
- Emergency stop

Note: *The 24 Vdc voltage used in each of the circuits above (except the speed signal) originate from the VS drive.*

The drive provides the following signals to the Unit Controller:

- Compressor On status
- Drive Fault status

Upon a call for mechanical cooling, the Unit Controller issues the command to start the compressor via a dry contact closure on XM32.3. The compressor then runs at the requested speed commanded by the unit controller. The compressor then runs at whatever speed commanded by the Unit Controller. Similarly, when the 1U1 drive receives a Controlled Stop signal it runs the compressor off.

The VS compressor HPC is wired in series with the 1U1 E-stop circuit. A VS compressor HPC event or upon a Unit Controller remote Emergency Stop input will immediately stop the VS compressor and lockout its operation on a manually resettable diagnostic.

Compressor Limit Conditions

Because the MSC uses suction and discharge pressure sensors rather than limit switches, the Unit Controller can sense when a refrigerant circuit is approaching a high- or low-pressure limit condition.

Low Pressure Limit conditions can be caused by the following:

- Low discharge air temperature
- Low airflow
- Dirty air filters
- Malfunctioning expansion valve
- Low refrigerant charge
- Faulty suction pressure sensor

High Pressure Limit conditions can be caused by the following:

- Low condenser water flow
- High entering condenser water temperature
- Fouled entering condenser water strainer
- Malfunctioning expansion valve
- Refrigerant over charge

- Water regulating valve (WRV) malfunction
- Faulty discharge pressure sensor

The Unit Controller's TD7 will annunciate a Limit Condition if an FS compressor circuit enters one. If the unit is equipped with WRV, the Unit Controller can open the valve to allow more flow through the condenser to help mitigate HPC trip.

If the VS circuit enters either a high- or low-pressure limit condition the Unit Controller can reduce compressor speed to help mitigate either a Low or High pressure diagnostic trip.

Compressor Staging

Fixed speed compressors cycle and the variable speed compressor loads/unloads to maintain the operating state required by the temperature controls. In the event of a compressor failure, the next available compressor turns on. During normal conditions, compressors will not turn on until they have been off for at least three minutes. Normal operating conditions are established on an individual compressor basis. When a compressor starts, its timer also starts.

Compressor Lead/Lag

Compressor lead/lag is present in the controls for all units with two or more fixed speed compressors. Only Compressors 2 and 3 rotate. Balanced run hours is achieved by changing the fixed speed compressors sequence number when commanded to rotate.

Variable speed compressor A is always the first stage on and last stage to turn off for mechanical cooling.

The Tandem compressor (6A and 6B) have an independent lead/lag rotation to ensure balanced run hours are achieved by changing the fixed speed compressors sequence number when commanded to rotate

Thermostatic Expansion Valve

Refrigerant system reliability and performance is heavily dependent upon proper superheat. The importance of maintaining the proper superheat cannot be overemphasized. Accurate measurements of superheat will provide the following information:

- How well the expansion valve is controlling the refrigerant flow
- The efficiency of the evaporator coil
- The amount of protection the compressor is receiving against flooding

The expected range for superheat is 11-15°F at full load conditions. At part load, expect a properly adjusted expansion valve to control to 8-12°F superheat.

Note: *Expansion valves are mid seated from the manufacturer and may require adjustment to properly balance superheat.*

Systems operating with lower superheat could cause serious compressor damage due to refrigerant flood-back.

Airside Components Support Sequences

Two-Position Damper Interface

Units with two-position damper ventilation interface are equipped with the necessary control sequences to allow opening of a two-position outdoor air damper to deliver ventilation air to the return air stream of the unit. When the unit is in the occupied mode and the supply fans are running, a binary output will turn on sending 24 Vac to the two-position damper to allow ventilation air into the unit.

Airside Economizer Interface with OA Reference

Units with airside economizer interface are equipped with the necessary control sequences to allow using outside air for the first stage of cooling, in occupied or unoccupied mode and when ambient conditions are favorable for economizing. Inherent in the unit controller is the ability to suppress the setpoint below the normal unit setpoint. This allows the building to improve comfort levels when possible, and at the same time, optimize building mechanical cooling operation for peak operating efficiency. An outside air temperature and relative humidity sensor are field sourced and installed.

Economizer operation enables when the outside air enthalpy is less than 25 BTU’s/lb. (adjustable 19 to 28 BTU’s/lb). During occupied mode, the outside air damper opens to 15 percent (adjustable 0 to 50%) for ventilation purposes. An analog 2 to 10 Vdc output is provided to modulate the field-provided and installed damper actuators.

Airside Economizer Interface with Comparative Enthalpy

Units with airside economizer interface and comparative enthalpy are equipped with the necessary control sequences to allow using outside air for the first stage of cooling, in occupied or unoccupied mode and when ambient conditions are favorable for economizing. Inherent in the unit controller is the ability to suppress the setpoint below the normal unit setpoint. This allows the building to improve comfort levels when possible, and at the same time, optimize building mechanical cooling operation for peak operating efficiency. Outdoor and Return Air temperature and relative humidity sensors are field sourced and installed. Economizer operation enables when the outside air enthalpy is 3 BTU’s/lb. less than the return air enthalpy. During occupied mode, the outside air damper opens to 15 percent (adjustable 0 to 100%) for ventilation purposes. An analog 2 to 10 Vdc output is provided to modulate the field provided and installed damper actuators.

Waterside Components Support Sequences

NOTICE

Proper Water Treatment Required!

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

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

Waterside components consist of water piping, water cooled condensers with optional water valves, water flow switch, water, and the economizer option.

Water Piping Options

Water piping is factory-installed with left-hand (standard) and right hand (optional) connections on units. Units with water regulating valves can be set to variable or constant flow. Units can be equipped with regulating valves without a waterside economizer. Also, units with waterside economizers can be set for either variable or constant water flow at the HI. See Figure 16, p. 39 for detailed piping configuration information.

With compatible piping configurations, the unit can be configured to provide:

- Constant water flow with basic or intermediate piping
- Variable water flow (head pressure control)

Constant water flow is for condenser pumping systems that are not capable of unloading the water-pumping system.

Variable water flow maximizes energy saving by unloading the water pumping system.

Basic Water Piping

This option is available on units without a waterside economizer and with condenser water applications above 54°F (12.2°C) that do not require condensing pressure control. Left hand water connections and piping are extended to the unit exterior. Manifold piping is factory installed.

Water Regulating Valve (WRV) (Optional)

If equipped, each compressor (Fixed or VS) uses a 24 Vac powered water regulating ball valve to control flow through the condenser. The Symbio™ 500 controller modulates the condenser flow to limit discharge pressure, help prevent high pressure cutout trips, and maintain a compressor minimum differential pressure.
The valve can also be used for condenser system chemical purge and condenser cooling loop system balance.

Water Flow Switch

A water flow switch is required to be installed in the condenser water pipe within the unit. It can be supplied from the factory as an option or it can be field-provided. When the flow switch detects a water flow loss prior to or during mechanical cooling, compressor operation locks out and a diagnostic code displays. If water flow is restored, the compressor operation automatically restores.

Note: *Water flow switches are not factory installed. If purchased with the unit the flow switch is a ship along component.*

Water Purge

This user-definable feature allows the user to select a purge schedule to automatically circulate water through the economizer and condensers periodically during non-operational times. This allows fresh chemicals to circulate in waterside heat exchangers.

Water Flow Control

With compatible piping configurations, the unit can be configured to provide variable water flow with the water regulating valve option only, which maximizes energy saving by unloading the water pumping system.

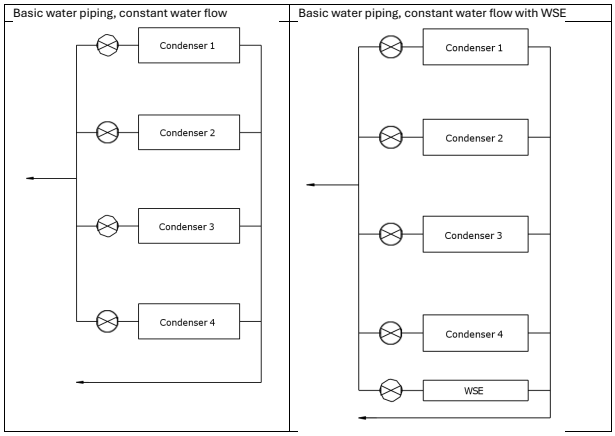
Waterside Economizer Option

The waterside economizer option takes advantage of cooling tower water to either pre-cool the entering air to aid the mechanical cooling process or, if the water temperature is low enough, provide total system cooling.

The waterside economizer includes a coil, modulating valves, controls, and piping. The coil construction is ½-inch (13 mm) OD seamless copper tubes expanded into aluminum fins. The evaporator and economizer coils share a common sloped (IAQ) drain pan. Drain pan options are either galvanized or stainless steel, and insulated.

The tubes are arranged in a staggered pattern to maximize heat transfer. The coil has round copper supply and return headers with removable clean-out and vent plugs.

Figure 16. Basic water piping, constant water flow



Unit Protection Support Sequences

Emergency Stop Input

A normally closed (N.C.) switch wired to the customer connection (2TB3) may be used during emergency situations to shut down all unit operations. When opened, an immediate shutdown occurs. An emergency stop diagnostic is entered into the user interface. The switch must be rated for 12 ma @ 24 VDC minimum.

Discharge Air High Temp Alarm (Software)

When the Discharge Air Temperature is above the Discharge Air High Temperature Cutout setpoint of 100 degrees for 5 minutes, the unit will perform a controlled shutdown. A Manual Reset alarm will be generated and need to be cleared before the unit can resume operating.

Discharge Air Low Temperature Alarm (Software)

When the Discharge Air Temperature is below the Discharge Air Temperature Cutout for 5 minutes, the unit will perform a controlled shutdown. A Manual Reset alarm will be generated and need to be cleared before the unit can resume operation.

Discharge Air Temperature Source Failure

When the Discharge Air Temperature is below the Discharge Air Temperature Cutout for 5 minutes, the unit will perform a controlled shutdown. A Manual Reset alarm will be generated and need to be cleared before the unit can resume operation.

Condenser Water Low Temperature Alarm (Software)

When either the entering or leaving condenser water temperature is below the Condenser Water Low Temperature cutout setpoint of 35 degrees for 5 minutes, the unit will perform a controlled shutdown. All Condenser water valves will be commanded open if installed, and a manual reset diagnostic will be generated and need to be cleared before the unit can resume operation.

Phase Monitor

Every unit includes a phase monitor. When a phase reversal is detected, the normally closed contacts will open, shutting down the compressors and fans, The unit controller will detect this and annunciate an alarm.

Refrigerant (R-454B) Detection and Mitigation Support Sequences

Equipment with R-454B refrigerant requires a refrigerant detection system based on the refrigerant charge. When the refrigerant detection system is in a normal state, the equipment provides normal heating, cooling, and ventilation.

Heat Cool Mode Status: Off

When the unit is in Off mode and a leak is detected or sensor fails, a diagnostic will trigger. Heat Cool Mode will transition to Fan Only. Compressor Operation is disabled, heating operation is disabled, and outdoor air dampers are closed all normal operation for Off mode).

The VAV Box Relay will be energized for Full Airflow at the VAV boxes. The main Building Management System will utilize either the VAV Box Relay, Refrigerant Mitigation Push binary output, or the Refrigerant Mitigation Active binary value to drive the VAV boxes full open. The supply fan will start and ramp to its minimum speed (10%) for 180 seconds to allow the VAV's to drive open. After 180 seconds expires, the fan(s) will ramp to maintain the duct static pressure at the duct static pressure setpoint (VAV units only) or the fan speed setpoint (CV units only). The DX Cooling will be disabled during this time.

Once the leak is cleared, the unit will continue to mitigate for five minutes. During this five-minute mitigation, the concentration or sensor failure diagnostics will clear but the mitigation diagnostic will remain. When the five-minute time expires, mitigation will terminate, and the unit will transition back to normal control.

Heat Cool Mode Status: Cool

When the unit is in Cool mode and a leak is detected or sensor fails (see the figure below), the same diagnostics will trigger.

The VAV Box Relay will be energized for Full Airflow at the VAV boxes. The main Building Management System will utilize either the VAV Box Relay, Refrigerant Mitigation Push binary output, or the Refrigerant Mitigation Active binary value to drive the VAV boxes full open. The supply fan will ramp to maintain the duct static pressure at the duct static pressure setpoint (VAV units only) or will continue to operate at the defined speed (CV units only). DX Cooling will be de-energized and compressor operation will be disabled. Heating will remain disabled, and the unit can continue to economize if the airside economizer interface option is installed.

Once the leak is cleared, the unit will continue to mitigate for five minutes. During this five-minute mitigation, the concentration or sensor failure diagnostics will clear but the mitigation diagnostic will remain. When the five-minute time expires, mitigation will terminate, and the unit will transition back to normal control.

Heat Cool Mode Status: Heat

When the unit is in Heat mode and a leak is detected or sensor fails (see the figure below), the same diagnostics will trigger.

The VAV Box Relay will be energized for Full Airflow at the VAV boxes. The main Building Management System will utilize either the VAV Box Relay, Refrigerant Mitigation Push binary output, or the Refrigerant Mitigation Active binary value to drive the VAV boxes full open. The supply fan will ramp to maintain the duct static pressure at the duct static pressure setpoint (VAV units only) or will continue to operate at the defined speed (CV units only). DX Cooling will be de-energized and compressor operation will be disabled. Heating will remain enabled and the unit can continue keep the outdoor air dampers at the minimum ventilation if the unit is equipped with an airside economizer interface. Once the leak is cleared, the unit will continue to mitigate for five minutes. During this five-minute mitigation, the concentration or sensor failure diagnostics will clear but the mitigation diagnostic will remain. When the five-minute time expires, mitigation will terminate, and the unit will transition back to normal control.

Note: *Refrigerant leak detection and mitigation actions are defined by UL requirements. Therefore, Supply Fan minimum speed is recommended to remain as defined by factory defaults.*

Optional Components Support Sequences

High Duct Temperature Thermostat

An optional factory-supplied temperature limit switch with reset element detects the supply air duct temperature. This sensor should be field installed downstream from the discharge in the supply air duct. If the supply air duct temperature exceeds 240°F (115.6°C), the unit shuts down and displays a diagnostic. A manual reset is required at the unit. High duct temperature can be adjusted at thermostat.

Dirty Air Filter Sensor Option

A factory installed differential pressure sensor senses the pressure differential across the filters. When the differential pressure exceeds a user selectable setting will display a diagnostic. The unit will continue to run until you replace the air filters.

Test Modes Support Sequences

In the TD7 under the Setup menu the Set Flow Switch binary value is located. If the unit is equipped with water regulating valves, this binary value is used to set the flow switch for the least amount of flow. When the value is set to true, 1 water regulating valve will open to 5% less than the minimum valve setpoint that is set at the factory. This valve will remain open for 20 minutes to allow adjustment of the switch. The 5% less than the minimum flow should prevent nuisance water flow loss alarms. The unit must be in a local stop condition in order for the override to put the unit into the test mode.

Unit Functional Test Mode

This testing mode needs to be performed in the exact steps listed below to get the unit to the desired condition. If the unit does not contain certain devices then that portion of the test can be skipped. Unit tests can not be performed if the Refrigerant Mitigation is active.

Fan Testing Steps

The fan(s) testing steps are the initial steps performed on the unit to get the fans at the proper condition to proceed with testing the heating or cooling. The test is started in the TD7 under the Setup menu by overriding the MJC MSC Testing Override. The MJC MSC Testing Status will indicate which step the unit is in. The testing Steps are listed below. To start the test override the multistate value to Start Test.

1. Test Inactive
2. Start Test

   The testing logic will not allow you to proceed until it runs through its safety check and ensures the unit is fully shut down. The status point will indicate when the test is ready to proceed. You can proceed to the exact test you want to perform or go 1 step at a time.
3. SF Cmd 1 On. This will turn on the Supply Fan Command relay to start fans 1-4 if all are installed.
4. SF Cmd 2 On. This will turn on the Supply Fan Command 2 relay to start fans 5-7 if all are installed
5. Fan 1 on at 30%.
6. Fan 1 off
7. Fan 2 on at 30%.
8. Fan 2 off
9. Fan 3 on at 30%.
10. Fan 3 off
11. Fan 4 on at 30%.
12. Fan 4 off
13. Fan 5 on at 30%.
14. Fan 5 off
15. Fan 6 on at 30%.
16. Fan 6 off
17. Fan 7 on at 30%.
18. Fan 7 off
19. All installed fans on at 25%
20. All installed fans on at 50%
21. All installed fans are in auto and either control to duct static or constant fan speed.

    After the fans are tested, the next steps will allow you to test the other functions of the unit

22. Cooling Test Start.
23. Heating Test Start.
24. Economizer Test Start
25. Test Disable/Auto Release.

Cooling Testing Steps

The DX Cooling can be tested by placing the MJC MSC Testing Override into the Cooling Test Start state. Once in this state, the MJC MSC Cooling Test Override to the Start Test off state to start the test (State 2).

Heating Testing Steps

The heating can be tested by placing the MJC MSC Testing Override into the Heating Test Start state. Once in this state, the MJC MSC Heating Test Override to the Start Test state to start the test (State 2).

1. Test Inactive
2. Start Test

   The test will not proceed to the next step until this state is verified. Once the MJC MSC Economizer Test Status indicates Test Ready, you can proceed with testing the following states.
3. Hydro 100% Open
4. Hydro 0% Open
5. Elect Stage 1 On
6. Elect Stage 1 Off
7. Elect Stage 2 On
8. Elect Stage 2 Off
9. Elect Stage 3 On
10. Elect Stage 3 Off
11. All Elect Stages On
12. All Elect Stages Off
13. Elect SCR 25%
14. Elect SCR 50%
15. Elect SCR 75%
16. Elect SCR 100%
17. Steam 25% Open
18. Steam 50% Open
19. Steam 75% Open
20. Steam 100% Open
21. Steam 0% Open
22. Test Complete/Auto Release. When at this step, it will shut down all heat and remove the overrides.

Economizer Testing Steps

The economizer can be tested by placing the MJC MSC Testing Override into the Economizer Test Start state. Once in this state, the MJC MSC Economizer Test Override to the All Comp off state to start the test (State 2). off state to start the test (State 2).

1. Test Inactive
2. Start Test

   The test will not proceed to the next step until this state is verified. Once the MJC MSC Economizer Test Status indicates Test Ready, you can proceed with testing the following states.
3. Open Economizer
4. Close Economizer
5. Test Complete/Auto Release

All Tests Complete

When all testing is complete, override the MJC MSC Testing Override to state 25, Testing Disable/Auto Release to end testing. This will safely shut down the unit and release all testing override and allow the unit to resume automatic control.

Controls

Unit Controller

The SWUD uses the Symbio™ 500 control platform for monitoring and control. XM expansion modules are used to expand the Symbio 500 I/O capabilities.

In the control panel, the following modules are used:

- Symbio 500
- TD-7
- XM90.1
- XM30.2
- XM30.3
- XM30.4

Note: *The number after the dot in the name (example: XM30.#) is the IMC bus address, which is set using the rotary switches on the module.*

Table 13. Points list

Hardware Connection		Point Name	Point Setup
Symbio 500 (Requires 50VA Transformer)	BO1	Cooling Tower Pump Request	Open = Off, Closed = On
	BO2	Unit Alarm Output Command	Open Normal, Closed = Alarm
	BO3	VAV Box Command Open	Open =Normal Operation, Closed = Drive Max Position
	BO4	Compressor 1 Command	Open = Off, Closed = On
	BO5	Compressor 2 Command	Open = Off, Closed = On
	BO6	Compressor 3 Command	Open = Off, Closed = On
	BO7	Compressor 4 Command	Open = Off, Closed = On
	BO8	Supply Fan Start Stop Command	Open = Off, Closed = On
	BO9	Supply Fan Start Stop Command 2	Open = Off, Closed = On
	AI1	Discharge Air Temperature	10k Ohm Resistor Trane Type 2
	AI2	Return Air Temperature Local	10k Ohm Resistor Trane Type 2
	AI3	Condenser Water Entering Temperature	10k Ohm Resistor Trane Type 2
	AI4	Condenser Water Leaving Temperature	10k Ohm Resistor Trane Type 2
	AI5	Evaporator Coil Leak Detector Signal	Open = Normal, Closed = Leak
	UI1	Occupancy Input	Open = Unoccupied, Closed = Occupied
	UI2	Space Tempertaure Sensor	10k Ohm Resistor Trane Type 2
	BI1	Emergency Stop	Open = Normal, Closed = Emergency Stop
	BI2	Circuit 1 High Pressure Cutout	Open = Alarm, Closed = Normal
	BI3	Circuit 2 High Pressure Cutout	Open = Alarm, Closed = Normal
	AO1/BI4	Ventilation Input Status	Open = Normal, Closed = Ventillation Mode
	AO2/BI5	Outdoor Air Damper Command	2 vdc = 0%, 10 vdc = 100%
	PI1	Duct Static Pressure Local	Honeywell Pressure Sensor
	PI2	Air Filter Differential Pressure	Honeywell Pressure Sensor

Table 13. Points list (continued)

Hardware Connection		Point Name	Point Setup
XM9.1 (Requires 50VA Transformer)	BO1	Heat Output 1	Open = Off, Closed = On
	BO2	Heat Output 2	Open = Off, Closed = On
	BO3	Heat Output 3	Open = Off, Closed = On
	BO4	Outdoor Air Damper (2 Position)	Open = Off, Closed = On
	BO5	Supply Fan Status Output	Open = Off, Closed = On
	BO6	—	—
	BO7	—	—
	BO8	—	—
	UI1	Compressor 1 Safety Circuit Status	Open = Circuit Open, Closed = Circuit Closed
	UI2	Compressor 2 Safety Circuit Status	Open = Circuit Open, Closed = Circuit Closed
	UI3	Compressor 3 Safety Circuit Status	Open = Circuit Open, Closed = Circuit Closed
	UI4	Compressor 4 Safety Circuit Status	Open = Circuit Open, Closed = Circuit Closed
	UI5	Circuit 1 Suction Temperature	10k Ohm Resistor Trane Type 2
	UI6	Circuit 1 Discharge Pressure Sensor	0.5 Vdc = 0 PSI, 4.5Vdc = 667 PSI
	UI7	Circuit 1 Suction Pressure Sensor	0.5 Vdc = 0 PSI, 4.5Vdc = 667 PSI
	UI8	Circuit 2 Discharge Pressure Sensor	0.5 Vdc = 0 PSI, 4.5Vdc = 667 PSI
	UI9	Circuit 2 Suction Pressure Sensor	0.5 Vdc = 0 PSI, 4.5Vdc = 667 PSI
	UI10	Circuit 2 Suction Temperature	10k Ohm Resistor Trane Type 2
	UI11	Supply Fan 1 ECM Fault	Open = Normal, Closed = Fault
	UI12	Supply Fan 2 ECM Fault	Open = Normal, Closed = Fault
	UI13	Supply Fan 3 ECM Fault	Open = Normal, Closed = Fault
	UI14	Supply Fan 4 ECM Fault	Open = Normal, Closed = Fault
	UI15	Condenser Water Flow Switch	Open = No Flow, Closed = Flow
	UI16	External Auto Stop Input Status	Open = Auto, Closed = Exterior Stop
	AO1/UI17	Compressor Coil Leak Detector Signal	Open = Normal, Closed = Leak
	AO2/UI18	Supply Fan 1 Speed Command	0 vdc = 0%, 10 vdc = 100%
	AO3/UI19	Supply Fan 2 Speed Command	0 vdc = 0%, 10 vdc = 100%
	AO4/UI20	Supply Fan 3 Speed Command	0 vdc = 0%, 10 vdc = 100%
	AO5/UI21	Supply Fan 4 Speed Command	0 vdc = 0%, 10 vdc = 100%
	AO6/UI22	Condenser Water Valve	0 vdc = 0%, 10 vdc = 100%
	AO7/UI23	Heating Output 1 Command	0 vdc = 0%, 10 vdc = 100%
	AO8/UI24	Phase Monitor Status	Open = Fault, Closed = Normal
XM30.2	AO1/UI1	Supply Fan 5 ECM Fault	Open = Normal, Closed = Fault (only on units 85 tons and above)
	AO2/UI2	Supply Fan 5 Speed Command	0 vdc = 0%, 10 vdc = 100%
	AO3/UI3	Supply Fan 6 ECM Fault	Open = Normal, Closed = Fault
	AO4/UI4	Supply Fan 6 Speed Command	0 vdc = 0%, 10 vdc = 100%
XM30.3	AO1/UI1	Supply Fan 7 ECM Fault	Open = Normal, Closed = Fault (only on 110 ton units)
	AO2/UI2	Supply Fan 7 Speed Command	0 vdc = 0%, 10 vdc = 100%
	AO3/UI3	—	—
	AO4/UI4	—	—
XM30.4	AO1/UI1	Outdoor Air Temperature Local	10k Ohm Resistor Trane Type 2 (only on units with economizer interfaces)
	AO2/UI2	Outdoor Air Relative Humidity Local	4 ma = 0, 20 ma = 100%
	AO3/UI3	Return Air Humidity Local	4 ma = 0, 20 ma = 100%
	AO4/UI4	Mixed Air Low Temperature Cutout Alarm	Open = Alarm

Navigating the TD-7

TD-7 Home Screen

To access the TD-7 home screen, press the **Home** button in the upper left of the screen.

Screen Element	Description
A	Home button
B	Displays the local Auto Stop button and displays the occupancy, Heat/Cool Mode, and Unit Information.
C	Displays information about the Air Filter.
D	Displays the Discharge Air Temperature, Setpoint, and Return Air Temperature. A red light displays if the sensor fails.
E	Displays when cooling is active and indicates the % of cooling capacity currently utilized.
F	The Water Side Econ Info tile is included on units with an economizer installed. Displays a snapshot of economizer operations and the mode of the economizer.
G	Displays fan status (on, off), duct static pressure setpoint and actual, and fan percentage.
H	Compressor 1 is always the lead compressor. This tile displays the compressor pressures, superheat, VFD signal, condenser water values (if included), and operating mode.
I	Tiles for compressors 2-4 display, depending on the number of compressors installed. The VFD compressor is always the lead compressor. The fixed speed compressors rotate to even out run time. Compressor tiles displays the compressor pressures, superheat, VFD signal, condenser water values (if included), and operating mode.
J	Displays the entering and leaving temperatures, pump command, flow status, and the condenser alarm status.

TD-7 Reports

Unit Status Report

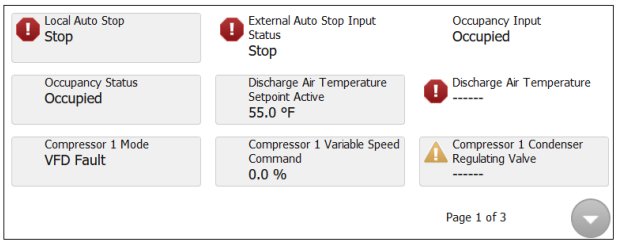
The Unit Status report provides an overview of how the unit is running and includes all available points that were pre-defined for the unit.

To access the Unit Status report:

1. Press the **Reports** button at the bottom of the screen.
2. Press **Unit Status** button.

Use the up and down arrows in the bottom right to scroll through the report.

Figure 17. Unit status report



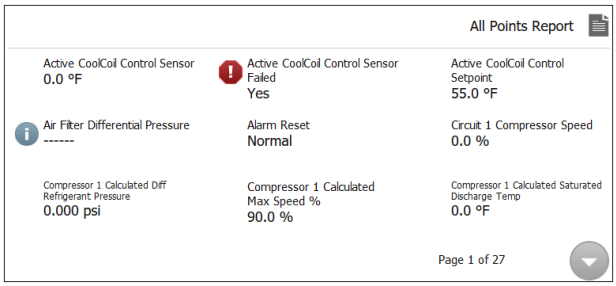
All Points Report

The All Points report provides details for all points for a unit. To access the All Points report:

1. Press the **Reports** button at the bottom of the screen.
2. Press the **All Points Report** button.

Use the up and down arrows in the bottom right to scroll through the report.

Figure 18. All points report



Starting the Unit

Before starting the unit, confirm:

- All checks are complete
- Alarms are cleared
- Compressors that you want to run are made available or locked out.

Local Auto/Stop Value

The Local Auto/Stop Value is used to stop by unit in a safe manner either locally in Tracer TU or at the TD-7 display. The factory default is set to **Auto**.

1. Navigate to the Home screen.
2. In the upper left tile, press the arrow next to either **Stop** or **Auto**.
3. To stop the unit, press the **Stop** button, or to put the unit in Auto default mode, press **Release Override**.

Figure 19. Local Auto/Stop

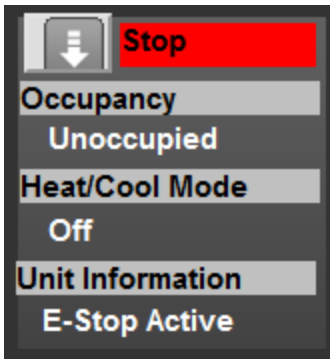
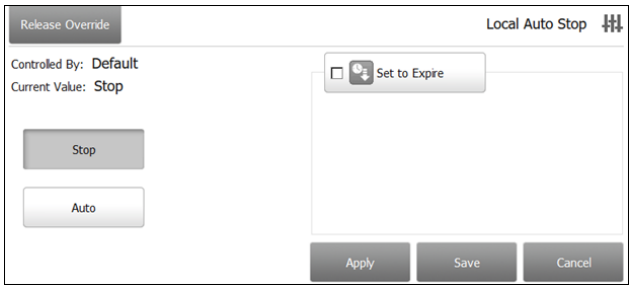


Figure 20. Stop or release override



Setpoint Adjustments

This section details control setpoints that can be modified from factory defaults and how to modify those setpoints.

Unit Setpoints

Table 14. Unit setpoints that can be modified in the TD-7

Setpoint Name	Description	Factory Default
Condenser Purge Time (on units with condenser valves only)	The amount of time (in minutes) that the compressor will open its condenser valve during purge mode when the unit is not operating.	20 minutes
Discharge Air Cooling Setpoint BAS	Used as the cooling setpoint on fixed setpoint units and on units that reset their discharge air temperature setpoint as the low value in the reset equation. This value should be set to the desired temperature needed for startup.	55°F
Discharge Air Cooling Setpoint Max BAS (reset DAT units only)	Sets the upper limit in the Reset Equation in Cooling Mode. This value can be adjusted to the desired maximum setpoint the discharge air should reach during cooling mode.	65°F
Discharge Air Heating Setpoint BAS (Units with Heat Only)	Used as the heating setpoint when the unit is in heating mode. This value should be set to the desired temperature needed for startup.	90°F
Discharge Air Low Temperature Cutout	Value that triggers a diagnostic when the discharge air temperature is below this value for 10 minutes. This value can be adjusted to the desired low air temperature, which triggers the diagnostic.	35°F
Duct Static Pressure Setpoint BAS	The duct static pressure setpoint is set by the analog value named duct static pressure setpoint BAS. This value should be set to the desired pressure needed for startup.	1 in (H_2O)
Duct Static Pressure Safety Lockout	Shuts down the unit if the duct static exceeds this setpoint. It should be set to the desired pressure needed for startup.	2 in (H_2O)
Dirty Air Filter DP	Generates a diagnostic for a dirty air filter when the differential pressure exceeds the setpoint.	10 in (H_2O)
Occupied Offset (DAT Reset Units Only)	Determines the occupied cooling and heating setpoints when the unit resets the discharge air temperature off either return or space temperature.	2°F
Occupied Standby Offset (DAT Reset Units Only)	Determines the occupied cooling and heating setpoints when the unit resets the discharge air temperature off either return or space temperature and is the occupied standby mode.	4°F
Space Temperature Setpoint BAS (DAT Reset by Space Temp Air Units Only)	Sets the space setpoint when the unit is selected to do discharge air reset based off the space temperature. This value is used to determine the occupied heating and cooling temperatures which reset the discharge air temperature setpoint.	72°F

Table 14. Unit setpoints that can be modified in the TD-7 (continued)

Setpoint Name	Description	Factory Default
Return Temperature Setpoint BAS (DAT Reset by Return Temp Air Units Only)	Sets the return setpoint when the unit is selected to do discharge air reset based off the return temperature. This value is used to determine the occupied heating and cooling temperatures which reset the discharge air temperature setpoint.	72°F
Water Side Economizer Enable Offset (Units with Water Side Economizer Only)	The temperature that the condenser entering water must be below the return air temperature before it will enable the economizer.	7°F
Water Side Economizer Sample Time (Units with Water Side Economizer Only)	Time that the controller will sample the water temperature for and compare it against the return air temperature to determine if the economizer can be enabled.	2 minutes

To modify any of the setpoints in the table above:

1. Press **Reports** at the bottom of the screen.
2. Press the **Unit Setpoints** button.
3. On the **Setpoint** report, locate the point in the menu. Use the arrows to scroll through the report if needed.
4. Use the up and down arrows to change the value, or press inside the box and type in the desired setpoint.
5. Press **Save**.

Unit Setup

Table 15. Unit setup setpoints that can be modified in the TD-7

Setpoint Name	Description	Factory Default
Condenser Control % of Design	Percent of the condenser pressure design the unit will control to and is user adjustable between 50-100%.	90%
Condenser Tee Strainer Sensor Calibration	The condenser water tee high and low pressure sensor can be calibrated to match the gauge readings or recorded readings by the balancer.	0
Condenser Purge Status (On Units with Condenser Valves Only)	Each compressor has its own condenser purge status value which indicates when the condenser valve is open in the purge mode. It can also be used to manually initiate the purge mode for each compressor.	Off
Condenser Water Flow Type (On Units with Condenser Valves Only)	Indicates if the unit is a constant or variable volume flow type unit. Even with the condenser water regulating valves installed on each compressor, the flow type can be changed. When the flow is changed from variable flow to constant flow, the water regulating valve will open to its maximum position when the unit is occupied. This can be done for constant volume flow systems that do not include a VFD Pump.	Variable flow
Water Side Economizer Lockout BAS (Units with Water Side Economizer Only)	The water side economizer can be locked out by the controls system.	Available
Compressor Lockout BAS	Each compressor can be locked out individually by the controls system.	Available
Fan Lockout BAS	Each fan can be locked out individually by the controls system. Fans should be made available prior to startup.	Available

To modify any of the setpoints in the table above:

1. Press **Reports** at the bottom of the screen.
2. Press the **Unit Setup** button.
3. On the **Setup** report, locate the point in the menu. Use the arrows to scroll through the report if needed.
4. Use the up and down arrows to change the value, or press inside the box and type in the desired setpoint.
5. Press **Save**.

Reports

To access Alarms, press the Alarms button in the lower left corner of the screen. If the Alarm tab is not blinking red, there are no alarms present.

Figure 21. Alarms tab

Compressor Alarms

If there is a compressor alarm, it will need to be manually reset after it is resolved. Each compressor needs to be reset manually:

1. Press **Reports** at the bottom of the display.
2. Press **Unit Setup**.
3. In the **Setup** report, locate the appropriate point. Use the arrows to scroll through the report if needed.
4. Select the specific compressor.
5. Change the value from Normal to **Reset**.
6. Press **Save**. The point will automatically revert to its default setting (Off).

Fan Alarms

If there is a fan alarm, it will need to be manually reset after it is resolved. There is one fan reset for the entire wall fan.

1. Press **Reports** at the bottom of the display.
2. Press **Unit Setup**.
3. In the **Setup** report, press **Supply Fan Failure Reset**. Use the arrows to scroll through the report if needed.
4. Press **Reset**.
5. Press **Save**.
6. When you want the fan to be available, press the **Release Override** button in the top left.

General Alarms

General alarms are alarms that are not tied to fans or compressors. They require a manual reset, and there is one alarm reset for these alarms.

To reset a general alarm:

1. Press **Reports** at the bottom of the display.
2. Press **Unit Setup**.
3. In the **Setup** report, press **Alarm Reset**. Use the arrows to scroll through the report if needed.
4. Press **Reset**.
5. Press **Save**.

Water Purge

NOTICE

Proper Water Treatment Required!

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

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

During the unoccupied mode, water-cooled units will periodically circulate water through the condensers and waterside economizer if the user has enabled the purge function at the HI. The water purge function circulates water to introduce fresh water-treatment chemicals and help prevent water stagnation. The number of hours between each periodic purge, or purge duration, is user-defined at the HI between 1-999 hours. If the periodic purge timer expires while the unit is in occupied mode, it will wait for the next available unoccupied time before initiating water purge.

Contrary, if a request for cooling occurs during a purge sequence, purge will terminate and cooling will commence.

Pre-Startup

Before starting up units, perform the following procedure to confirm proper unit operation.

Pre-Startup Checklist

Complete this checklist after installing unit to verify all recommended installation procedures are complete before start-up. This does not replace the detailed instructions in the appropriate sections of this manual. Always read the entire section carefully to become familiar with the procedures.

Supply Fan

Confirm the fan rotates freely.

Ductwork

- Confirm trunk ductwork to VAV boxes is complete and secure to prevent leaks.
- Verify that all ductwork conforms to NFPA 90A or 90B and all applicable local codes.

Water-Cooled Unit Piping

Verify condensate drain, water piping drain plugs, economizer header, strainer pressure transducers, and condenser vent plug are installed.

Units with Hydronic Heat

Verify the entering water temperature sensor is installed upstream of the hydronic coil.

Electrical

Verify electrical connections are tight.

Components

- Verify liquid line service valve, and suction and discharge service valves if present, are open at start-up.

  Note: *Each compressor suction line contains a low pressure sensor that will shut the compressor down in low pressure situations.*
- Confirm system components are properly set and installed.

Start-Up

⚠ WARNING

Live Electrical Components!

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

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

NOTICE

Compressor Damage!

Failure to follow instructions below will cause the compressor to operate in a vacuum and result in compressor damage.

Never manually or automatically pump down system below 7 psig.

NOTICE

Compressor Damage!

Failure to follow instructions could result in compressor damage.

Keep crankcase heaters on whenever refrigerant is in the system.

If crankcase heaters have not been on with refrigerant in the system, turn the crankcase heaters on for a minimum of 24 hours before starting compressors.

To start the unit, complete the following steps in order.

Review "Refrigerant System," p. 28, if applicable. Confirm all steps were completed.

Final Refrigerant Charge

If full charge was not used during installation, follow these steps:

1. Determine remaining charge required by subtracting charge added during "Refrigerant System," p. 28 from the total.
2. With all circuit compressors running, SLOWLY meter remaining R-454B into the suction line from the LIQUID charging connection.

NOTICE

Compressor Damage!

Overcharging system could result in compressor failure and/or reduced compressor life.

Do not overcharge system. Excessive refrigerant charging can cause compressor liquid slugging at startup, and conditions where compressors and/or condenser fans short cycle.

NOTICE

Compressor Damage!

Failure to follow instructions below could result in compressor failure and/or reduced compressor life.

To prevent compressor liquid slugging, only add liquid in the suction line when the compressor is running. Use extreme caution to meter liquid refrigerant into the suction line slowly. If liquid is added too rapidly, compressor oil dilution and oil pumpout could occur.

3. Use an accurate scale to measure and record amount of R-454B added.
4. After unit has been operating for approximately 30 minutes at full load, measure and record operating pressures.
5. Repeat for other circuits.
6. Confirm, and adjust charge, if necessary, by checking subcooling at AHRI 340/360 full load operating conditions (80°/67°F db/wb entering evaporator, ~300 cfm/ton, 85°/95°F EWT/LWT).

   Some TXV superheat adjustment may be necessary, but only, after adequate subcooling has been reached.

   Note: *Water-cooled subcooling should be 10.5°F to 12.5°F.*

Start-Up Procedure

Using the start-up log on the following pages, establish nominal conditions for consistent measurements as follows:

- Leaving air greater than 60°F
- Entering air temperature = 70 to 90°F
- Entering water temperature > 60°F

With all compressors running at full load:

1. Compute superheat from the suction line pressure and temperature at the compressor on each circuit. Adjust the thermal expansion valve settings if necessary. Superheat should be between 14°F and 20°F.
2. Inspect refrigerant flow in the liquid line sight glass. Flow should be smooth and even, with no bubbles once the system has stabilized.

   Note: *Sight glass moisture indicator may show caution or wet at start-up. May need up to 12 hours of operation for system to reach equilibrium and correctly show moisture.*

Normal startup will occur provided Tracer® Summit is not controlling the module outputs or the generic BAS is not keeping the unit off. To prevent Tracer Summit from affecting unit operation, remove Tracer wiring and make required changes to setpoint and sensor sources.

Operating and Programming Instructions

See *IntelliPak™ Commercial Self-Contained Signature Series 20 to 110 Ton, Modular Series 20 to 35 Ton Programming Guide* (PKG-SVP01*-EN) for available unit operating setpoints and instructions. A copy ships with each unit. For units with VFD option, see installer guide that ships with each VFD.

Start-Up Log

Unit:	
Unit Location:	
Unit Voltage	

Evaporator		
Evaporator fan motor horsepower:		
Evaporator fan motor amps:		
Evaporator fan rpm (actual):		
Evaporator system static (from test and balance report or actual readings)	**Supply duct static:**	**Return duct static:**
Evaporator system cfm (test and balance sheet or actual tested):		

Evaporator Air Conditioners (with all compressor operating)			
Entering		**Leaving**	
Dry-bulb °F:		**Dry-bulb °F:**	
Wet-bulb °F:		**Wet-bulb °F:**	

Water-Cooled Units				
	Circuit A	**Circuit B**	**Circuit C**	**Circuit D**
Entering water temp °F				
Leaving water temp °F				
Entering water pressure psig				
Leaving water pressure psig				

Maintenance

Service Access

All service accessible areas are provided with hinged doors that allow doors to swing open or be removed completely.

To use as a hinge, simply open hinge handle, depress Y latch and swing door open.

To remove completely, open hinge handle and depress Y latch on back side of hinge. Work door off of unit being careful to not drop door.

Note: *Evaporator door is 75 lbs and requires two-man lift to remove safely.*

Access unit controls through the front. The panel is secured with two quick release hinges. Hinged panels allow access to the fans and also the compressor and condensers. Hinges also allow for complete removal of panel. Left and right hinges allow for access to evaporator section and also allow for removable of the entire panel. Expansion valves and filter driers are easily accessible from here. Filters are accessible via a hinged panel.

Power is accessible through a hinged door on the unit (left hand is standard and right hand is optional). Hinge also allows for panel to be removed.

Air Filters

⚠ WARNING

Hazardous Voltage w/Capacitors!

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

Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. Verify with a CAT III or IV voltmeter rated per NFPA 70E that all capacitors have discharged.

Filter access doors are shared with the evaporator cassette access door. To replace throwaway filters, remove the dirty elements and install new filters with the filter directional arrows pointing toward the fan. Verify no air bypasses the filters. See Table 16, p. 53 for proper filter placement.

Table 16. Unit filter sizes

Unit size	Qty	Filter size
20 to 35	9	20 x 24 inches
40 to 60	12	
65 to 85	15	
90 to 110	21	

Inspecting and Cleaning the Drain Pan

Check the condensate drain pan and drain line to confirm the condensate drains properly at least every six months or as dictated by operating experience.

If evidence of standing water or condensate overflow exists, take steps to identify and remedy the cause immediately. Refer to the "Troubleshooting," p. 62 for possible causes and solutions.

⚠ WARNING

Hazardous Voltage w/Capacitors!

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

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

Clean drain pans using the following procedure:

1. Disconnect all electrical power to the unit.
2. Don the appropriate personal protective equipment (PPE).
3. Remove all standing water.
4. Use a scraper or other tools to remove and solid matter. Remove solid matter with a vacuum device that utilizes high efficiency particulate arrestance (HEPA) filters with a minimum efficiency of 99.97% at 0.3 micron particle size.
5. Thoroughly clean the contaminated area(s) with a mild bleach and water solution or an EPA-approved sanitizer specifically designed for HVAC use. Carefully follow the sanitizer manufacturer's instructions regarding product use.
6. Immediately rinse the drain pan thoroughly with fresh water to prevent potential corrosion from the cleaning solution.
7. Allow the unit to dry thoroughly before putting the system back into service.
8. Properly dispose of all contaminated materials and cleaning solution.

Compressors

Scroll Compressor Failure Diagnosis and Replacement

If compressor failure is suspected, refer to *CSHD and CSHN/CSHL Compressors Installation and Service Installation Instructions* (COM-SVN01*-EN) for detailed information regarding compressor failure diagnosis and replacement of scroll compressors.

Refrigerant System

If refrigerant system repair is required, Leak Test, Brazing and Evacuation Procedures are described.

Preliminary charging is described in the Installation – Mechanical section, "Refrigerant System," p. 28 and final charging is described in the Start-Up section, "Final Refrigerant Charge," p. 51.

Refrigerant systems that have been opened must have filter driers replaced and complete leak test and evacuation before recharging. Unit is equipped with replaceable filter core option for easy maintenance.

Refrigerant Leak Test Procedure

⚠ WARNING

Confined Space Hazards!

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

Do not work in confined spaces where refrigerant or other hazardous, toxic, or flammable gas may be leaking. Refrigerant or other gases could displace available oxygen to breathe, causing possible asphyxiation or other serious health risks. Some gases may be flammable and/or explosive. If a leak in such spaces is detected, evacuate the area immediately and contact the proper rescue or response authority.

⚠ WARNING

Explosion Hazard!

Failure to follow safe leak test procedures below could result in death or serious injury or equipment or property-only-damage.

Never use an open flame to detect gas leaks. Use a leak test solution for leak testing.

⚠ WARNING

Explosion Hazard!

Failure to follow these instructions could result in death or serious injury or equipment or property-only damage.

Use only dry nitrogen with a pressure regulator for pressurizing unit. Do not use acetylene, oxygen or compressed air or mixtures containing them for pressure testing. Do not use hydrogen mixtures containing refrigerant and air above atmospheric pressure for pressure testing as they may become flammable and could result in an explosion.

Refrigerant, when used as a trace gas should only be mixed with dry nitrogen for pressurizing units.

⚠ WARNING

Explosion Hazard!

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

Do not exceed unit nameplate design pressures when leak testing system.

⚠ WARNING

R-410A Refrigerant under Higher Pressure than R-22!

Failure to use proper equipment or components as described below, could result in equipment failing and possibly exploding, which could result in death, serious injury, or equipment damage.

The units described in this manual use R-410A refrigerant which operates at higher pressures than R-22. Use ONLY R-410A rated service equipment or components with these units. For specific handling concerns with R-410A, please contact your local Trane representative.

⚠ WARNING

Refrigerant under High Pressure!

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

System contains refrigerant 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.

Note: *These service procedures require working with refrigerant. Do not release refrigerant to the atmosphere. The service technician must comply with all federal, state, and local laws.*

When leak-testing refrigerant systems, observe all safety precautions. Leak test only one circuit at a time to minimize system exposure to potentially harmful moisture in the air.

System Repair

1. If system is water cooled with service valves, high and low side may be tested independently by closing liquid line angle valve and water cooled unit discharge line ball valve. Otherwise leave all valves open and DO NOT exceed low side design pressure.
2. Connect R-454B refrigerant cylinder to charging port, add refrigerant to reach pressure of 12 to 15 psig.
3. Disconnect refrigerant cylinder. Connect dry nitrogen cylinder to high side charging port and increase pressure to 150 psig. DO NOT exceed unit nameplate design pressures. If testing complete system, low side design pressure is maximum.
4. Check piping and/or components as appropriate for leaks.
5. Recommend using electronic detector capable of measuring 0.1 oz/year leak rate.
6. If a leak is located, use proper procedures to remove the refrigerant/nitrogen mixture, break connections and make repairs. Retest for leaks.
7. Confirm all service valves are open.

Brazing Procedures

⚠ WARNING

Explosion Hazard and Deadly Gases!

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

Proper brazing techniques are essential when installing refrigerant piping. The following factors should be kept in mind when forming sweat connections:

1. When heating copper in the presence of air, copper oxide forms. To prevent copper oxide from forming inside the tubing during brazing, sweep an inert gas, such as dry nitrogen, through the tubing. A nitrogen flow of 1 to 3 cubic feet per minute is sufficient to displace the air in the tubing and prevent oxidation of the interior surfaces. Use a pressure regulating valve or flow meter to control the flow.
2. Confirm the tubing surfaces requiring brazing are clean, and that the tube ends are carefully reamed to remove any burrs.
3. Confirm the inner and outer tubes of the joint are symmetrical and have a close clearance, providing an easy slip fit. If the joint is too loose, the connection tensile strength is significantly reduced. Confirm the overlap distance is equal to the inner tube diameter.
4. Wrap each refrigerant line component with a wet cloth to keep it cool during brazing. Excessive heat can damage the internal components.

   Note: *Use 40-45% silver brazing alloy (BAg-7 or BAg-28) on dissimilar metals. Use BCup-6 brazing alloy on copper-to-copper joints.*
5. If using flux, apply it sparingly to the joint. Excess flux will contaminate the refrigerant system.
6. Apply heat evenly over the length and circumference of the joint.
7. Begin brazing when the joint is hot enough to melt the brazing rod. The hot copper tubing, not the flame, should melt the rod.
8. Continue to apply heat evenly around the joint circumference until the brazing material is drawn into the joint by capillary action, making a mechanically sound and gas-tight connection.
9. Visually inspect the connection after brazing to locate any pinholes or crevices in the joint. Use a mirror if joint locations are difficult to see.

System Evacuation Procedures

- Each refrigeration circuit must be evacuated before the unit can be charged and started.
- Use a rotary type vacuum pump capable of pulling a vacuum of 100 microns or less.
- Verify that the unit disconnect switch and the system control circuit switches are **OFF**.
- Oil in the vacuum pump should be changed each time the pump is used with high quality vacuum pump oil. Before using any oil, check the oil container for discoloration, which usually indicates moisture in the oil and/or water droplets. Moisture in the oil adds to what the pump has to remove from the system, making the pump inefficient.
- When connecting vacuum pump to refrigeration system, it is important to manifold vacuum pump to both high and low side of system (liquid line access valve and suction line access valve). Follow pump manufacturer's directions for proper methods of using vacuum pump.
- Lines used to connect the pump to the system should be copper and of the largest diameter that can practically be used. Using larger line sizes with minimum flow resistance can significantly reduce evacuation time.
- Rubber or synthetic hoses are not recommended for system evacuation. They have moisture absorbing characteristics that result in excessive rates of

evaporation, causing pressure rise during standing vacuum test. This makes it impossible to determine if system has a leak, excessive residual moisture, or continual or high rate of pressure increase due to hoses.

- Install an electronic micron vacuum gauge in the common line ahead of the vacuum pump shutoff valve, as shown in Figure 22, p. 56. Close valves B and C, and open Valve A.
- Start vacuum pump. After several minutes the gauge reading will indicate the maximum vacuum the pump is capable of pulling. Rotary pumps should produce vacuums of 100 microns or less.

NOTICE

Motor Winding Damage!

Failure to follow instructions below could result in compressor motor winding damage.

Do not use a megohm meter or apply voltage greater than 50 VDC to a compressor motor winding while it is under a deep vacuum.

- Open valves B and C. Evacuate system to a pressure of 300 microns or less. As vacuum is being pulled on system, it may appear that no further vacuum is being obtained, yet pressure is high. It is recommended during evacuation process to break vacuum to facilitate evacuation.
- To break the vacuum, shut valves A, B, and C and connect a refrigerant cylinder to charging port on manifold. Purge air from hose. Raise standing vacuum pressure in system to zero (0 psig) gauge pressure. Repeat process two or three times during evacuation.

Note: *It is unlawful to release refrigerant into the atmosphere. When service procedures require working with refrigerants, the service technician must comply with all Federal, State, and local laws.*

Standing Vacuum Test

Once 300 microns or less is obtained, close valve A and leave valves B and C open to allow the vacuum gauge to read the actual system pressure. Let system equalize for approximately 15 minutes. This is referred to as a standing vacuum test where time versus pressure rise. Maximum allowable rise over a 15 minute period is 200 microns. If pressure rise is greater than 200 microns but levels off to a constant value, excessive moisture is present. If pressure steadily continues to rise, a leak is indicated. Figure 23, p. 57 illustrates three possible results of standing vacuum test.

If a leak is encountered, repair the system and repeat the evacuation process until the recommended vacuum is obtained. Once the system has been evacuated, break the vacuum with refrigerant and complete the remaining Pre-Start procedures before starting the unit.

Figure 22. Typical vacuum pump hookup

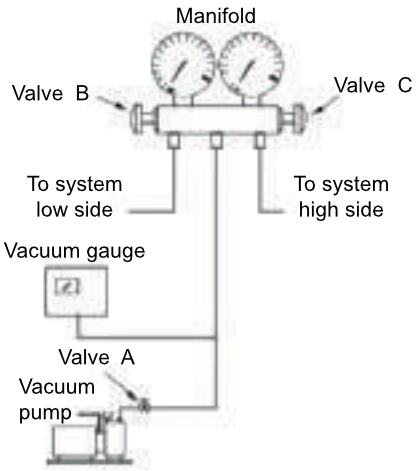
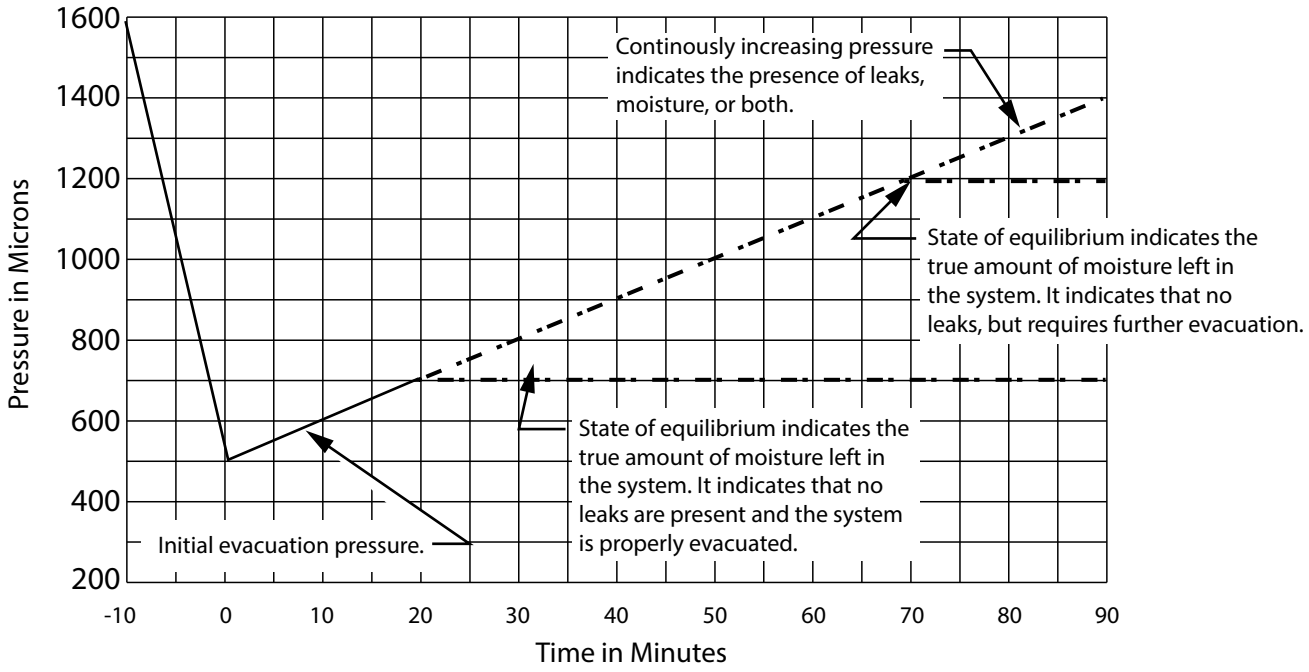


Figure 23. Evacuation time vs. pressure rise



Compressors

Scroll Compressor Failure Diagnosis and Replacement

If compressor failure is suspected, refer to *CSHD and CSHN/CSHL Compressors Installation and Service Installation Instructions* (COM-SVN01*-EN) for detailed information regarding compressor failure diagnosis and replacement of scroll compressors.

Components

Cleaning Coil Fin

⚠ WARNING

Hazardous Chemicals!

Failure to follow this safety precaution could result in death or serious injury. Coil cleaning agents can be either acidic or highly alkaline and can burn severely if contact with skin or eyes occurs.

Handle chemical carefully and avoid contact with skin. ALWAYS wear Personal Protective Equipment (PPE) including goggles or face shield, chemical resistant gloves, boots, apron or suit as required. For personal safety refer to the cleaning agent manufacturer's Materials Safety Data Sheet and follow all recommended safe handling practices.

⚠ WARNING

Hazardous Voltage w/Capacitors!

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

Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. Verify with a CAT III or IV voltmeter rated per NFPA 70E that all capacitors have discharged.

NOTICE

Coil Damage!

Failure to follow instructions below could result in coil damage.

Do not clean the refrigerant coil with hot water or steam as it could cause high pressure inside the coil tubing.

Do not use acidic chemical coil cleaners. Also, do not use alkaline chemical coil cleaners with a pH value greater then 8.5 (after mixing) without using an aluminum corrosion inhibitor in the cleaning solution.

- Keep coils clean to maintain maximum performance. For operation at its highest efficiency, clean the refrigerant coil often during periods of high cooling demand or when dirty conditions prevail. Clean the coil a minimum of once per year to prevent dirt buildup in the coil fins, where it may not be visible.

- Remove large debris from the coils and straighten fins before cleaning. Remove filters before cleaning.
- Clean refrigerant coils with cold water and detergent, or with one of the commercially available chemical coil cleaners. Rinse coils thoroughly after cleaning.
- Economizer and evaporator coils are installed so the evaporator is directly behind the economizer. To clean between the coils, remove the sheet metal block off. Access the block off by removing the corner panels on the left or right rear side of the unit.
- If the refrigerant coil is installed back to back with the waterside economizer coil, use a cleaner that is acceptable for cleaning both types of coils.

Inspecting and Cleaning Coils

Coils become externally fouled as a result of normal operation. Coil surface dirt reduces heat transfer ability and can cause comfort problems, increased airflow resistance and thus increased operating energy costs.

Inspect coils at least every six months or more frequently as dictated by operating experience. Cleaning frequently is dependent upon system operating hours, filter maintenance, efficiency, and dirt load. Following is the suggested method for cleaning steam and hot water coils.

Hot Water Coils

⚠ WARNING

Hazardous Voltage w/Capacitors!

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

Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. Verify with a CAT III or IV voltmeter rated per NFPA 70E that all capacitors have discharged.

1. Disconnect all electrical power to the unit.
2. Wear appropriate personal protective equipment (PPE).
3. Access both sides of the coil section.
4. Use a soft brush to remove loose debris from both sides of the coil.
5. Use a steam cleaning machine, starting from the top of the coil and working downward. Clean the leaving air side of the coil first, then the entering air side. Use a block-off to prevent steam from blowing through the coil and into a dry section of the unit.
6. Repeat Step 5 as necessary. Confirm that the drain line is open following completion of the cleaning process.
7. Allow the unit to dry thoroughly before putting the system back into service.
8. Straighten any coil fins that may be damaged with a fin rake.
9. Replace all panels and parts and restore electrical power to the unit.
10. Confirm contaminated material does not contact other areas of the equipment or building. Properly dispose of all contaminated materials and cleaning solutions.

Refrigerant Coils

⚠ WARNING

Hazardous Voltage w/Capacitors!

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

Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. Verify with a CAT III or IV voltmeter rated per NFPA 70E that all capacitors have discharged.

1. Disconnect all electrical power to the unit.
2. Wear the appropriate personal protective equipment (PPE).
3. Access to the coil section of the unit (both sides).
4. Use a soft brush to remove loose debris from both sides of the coil.
5. Mix a high quality coil cleaning detergent with water according to the manufacturer's instructions. If the detergent is strongly alkaline after mixing (pH 8.5 or higher), it must contain an inhibitor. Carefully follow the cleaning solution manufacturer's instructions regarding product use.
6. Place the mixed solution in a garden pump-up sprayer or high pressure sprayer. If using a high pressure sprayer note the following:
   - Maintain a minimum nozzle spray angle of 15°.
   - Spray perpendicular to the coil face.
   - Protect other areas of the equipment and internal controls from contact with moisture or the cleaning solution.
   - Keep the nozzle at least 6 inches from the coil.
   - Do not exceed 600 psig.

Draining the Waterside Economizer Coil

NOTICE

Coil Freeze-Up!

Failure to follow instruction below could result in equipment damage.

Drain and vent coils when not in use. Trane recommends glycol protection in all possible freezing applications. Use a glycol approved for use with commercial cooling and heating systems and copper tube coils.

Drain plugs are in the piping below supply and return header for each coil. Use these plugs to drain the coil and piping. When draining the coil, open the vents at the top of the supply and return headers. Also, a drain plug is at the bottom of the inlet condenser manifold and in the outlet pipe near the left side of the unit. Remove these plugs to drain the condensers. Be sure to open the vent plugs at the top of the condenser inlet and outlet manifold.

When refilling the condenser/waterside economizer coil system with water, provide adequate water treatment to prevent the formation of scale or corrosion.

Chemical Cleaning of Economizer Coil

NOTICE

Proper Water Treatment Required!

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

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

Chemical cleaning removes scale deposits built up by minerals in the water. For a suitable chemical solution, consult a water treatment specialist. The condenser water circuit is composed of copper, steel, and cast iron. The chemical supply house should approve or provide all materials used in the external circulating system, along with the quantity of cleaning material, duration of cleaning time, and safety precautions necessary for handling the cleaning agent.

Piping Components

Water Valves

⚠ WARNING

Hazardous Voltage w/Capacitors!

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

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

Water valves have a stern packing nut. If there is evidence of water leakage at the valve stem, proceed as follows:

1. Remove actuator motor from support plate.
2. Remove shaft coupling.
3. Torque the packing nut to 10-ft.-lbs. of torque.
4. Replace shaft coupling.
5. Replace actuator motor.

Water Flow Switch

A water flow switch is required to be installed in the condenser water pipe within the unit. It is a standard feature and supplied from the factory.

When the flow switch detects a water flow loss prior to or during mechanical cooling, the compressor operation locks out and a diagnostic code displays. If water flow is restored, the compressor operation automatically restores.

Maintenance Periodic Checklists

⚠ WARNING

Hazardous Service Procedures!

Failure to follow all precautions in this manual and on the tags, stickers, and labels could result in death or serious injury.

Technicians, in order to protect themselves from potential electrical, mechanical, and chemical hazards, MUST follow precautions in this manual and on the tags, stickers, and labels, as well as the following instructions: Unless specified otherwise, disconnect all electrical power including remote disconnect and discharge all energy storing devices such as capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. When necessary to work with live electrical components, have a qualified licensed electrician or other individual who has been trained in handling live electrical components perform these tasks.

Monthly Checklist

The following check list provides the recommended maintenance schedule to keep the commercial self-contained equipment running efficiently.

1. Inspect unit air filters. Clean or replace if airflow is blocked or if filters are dirty.
2. Inspect coils for excess moisture or icing. Icing on the coils may indicate low airflow supply, restricted airflow from dirty fins, evaporator frost protection sensor problems, or a shortage of refrigerant flowing through the coil.
3. Check that condensate from the evaporator and economizer coils flows freely through the condensate piping, traps, drain pan, and drainage holes. Remove algae and or any airflow obstructions.
4. Check the condition and tension of fan belts. Adjust tension if belts are floppy or squeal continually. Replace worn or fraying belts in matched sets.

   Note: *Check belt tension and adjust it at least twice daily the first days of new belt operation. Belt tension will rapidly decrease until the belts are run in.*
5. Check the liquid line sight glasses during operation. Bubbles in the sight glasses indicate a possible shortage of refrigerant or an obstruction in the liquid lines, e.g. dirty liquid line filter driers.
6. Inspect filter driers for leaks, flow obstructions, or temperature drop across the filter drier. A noticeable temperature differential, e.g. 5°F, in the liquid line may indicate an obstruction. Replace the filter drier if it appears clogged.
7. Inspect the optional waterside economizer coil. Clean the coil to prevent airflow restrictions through the fins.
8. Check and record operating pressures.

Semi-Annual Maintenance

⚠ WARNING

Rotating Components!

Failure to disconnect power before servicing could result in rotating components cutting and slashing technician which could result in death or serious injury.

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized.

1. Verify the fan motor is properly lubricated. Follow lubrication recommendations on the motor tag or nameplate. Contact the motor manufacturer for more information.
2. Lubricate fan bearings. For best results, lubricate bearings during unit operation. Refer to the “Fan Bearings” section for recommended grease.

   Note: *The bearings are manufactured using a special synthetic lithium-based grease designed for long life and minimum lube intervals. Over lubrication can be just as harmful as not enough.*
3. With power disconnected, manually rotate the fan wheel to check for obstructions in the housing or interference with fan blades. Remove obstructions and debris. Center the fan wheel if necessary.Inspect for any damage to fan blades and housing. Check impeller for wear/deposits/corrosion and damage.
4. Check the fan assembly sheave alignment. Tighten set screws to their proper torques.
5. Check water valves for leakage at valve stem packing nut.

   Note: *Perform this procedure monthly if the unit is in a coastal or corrosive environment.*

Annual Maintenance

Check and tighten all set screws, bolts, locking collars and sheaves.

1. Inspect, clean, and tighten all electrical connections.
2. Visually inspect the entire unit casing for chips or corrosion. Remove rust or corrosion and repaint surfaces.
3. Visually check for leaks in refrigerant piping.
4. Inspect fan, motor, and control contacts. Replace badly worn or eroded contacts.
5. Inspect the thermal expansion valve sensing bulbs for cleanliness, good contact with the suction line, and adequate insulation from ambient air.
6. Verify the superheat setting is 12°F to 17°F at the compressor.

When checking operating pressures and conditions, establish the following nominal conditions for consistent measurements.

- Leaving air temperature greater than 60°F.
- Entering air temperature is 80°F to 90°F.
- Entering water temperature greater than 65°F.
- Compressors running at full load.
- Drain the condensing water system and inspect it thoroughly for fouling; clean if necessary.

Diagnostics

Troubleshooting

System Checks

⚠ WARNING

Live Electrical Components!

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

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

Before proceeding with technical trouble charts or controls checkout, complete the following system analysis:

1. Measure actual supply voltage at the compressor and an motor terminals with the unit running. Voltage must be within the range listed on the motor nameplate. Phase imbalance must be less than 2.0 percent.
2. Check all wiring and connections to be sure that they are intact, secure and properly routed. The as wired system diagrams are provided in the unit control panel.
3. Check that all fuses are installed and properly sized.
4. Inspect air filters and coils to be sure that airflow to the unit is not restricted.
5. Check the zone thermostat settings.
6. Confirm the fan is rotating in the proper direction. If phasing is wrong at the main power terminal block, the fan and compressors will not run correctly.
7. Inspect ductwork and duct connections for tightness.

Operating Procedures

Install pressure gauges on the discharge and suction line access valves. When the unit has stabilized (after operating approximately 15 minutes at full load), record suction and discharge pressures. System malfunctions such as low airflow, line restrictions, incorrect refrigerant charge, malfunctioning of expansion valves, damaged compressors, etc. will result in pressure variations which are outside the normal range.

Note: *If phasing at the main incoming power terminal is incorrect, switch two of the three incoming power leads. If a compressor has been replaced and the phase is changed at the compressor, it will run backwards and discharge pressure will be very low. To resolve incorrect compressor wire phasing, change phasing at the compressor.*

It is important that pressures be measured under stable and constant conditions in order for the readings to be useful.

Voltage Imbalance

Voltage imbalance on three-phase systems can cause motor overheating and premature failure. Maximum allowable imbalance is 2.0 percent, and the readings used to determine it must be measured at the compressor terminals.

Voltage imbalance is defined as 100 times the sum of the division of the three voltages from the average voltage. If, for example, the three measured voltages are 221, 230, 227, the average is:

$$\frac{221 + 230 + 227}{3} = 226 \text{ volts}$$

Therefore, the percentage of voltage imbalance is:

100*(226-221)/226 = 2.2%

In this example, 2.2 percent imbalance of more than 2.0 percent exists, be sure to check the voltage at the unit disconnect and terminal block switch. If an imbalance at the unit disconnect switch does not exceed 2.0 percent, the imbalance is caused by faulty wiring within the unit. Be sure to conduct a thorough inspection of the unit electrical wiring connections to locate the fault, and make any repairs necessary.

Table 17. Potential unit issues and solutions

Problem	Possible Cause	Remedy
Drain pan is overflowing	Plugged drain line Unit not level	Clean drain line Level unit
Standing water in drain pan	Unit not level Plugged drain line	Level Unit Clean drain line
Wet interior insulation	Coil face velocity too high Improper trap design Drain pan leaks/overflowing Condensation on surfaces	Reduce fan speed Design trap per unit installation instructions Repair Leaks Insulate surfaces
Excess dirt in unit	Missing filters Filter bypass	Replace filters Reduce filter bypass
Microbial growth (mold)	Standing water in drain pan	See "Standing water in drain pan" above

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