

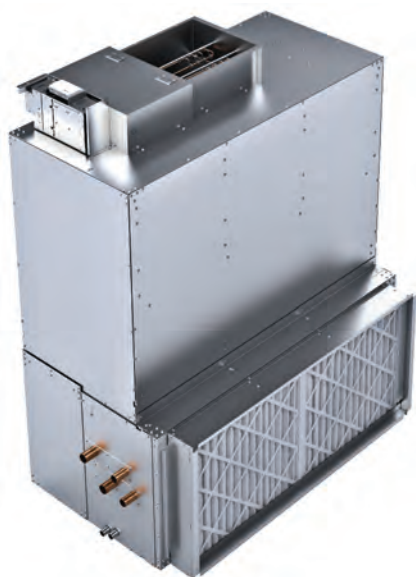


Installation, Operation, and Maintenance

Blower Coil Air Handler

Models BCHE and BCVE

Single Zone Air Handler, 400 to 4000 CFM



⚠ 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.



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 or R-32 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 or R-32 refrigerant which is flammable (A2L). Use **ONLY** R-454B or R-32 rated service equipment and components. For specific handling concerns with R-454B or R-32, contact your local representative.

⚠ WARNING**Cancer and Reproductive Harm!**

This product can expose you to chemicals including lead and bisphenol A (BPA), which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov.

⚠ WARNING**Electrical Shock Hazard!**

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

Properly connect the system's oversized protective earthing (grounding) terminal(s).

NOTICE**Equipment Damage!**

Failure to follow instructions below could result in equipment damage.

Connect **PARTIAL UNITS** only to an appliance suitable for the same refrigerant.

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Product Safety Information

This appliance is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction concerning use of the appliance by a person responsible for their safety. Children should be supervised to ensure that they do not play with the appliance.

Maximum altitude of use 3000 meters.

This appliance incorporates an earth connection for functional purposes only.

Revision History

- Updated the Available Electric Heat (kW) table in the Electrical Data chapter.
- Added information about R-32 refrigerant.
- Updated A2L Information chapter.



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Model Number Description

Digit 1, 2, 3, 4 — Unit Model

BCHE = Horizontal Blower Coil
BCVE = Vertical Blower Coil

Digit 5, 6, 7 — Unit Size

012 = Unit size 12 - 1 Ton
018 = Unit size 18 - 1.5 Ton
024 = Unit size 24 - 2 Ton
036 = Unit size 36 - 3 Ton
048 = Unit size 48 - 4 Ton
054 = Unit size 54 - 4.5 Ton
060 = Unit size 60 - 5 Ton
072 = Unit size 72 - 6 Ton
090 = Unit size 90 - 7.5 Ton
120 = Unit size 120 - 10 Ton

Digit 8 — Unit Voltage

A = 115V/60 Hz/1 pH
B = 208V/60 Hz/1 pH
C = 230V/60 Hz/1 pH
D = 277V/60 Hz/1 pH
E = 208V/60 Hz/3 pH
F = 230V/60 Hz/3 pH
G = 460V/60 Hz/3 pH
J = 220V/50 Hz/1 pH
K = 240V/50 Hz/1 pH
L = 380V/50 Hz/3 pH
M = 415V/50 Hz/3 pH
N = 575V/60 Hz/3 pH

Digit 9 — Insulation

A = Matte faced insulation 1-in.
B = Double wall insulation 1-in.

Digit 10, 11 — Design Sequence

** = Factory assigned

Digit 12 — Motor/Control Box Location or Inlet Location

A = Same side as coil connections
B = Front return
C = Bottom return

Digit 13 — Coil Connection Side

0 = None
1 = PVC drain pan right hand coil
2 = PVC drain pan left hand coil
3 = SST drain pan right hand coil
4 = SST drain pan left hand coil
5 = PVC drain pan front connection
6 = SST drain pan front connection

Digit 14 — Coil #1 First Coil in Air Stream

0 = None
A = 1-row hydronic preheat
B = 4-row hydronic
C = 6-row hydronic
D = 4-row hydronic changeover / dual purpose coil
E = 6-row hydronic changeover / dual purpose coil
F = 2-row hydronic preheat
G = 3-row DX 3/16-in.
H = 4-row DX 3/16-in.
J = 6-row DX 3/16-in.
K = 4-row DX 3/16-in. (0.049) Dist, Heat Pump
L = 6-row DX 3/16-in. (0.049) Dist, heat pump
M = 8-row hydronic
N = 8-row hydronic changeover / dual purpose coil

Digit 15 — Coil #2 Second Coil in Air Stream

0 = None
A = 1-row hydronic reheat
B = 4-row hydronic
C = 6-row hydronic
F = 2-row hydronic reheat
G = 3-row DX 3/16-in.
H = 4-row DX 3/16-in.
J = 6-row DX 3/16-in.
K = 4-row DX 3/16-in. Dist, Heat Pump
L = 6-row DX 3/16-in. Dist, heat pump

Digit 16 — Motor Horsepower

2 = 0.5 HP (0.4 HP 3PH 50 HZ)
4 = 1 HP (0.8 HP 3PH 50 HZ)
5 = 1.5 HP (1.25 HP 3PH 50 HZ)
7 = 3 HP (2.5 HP 3PH 50 HZ)
8 = 2.3 HP
9 = 3.5 HP
A = 5 HP (4.5 HP 3PH 50 HZ)

Digit 17 — Refrigerant Types

A = No Refrigerant
C = R-454B
D = R-410A replacement only
E = R-32

Digit 18 — Electric Heat Stages

0 = None
1 = 1-stage
2 = 2-stage
3 = SCR

Digit 19, 20, 21 — Electric Heat kW

000 = None
010 = 1.0 kW
020 = 2.0 kW
030 = 3.0 kW
040 = 4.0 kW
050 = 5.0 kW
060 = 6.0 kW
070 = 7.0 kW
080 = 8.0 kW
090 = 9.0 kW
100 = 10.0 kW
120 = 12.0 kW
150 = 15.0 kW
170 = 17.0 kW
200 = 20.0 kW
240 = 24.0 kW
300 = 30.0 kW

Digit 22 — Reserved

0 = Factory Set

Digit 23 — Electric Heat Options

0 = None
A = Interlocking disconnect switch
B = Interlock disc and heater fuse

Digit 24 — Filters

0 = None
A = 1-in. Throwaway
B = 2-in. MERV 8
C = 2-in. MERV 13
D = 2-in. MERV 8 and 2-in MERV 13 Combination

Digit 25 — Accessory Section

0 = None
B = Angle filter box
C = Angle filter/mix box
D = Bottom (or top) access filter mod
E = Discharge attenuator
G = Discharge attenuator and angle filter box
H = Discharge attenuator and angle filter/mixing box
J = Discharge attenuator and bottom (or top) access filter mod
L = Return attenuator with angle filter box
M = Return attenuator with bottom (or top) access filter mod
N = Discharge and inlet attenuator
P = Return attenuator and discharge attenuator and Bottom (or Top) access filter mod
Q = Return attenuator and discharge attenuator and angle filter box
R = Bottom (or top) access filter mod and mixing box

Digit 26 — Control Type

A = CSTI fan status
B = CSTI
E = Symbio™ 400B
F = Symbio 400B and WCI

Digit 27 — Coil #1 Control Valve Type

0 = None
A = 2-way, 2 position N.C.
B = 2-way, 2 position N.O.
C = 3-way, 2 position N.C.
D = 3-way, 2 position N.O.
E = 2-way, modulating
F = 3-way, modulating
G = Field supplied, 2 position N.C.
H = Field supplied, 2 position N.O.
J = Field supplied, modulating
K = Field supplied, analog (2-10 Vdc)

Digit 28 — Coil #1 Control Valve Cv

0 = None
A = 2-way 2.3 Cv 3/4-in. valve
B = 2-way 3.3 Cv 3/4-in. valve
C = 2-way 4.6 Cv 3/4-in. valve
D = 2-way and 3-way 7.4 Cv 1-in. valve
E = 2-way and 3-way 10.0 Cv 1-in. valve
F = 3-way 1.0 Cv 1/2-in. valve
G = 3-Way 2.7 Cv 1/2-in. valve
H = 3-Way 4.6 Cv 3/4-in. valve
J = 2-way PIC 0.9 GPM
K = 2-way PIC 2 GPM
L = 2-way PIC 4.3 GPM
M = 2-way PIC 9 GPM

Digit 29 — Reserved

0 = Factory set

Digit 30 — Coil #2 Control Valve

0 = None
A = 2-way, 2 position N.C.
B = 2-way, 2 position N.O.
C = 3-way, 2 position N.C.
D = 3-way, 2 position N.O.
E = 2-way, modulating
F = 3-way, modulating
G = Field supplied, 2 position N.C.
H = Field supplied, 2 position N.O.
J = Field supplied, modulating
K = Field supplied, analog (2-10 VDC)

Digit 31 — Coil #2 Control Valve Cv

0 = None
A = 2-way 2.3 Cv 3/4-in. valve
B = 2-way 3.3 Cv 3/4-in. valve
C = 2-way 4.6 Cv 3/4-in. valve
D = 2-way and 3-way 7.4 Cv 1-in.
E = 2-way and 3-way 10.0 Cv 1-in. valve
F = 3-way 1.0 Cv 1/2-in. valve
G = 3-way 2.7 Cv 1/2-in. valve
H = 3-way 4.6 Cv 3/4-in. valve
J = 2-way PIC 0.9 GPM
K = 2-way PIC 2 GPM
L = 2-way PIC 4.3 GPM
M = 2-way PIC 9 GPM

Digit 32 — Reserved

0 = Future offering

Digit 33 — Reserved

0 = Future offering

Digit 34 — Mixing Box Damper Actuator

0 = None
2 = Modulating, N.C.
3 = Modulating, N.O.

Digit 35 — Factory Mounted Control Options

0 = None
A = Condensate overflow
B = Condensate Overflow and Low Limit

Digit 36 — Control Options 2

0 = None
A = Outside air sensor, field mounted
B = Discharge air sensor
C = Outside air and discharge air sensor

Digit 37 — Control Options 3

0 = None
A = Dehumidification with local sensor
B = CO₂ sensor
C = Air-Fi® Dehumidification and CO₂
D = Air-Fi Dehumidification
E = Air-Fi CO₂

Digit 38 — Zone Sensors

0 = None
A = Wall-mounted temperature sensor (OCC/UNOCC, COMM)
B = Wall-mounted
C = Wall-mounted temperature sensor (SP, OALMH, OCC/UNOCC, COMM)
D = Wall-mounted display sensor (SP, OALHH, COMM)
E = Wireless display sensor, Unit-mounted receiver (SP, OALMH)
F = Wall-mounted FSS

Digit 39 — Seismic Certification

0 = None
A = IBC seismic certification
B = OSHPD seismic certification

Digit 40 — Extra filter

0 = None
1 = Extra 1-in. throwaway ship loose
2 = Extra 2-in. MERV 8 pleated throwaway ship loose
3 = Extra 2-in. MERV 13 pleated throwaway ship loose
4 = Extra 2-in. MERV 8 and MERV 13 pleated throwaway ship loose



General Information

Blower Coil units are draw-thru air handlers for cooling load conditions of 400–4000 cfm. Units are available in horizontal (model BCHE) and vertical (model BCVE) configurations. Horizontal units are typically ceiling suspended via threaded rods.

Lugs are provided on all four corners to secure the rods. Horizontal units can also be floor mounted. Vertical units are typically floor mounted. They have a side inlet for easy duct connection, and do not require a field fabricated inlet plenum. Vertical units ship in either one piece (size 24 to 60) or two pieces (size 72 to 120). Horizontal and Vertical Accessory sections ship separate from the main unit.

Basic unit components consist of a coil, condensate drain pan, filter, duct collars, one fan wheel, and an electronically commutated motor (ECM).

Four-row, six-row or eight-row main coils are available for either hydronic cooling or heating. Three, four, or six-row direct expansion (DX) coils are also available for cooling. An optional one-row or two-row heating coil is available factory-installed in either the preheat or reheat position.

All units have a bolt on flat filter frame for one or two 2-inch filters. An optional angle filter box (two inch only), mixing box, bottom filter access box, or combination angle filter mixing box is available. In addition, all units are available with valve kit. The valve kit consists of a control valve (Pressure Independent Control (PIC) valve available as an option), a circuit setter, and a strainer.

Direct-drive motors range from 1/2 to 5 horsepower in a wide range of voltages. All motors have internal current overload protection, permanently sealed ball bearings, and rubber grommets on the mounting brackets to reduce noise and vibration transmission.

Motors come factory programmed for specific job requirements. Field adjustment of motor speeds can be made through the VelociTach™ motor control board. This enables the unit to be easily balanced for changes to design static pressures. Refer to the original sales order and the motor control board label on the unit for the programmed motor speed. Several factory installed and tested control options are available.

NOTICE

Equipment Damage!

Failure to follow instructions below could result in equipment damage.

This unit is a partial unit air conditioner, complying with partial unit requirements of standards listed, and must only be connected to other units that have been confirmed as complying to corresponding PARTIAL UNIT requirements of these Standards: UL 60335-2-40/ CSA C22.2 No. 60335-2-40, or UL 1995/CSA C22.2 No 236.

Figure 1. Horizontal Blower Coil (BCHE model)

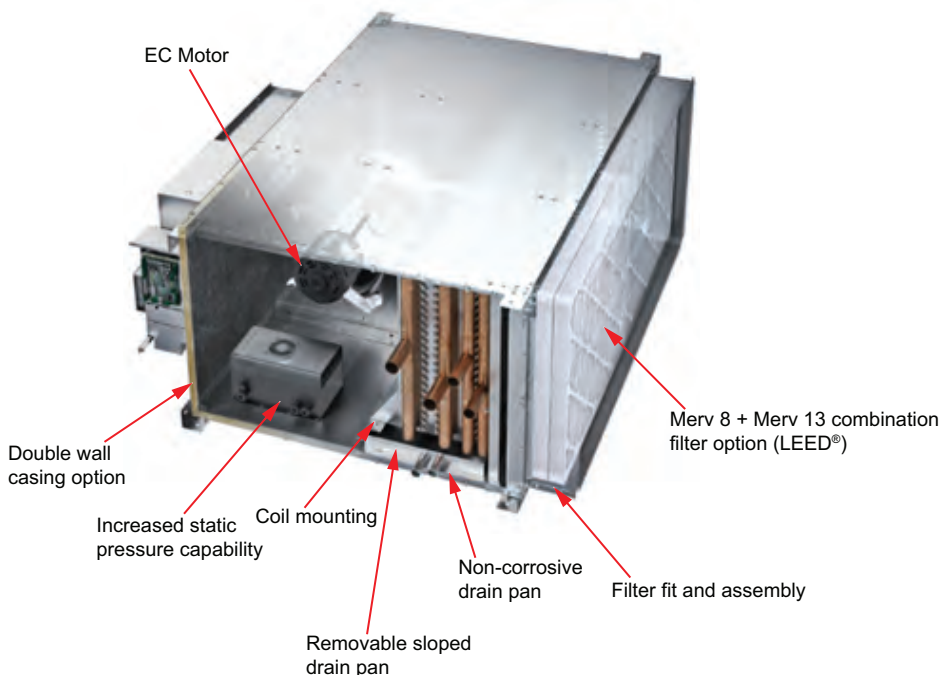
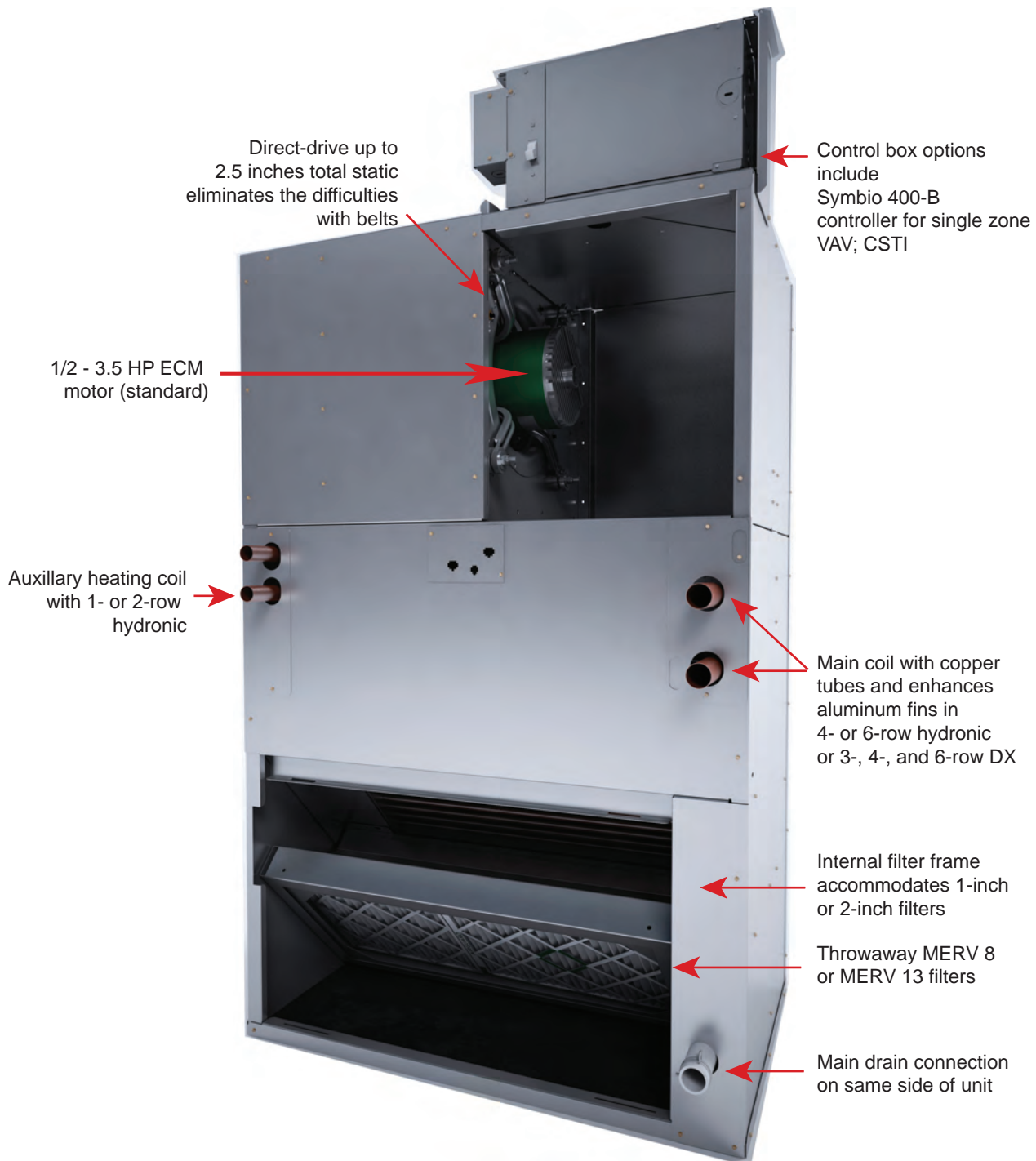


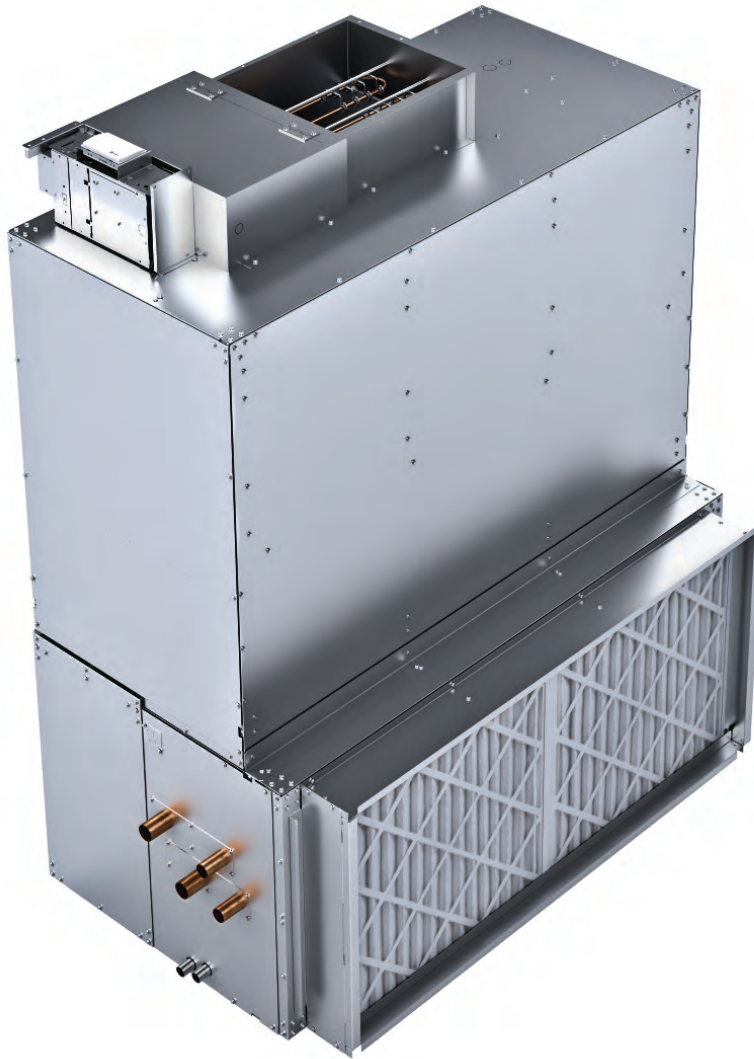
Figure 2. Vertical Blower Coil BCVE size 24 to 60





General Information

Figure 3. Vertical Blower Coil BCVE size 72 to 120





Pre-Installation

Receiving and Handling

Inspection

Upon delivery, thoroughly inspect all components for any shipping damage that may have occurred, and confirm that the shipment is complete.

Note: *Delivery cannot be refused. All units are shipped F.O.B. factory. Trane is not responsible for shipping damage.*

Packaging/Shipping

Blower Coil units ship assembled on skids with protective coverings over the coil and discharge openings.

Field-installed sensors ship separately inside the unit's main control panel. Valve kits and accessories are packaged separately and ship separate from the unit. The valve kits are shrink wrapped to a board and packaged in a box.

Identification

Each unit includes a nameplate identifying the section type and functional components, customer tagging information, unit serial number, unit order number, and the unit model number. The valve kits are individually labeled with customer tagging and order numbers.

Handling

The unit ships on skids that provide forklift locations from the front or rear. The skid allows easy maneuverability of the unit during storage and transportation. Trane recommends leaving units and accessories in their shipping packages/skids for protection and handling ease until installation. Remove the skids using a forklift or jack before placing the unit in its permanent location.

Receiving Checklist

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

- ☐ Check to ensure that the shipment is complete. Small components may ship inside the unit or ship separately. Check the parts list to ensure all materials are present. If any component is missing, contact your local Trane sales office.
- ☐ Check all units, components, connections, and piping. Check fan wheel for free rotation by spinning manually. Check all doors, latches and hinges. Inspect interior of each unit or section. Inspect coils for damage to fin surface and coil connections. Check for rattles, bent corners, or other visible indications of shipping damage. Tighten loose connections.
- ☐ If a unit is damaged, make specific notations using pictures and/or video concerning the damage on the freight bill. Do not refuse delivery.

- ☐ Notify the carrier's terminal of the damage immediately by phone and mail. Request an immediate joint inspection of the damage by the carrier and consignee.
- ☐ Notify your Trane sales representative of the damage and arrange for repair. Do not attempt to repair the unit without consulting the Trane representative.
- ☐ Inspect the unit for concealed damage as soon as possible after delivery. Report concealed damage to the freight line. It is the receiver's responsibility to provide reasonable evidence that concealed damage did not occur after delivery. Take photos of damaged material if possible.

Note: *Concealed damage must be reported within 15 days of receipt.*

Jobsite Storage

This unit is intended for indoor use only. It is the sole responsibility of the customer to provide the necessary protection to prevent vandalism and weather protection of the equipment. Under no circumstance should the unit be left unprotected from the elements.

NOTICE

Microbial Growth!

Failure to follow instructions below could result in odors and damage to the equipment and building materials.

The floor or foundation must be level and the condensate drain at the proper height for proper drainage and condensate flow. Standing water and wet surfaces inside the equipment can become an amplification site for microbial growth (mold). If there is evidence of microbial growth on the interior insulation, it should be removed and replaced prior to operating the system.

Outdoor Storage

Outdoor storage is **not** recommended. However, when indoor storage is not possible, Trane makes the following recommendations to prevent damage:

Note: *Keep the equipment on the original wooden blocks/skid for protection and ease of handling.*

- Select a well-drained area, preferably a concrete pad or blacktop surface.
- Place the unit on a dry surface or raised off the ground to assure adequate air circulation beneath the unit and to assure no portion of the unit will contact standing water at any time.
- Cover the unit securely with a canvas tarp.



Pre-Installation

NOTICE

Unit Corrosion Damage!

Plastic tarps can cause condensation to form in and on the equipment, which could result in corrosion damage or wet storage stains.

Use only canvas tarps to cover equipment.

- Do not stack units.
- Do not pile other material on the unit.

- The fan wheel and main drain pan are easily removable for cleaning.

Site Preparation

- Ensure the installation site can support the total weight of the unit. Refer to the unit submittals for actual weights.
- Allow sufficient space for adequate free air and necessary service access. Refer to submittals for specific minimums.
- Allow room for supply and return piping, ductwork, electrical connections, and coil removal. Support all piping and ductwork independently of the unit to prevent excess noise and vibration.
- Ensure there is adequate height for coil piping and condensate drain requirements.
- Consider coil piping and condensate drain requirements. Verify condensate line is continuously pitched 1 inch per 10 feet of condensate line run to adequately drain condensate.
- Confirm the floor or foundation is level. For proper unit operation, the unit must be level (zero tolerance) in both horizontal axis.

NOTICE

Microbial Growth!

Failure to follow instructions below could result in odors and damage to the equipment and building materials.

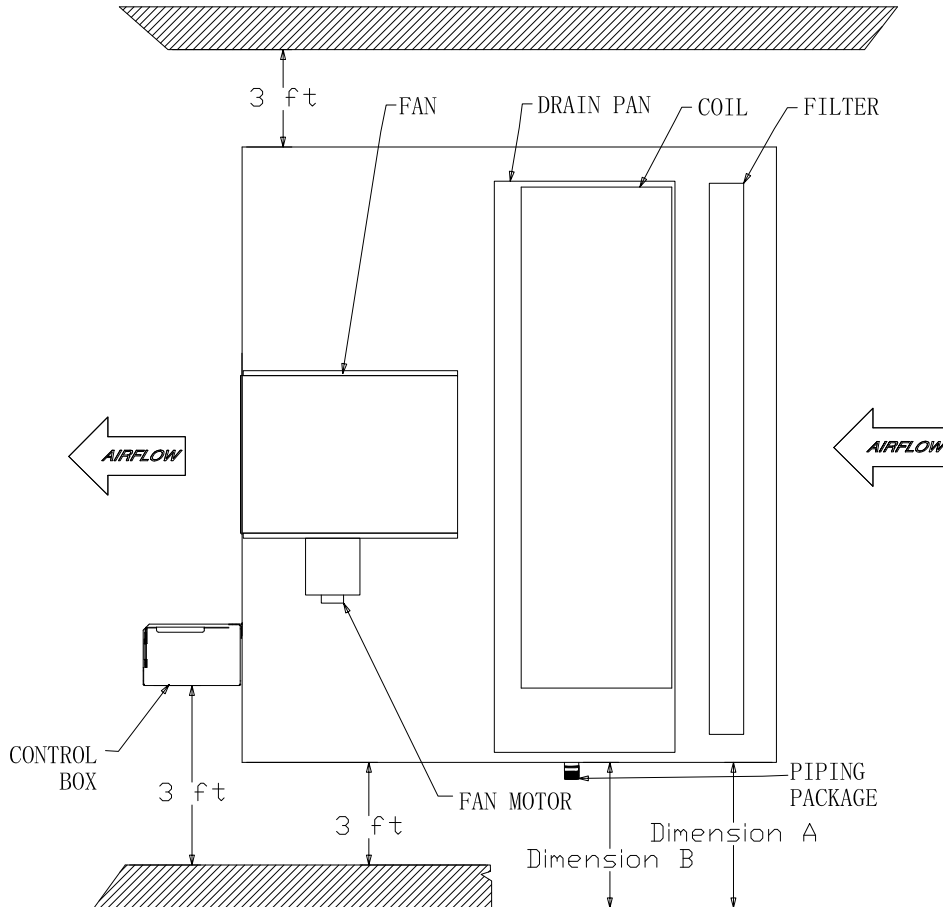
The floor or foundation must be level and the condensate drain at the proper height for proper drainage and condensate flow. Standing water and wet surfaces inside the equipment can become an amplification site for microbial growth (mold). If there is evidence of microbial growth on the interior insulation, it should be removed and replaced prior to operating the system.

- If the unit is to be ceiling mounted, the installer/contractor must provide threaded suspension rods. All units must be installed level.
- BCHE and BCVE units have either right or left hand piping. Reference piping locations by facing the front of the unit (airflow discharges from the front for BCHE and top for BCVE). The control panel is always on the end on the same side as the piping. Size 24-60 BCVE units have piping on the front of the unit.

Dimensions and Weights

Service Clearances

Figure 4. Recommended service clearance



Dimensions and Weights

Figure 5. Recommended service clearance for Blower Coil with electric heat

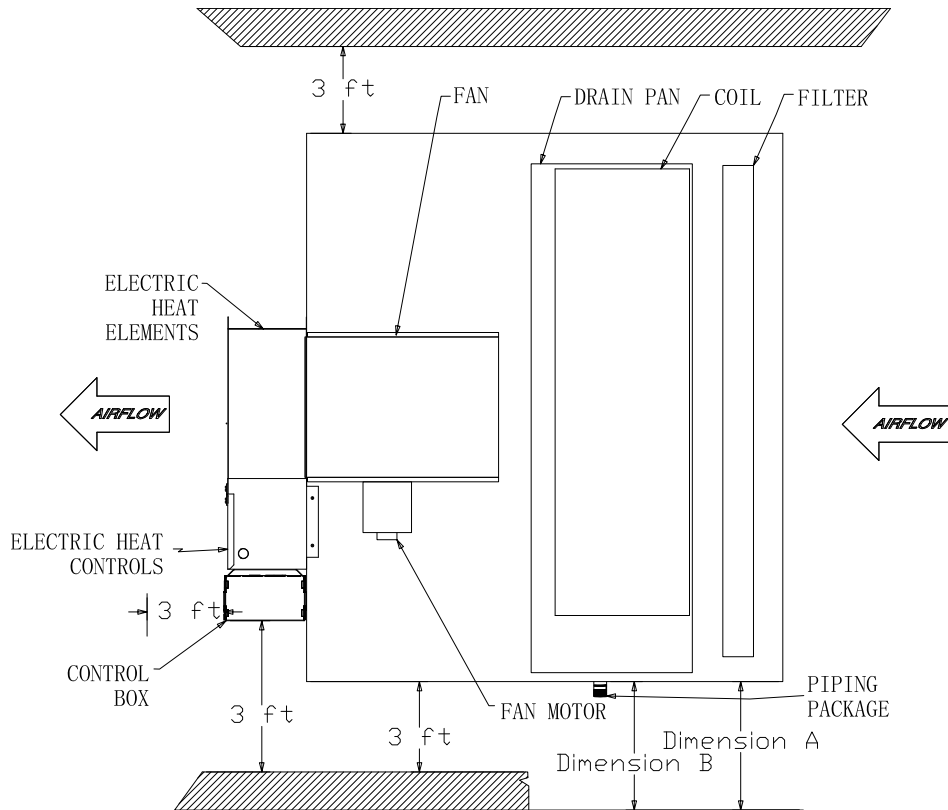
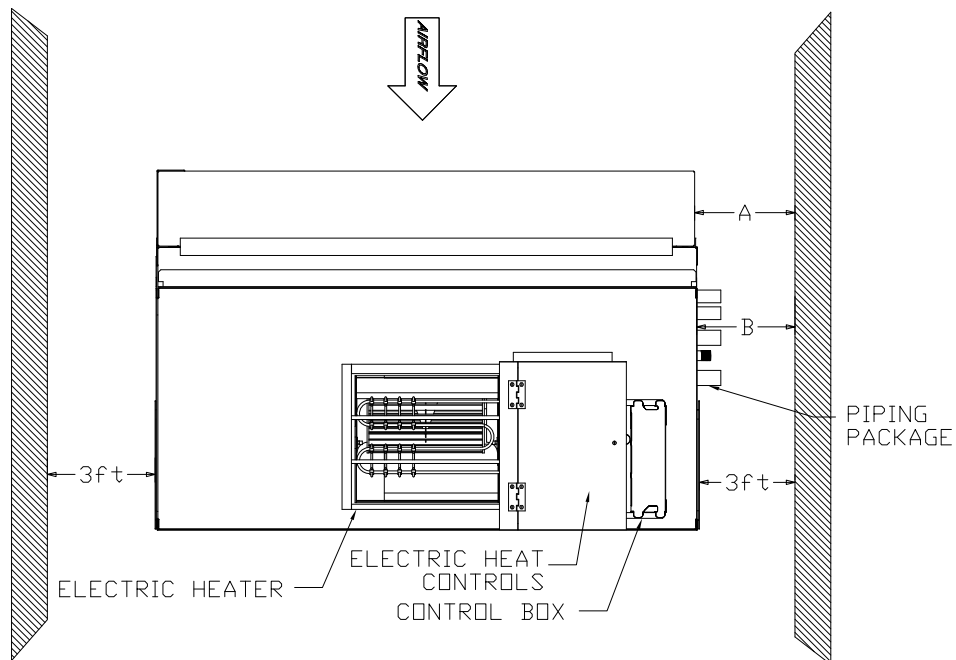


Table 1. Service requirements (inches)

Unit Size	Dimension A Filter Section	Dimension B Coil Section
12	24	26
18	30	30
24	30	30
36	30	42
54	30	48
72	30	60
90	30	50
120	30	60

Figure 6. Recommended service clearance for BCVE 72 to 120 with electric heat (top view)



Dimensions and Weights

Figure 7. Recommended service clearances for BCVE 72 to 120 (side view)

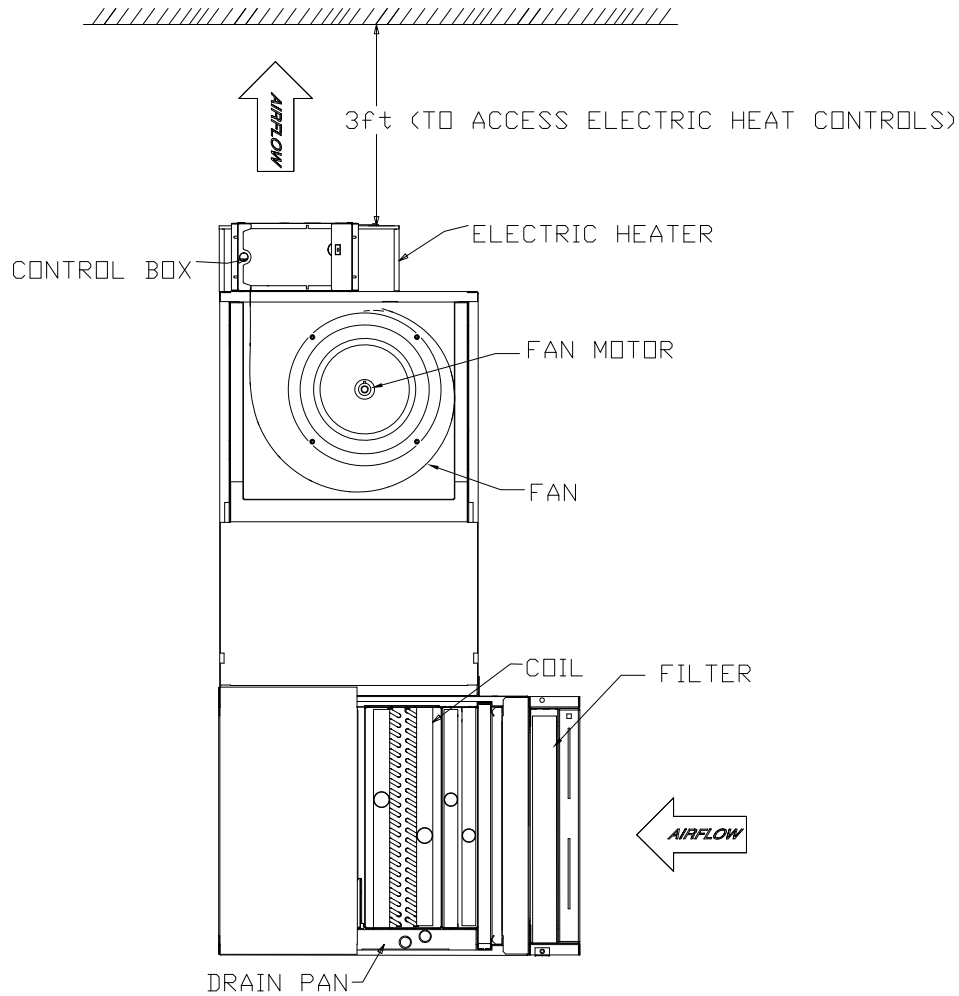
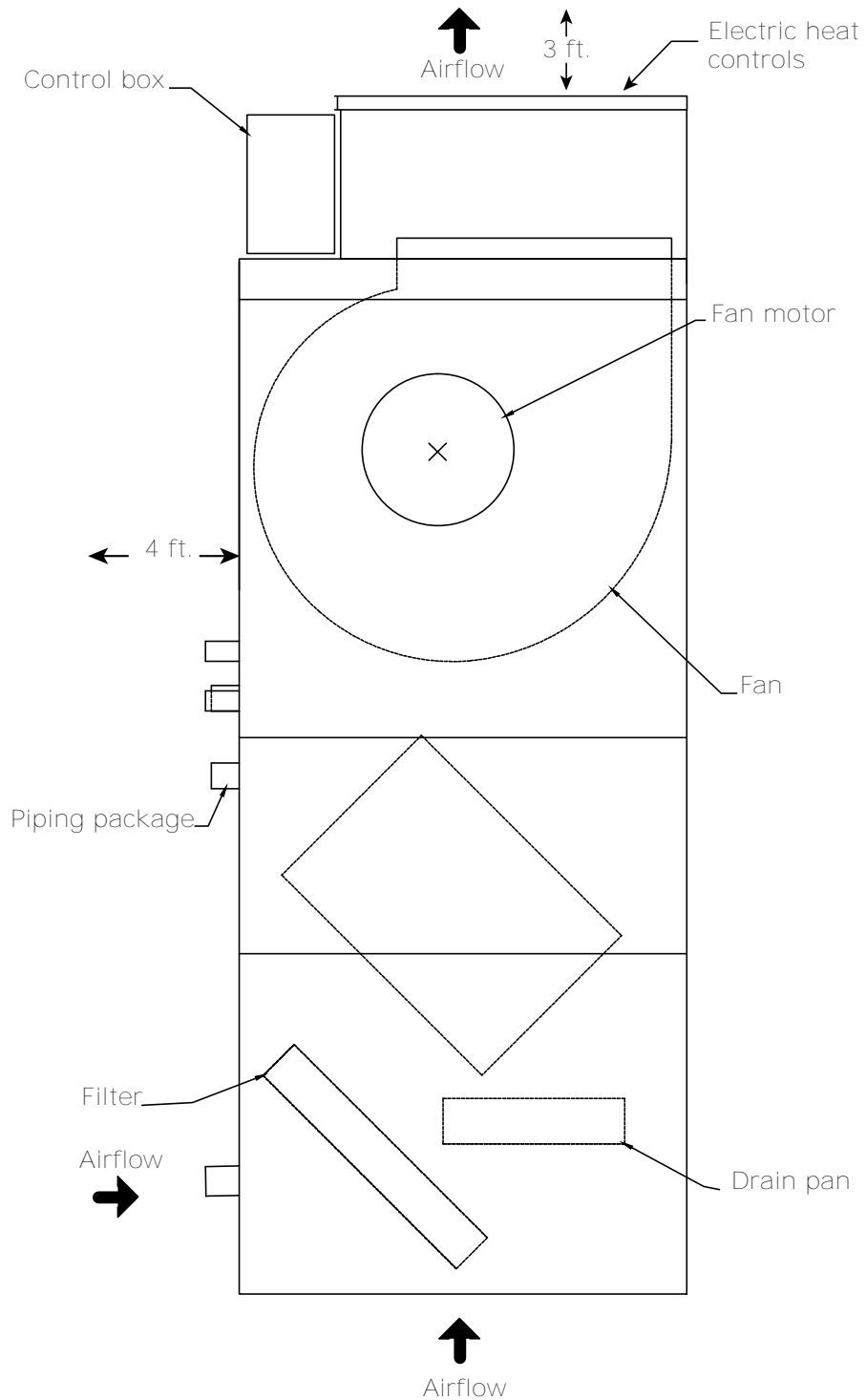


Figure 8. Service clearance for BCVE size 24 to 60



Horizontal Blower Coil

Figure 9. BCHE horizontal Blower Coil

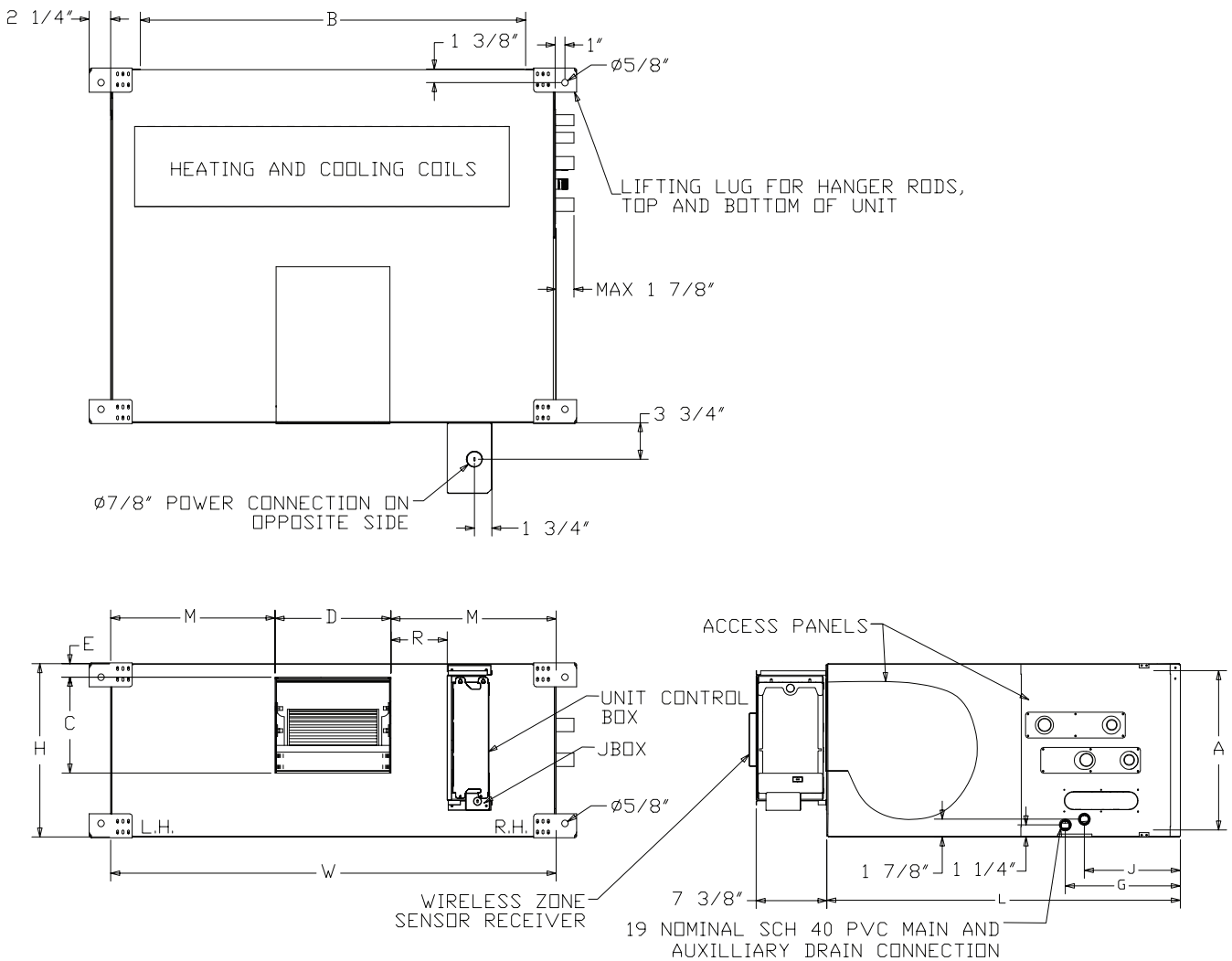


Table 2. BCHE horizontal Blower Coil dimensions (inches) and weights (lb)

Unit Size	H	W	L	A	B	C	D	E
12	17	24	30 1/4	15	18	10 3/4	7 1/8	2 1/4
18	17	28	30 1/4	15	22	10 3/4	7 1/8	2 1/4
24	17	30	30 1/4	15	24	10 3/4	7 1/8	2 1/4
36	17	42	34 1/4	15	36	9 7/8	8 5/8	1 1/8
54	18	46	36 7/8	16	40	10	12 1/8	1 3/8
72	18	58	35 7/8	16	52	10	12 1/8	1 3/8
90	26	48	40 3/4	24	42	13 3/4	12 5/8	2 7/8
120	26	58	40 3/4	24	52	13 3/4	15 5/8	2 7/8
Unit Size	G(RH)	G(LH)	J(RH)	J(LH)	M	R	Weight SW	Weight DW
12	10 5/8	12 5/8	8 5/8	10 5/8	8 3/8	1 1/2	86	109
18	10 5/8	12 5/8	8 5/8	10 5/8	10 3/8	3 1/2	90	115
24	10 5/8	12 5/8	8 5/8	10 5/8	11 3/8	2 1/4	92	118

Table 2. BCHE horizontal Blower Coil dimensions (inches) and weights (lb) (continued)

Notes:

1. All coil connections are sweat style.
2. Weight of basic unit includes cabinet, fan, wiring and average filter. It does not include coil, motor or shipping package.
3. Control box factory-mounted on drive side.
4. Single Wall (SW), Double Wall (DW). Dimensions are the same for SW and DW units.
5. All weights and dimensions are nominal.

Figure 10. Size 24 to 60 BCVE vertical Blower Coil

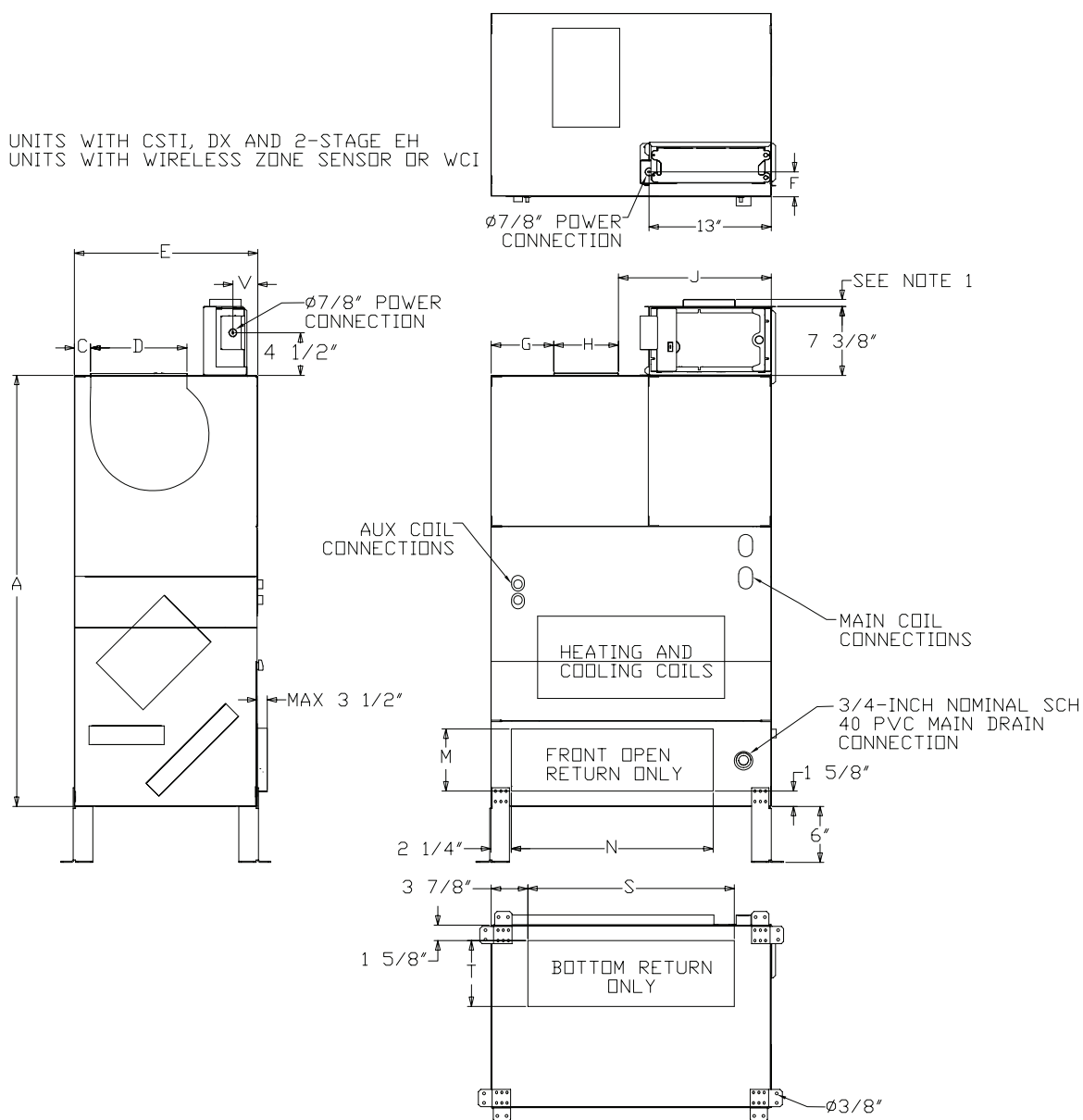


Figure 11. Size 72 to 120 BCVE vertical Blower Coil

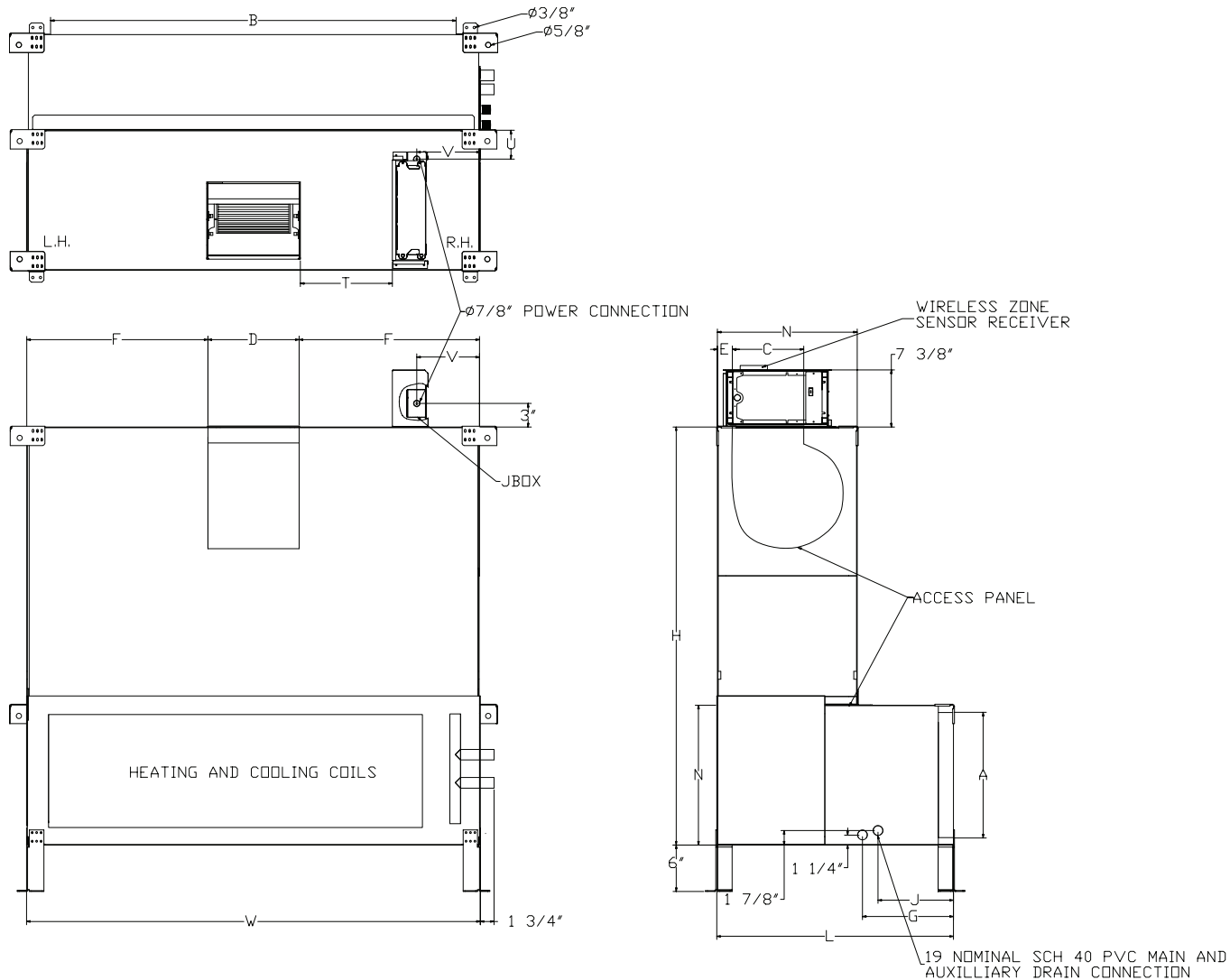


Table 3. BCVE 24 to 60 vertical Blower Coil dimensions (inches) and weights (lb)

Unit Size	A	B	C	D	E	F	G	H
24	45 7/8	29 3/4	1 1/2	10 3/4	19 1/2	2 5/8	6 5/8	7 1/8
36	49 7/8	29 3/4	2 1/4	10 7/8	23	2 5/8	6 3/8	9
48	56 5/8	34 3/4	1 5/8	13 7/8	24 1/2	2 5/8	7 7/8	11 1/2
60	58 5/8	34 3/4	1 1/2	13 7/8	27 1/2	2 5/8	7 7/8	11 1/2
Unit Size	J	M	N	S	T	V	Weight SW	Weight DW
24	16	6 3/4	21 3/4	22	7	2 5/8	118	163
36	14 3/8	10 1/4	21 3/4	22	11 1/4	2 5/8	135	188
48	15 3/8	12 1/8	26 3/4	27	12 1/2	2 5/8	170	237

Table 3. BCVE 24 to 60 vertical Blower Coil dimensions (inches) and weights (lb) (continued)

Unit Size	J	M	N	S	T	V	Weight SW	Weight DW
60	15 3/8	14 3/4	24 7/8	27	15 1/2	2 5/8	190	263

Notes:

1. All coil connections are sweat style.
2. Weight of basic unit includes cabinet, fan, wiring and average filter. It does not include coil, motor or shipping package.
3. Vertical units (size 24 to 60) provided with 6-inch mounting legs when seismic certification is required. Legs are required for seismic installations.
4. Single Wall (SW), Double Wall (DW). Dimensions are the same for SW and DW units.
5. All weights and dimensions are nominal.

Table 4. BCVE 72 to 120 vertical Blower Coil dimensions (inches) and weights (lb)

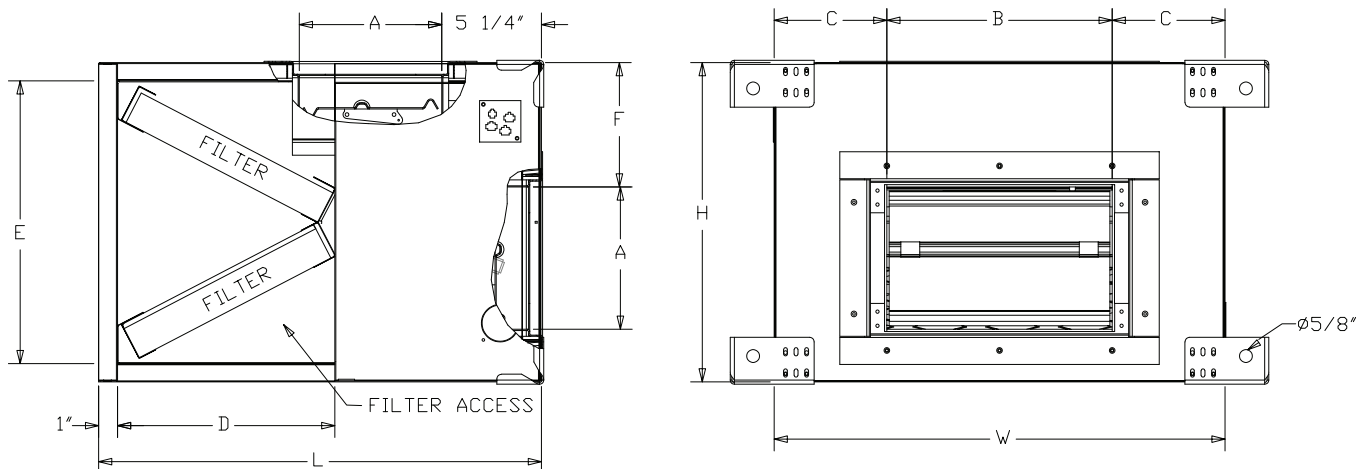
Unit Size	W	H	L	A	B	C	D	E	F	G(RH)
72	58	53 7/8	30 1/2	16	52	10	12	1 3/8	23	12
90	48	66 3/4	30 1/2	24	42	13 5/8	12 1/2	2 7/8	17 3/4	12
120	58	66 3/4	30 1/2	24	52	13 5/8	15 1/2	2 7/8	21 1/4	12
Unit Size	G(LH)	J(RH)	J(LH)	N	T	U	V	Weight SW	Weight DW	
72	14	10	12	18	11 7/8	3 3/4	8 1/8	214	302	
90	14	10	12	26	6 5/8	11 3/4	8 1/8	223	319	
120	14	10	12	26	10 1/8	11 3/4	8 1/8	245	355	

Notes:

1. All coil connections are sweat style.
2. Weight of basic unit includes cabinet, fan, wiring and average filter. It does not include coil, motor or shipping package.
3. Vertical coil and filter section ships separate for field installation.
4. Vertical units (size 24 to 60) provided with 6-inch mounting legs when seismic certification is required. Legs are required for seismic installations.
5. Single Wall (SW), Double Wall (DW). Dimensions are the same for SW and DW units.
6. All weights and dimensions are nominal.

Options

Angle Filter and Mixing Box

Figure 12. Combination angle filter and mixing box dimension


Dimensions and Weights

Figure 13. Mixing box dimension

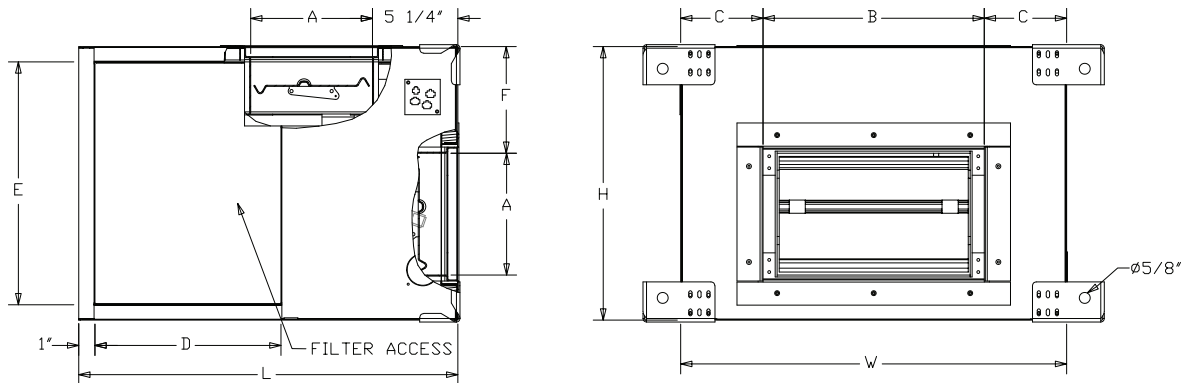


Figure 14. Angle filter box dimension

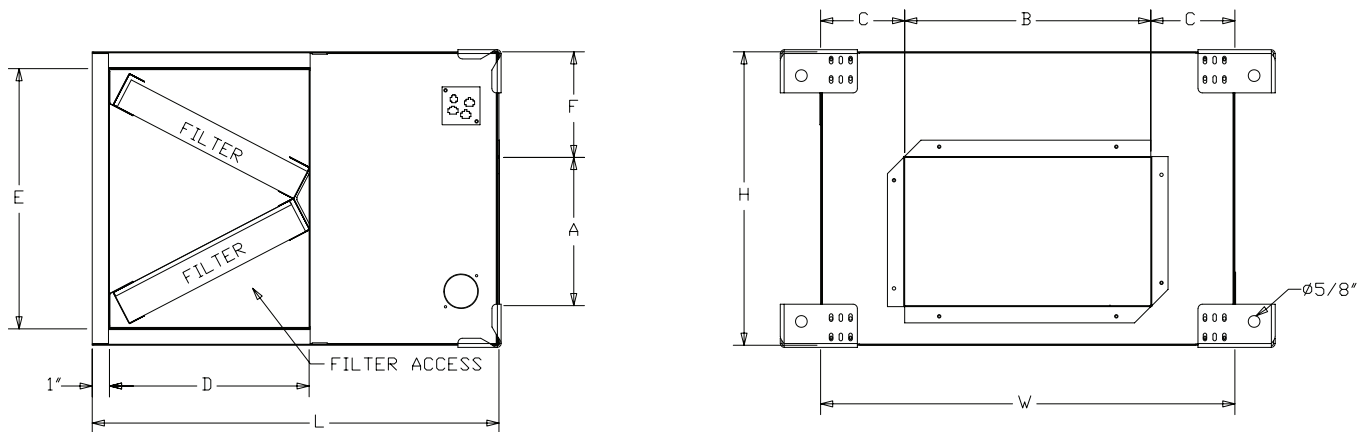


Table 5. Angle filter and mixing box dimensions (inches) and weights (lb)

Unit Size	H ^(a)	W	L	A	B	C	D	E
12	17	24	23 5/8	8 3/8	14	5	11 5/8	15
18	17	28	23 5/8	8 3/8	14	7	11 5/8	15
24	17	30	23 5/8	8 3/8	20	5	11 5/8	15
36	17	42	23 5/8	8 3/8	20	11	11 5/8	15
54	18	46	24 1/8	10 1/2	36	5	11 3/8	16
72	18	58	24 1/8	10 1/2	36	11	11 3/8	16
90	26	48	30 1/4	15 1/2	38	5	18 3/8	24
120	26	58	30 1/4	15 1/2	38	10	18 3/8	24
Unit Size	F	Weight Single Wall			Weight Double Wall			
		Mix Box and Angle Filter	Mix Box Only	Angle Filter Only	Mix Box and Angle Filter	Mix Box Only	Angle Filter Only	
12	6 1/4	56	48	38	72	64	54	
18	6 1/4	59	51	41	77	69	59	
24	6 1/4	66	57	43	84	75	61	
36	6 1/4	80	67	55	104	91	79	
54	5	102	89	56	126	113	80	
72	5	116	99	69	146	129	99	
90	5	140	122	76	175	157	111	

Table 5. Angle filter and mixing box dimensions (inches) and weights (lb) (continued)

Unit Size	F	Weight Single Wall			Weight Double Wall		
		Mix Box and Angle Filter	Mix Box Only	Angle Filter Only	Mix Box and Angle Filter	Mix Box Only	Angle Filter Only
120	5	155	133	90	196	175	131

Notes:

1. A and B dimensions do not include damper flanges.
2. All weights and dimensions are nominal.
- (a) Add 6-inch to height for size 72-120 BCVE units for factory-provided leveling legs. Legs are required for seismic installations.

Bottom/Top Access Filter Box

Figure 15. Bottom/top access filter box

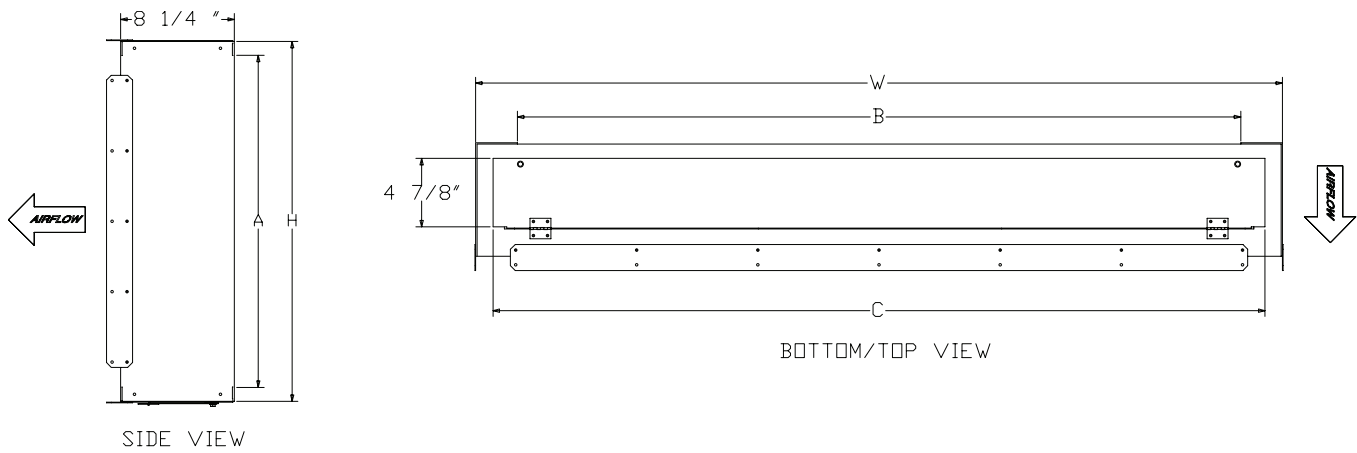


Table 6. Bottom/top access filter box dimensions (inches) and weights (lb)

Unit Size	Unit Type	H	W	L	A	B	C	SW Weight	DW Weight
12	BCHE	17	24	8 1/8	15	18	19 7/8	15	22
18	BCHE	17	28	8 1/8	15	22	23 7/8	17	24
24	BCHE	17	30	8 1/8	15	24	25 7/8	17	25
36	BCHE	17	42	8 1/8	15	36	37 7/8	23	32
54	BCHE	18	46	8 1/8	16	40	41 7/8	25	35
72	BCHE/BCVE	18	58	8 1/8	16	52	53 7/8	30	43
90	BCHE/BCVE	26	48	8 1/8	24	42	43 7/8	29	41
120	BCHE/BCVE	26	58	8 1/8	24	52	53 7/8	33	46

Notes:

1. Out swing hinged door on bottom of unit.
2. Single Wall (SW), Double Wall (DW). Dimensions are the same for SW and DW units.
3. All weights and dimensions are nominal.



Dimensions and Weights

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 or R-32 refrigerant. Use ONLY R-454B or R-32 rated service equipment or components with these units. For specific handling concerns with R-454B or R-32 refrigerant, 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.

Return and Discharge Attenuators

Figure 16. BCHE 12 to 120 and BCVE 72 to 120 attenuator

BCHE 12 to 120 and BCVE 72 to 120 attenuator

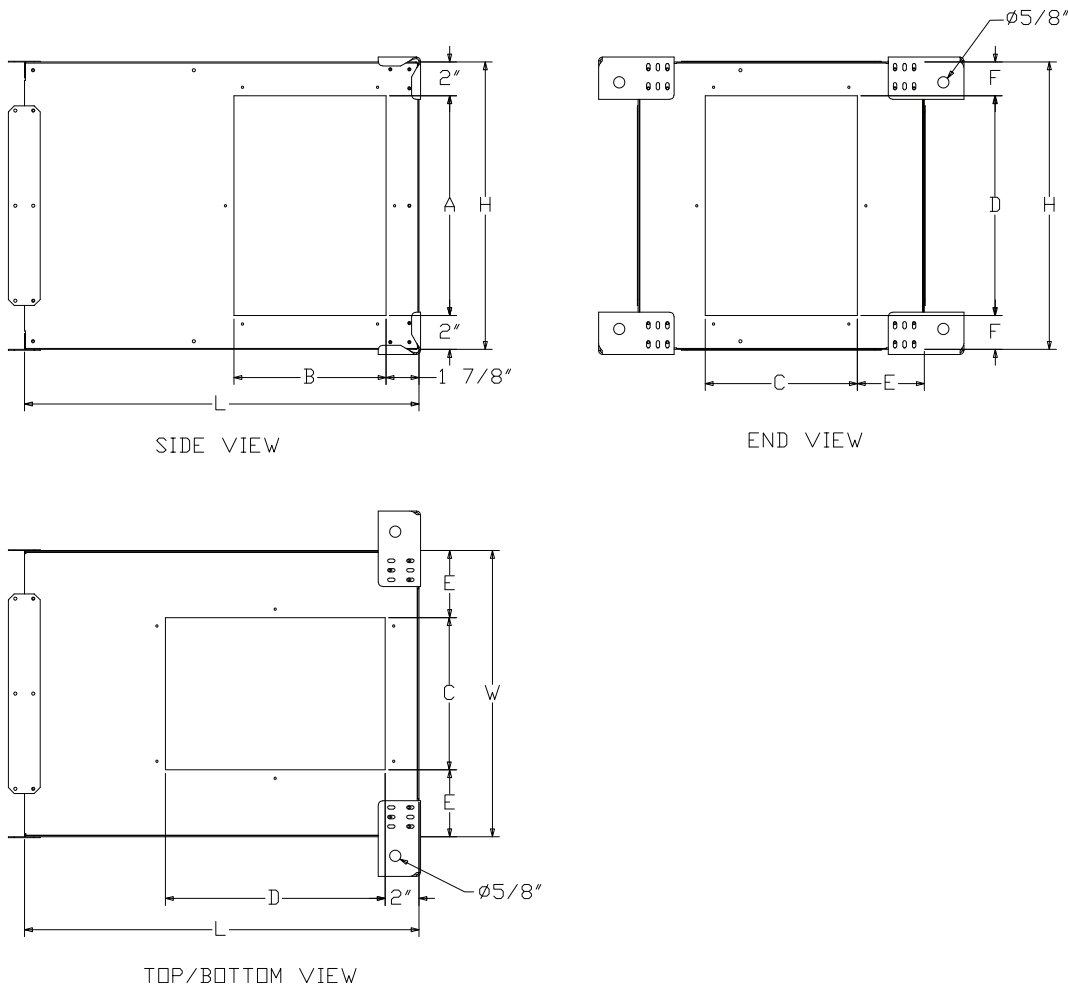


Table 7. BCHE 12 to 120 and BCVE 72 to 120 return attenuator dimensions (inches) and weights (lb)

Unit Size	H ^(a)	L	W	A	B	C	D	E	F	Weight
12	17	14	24	13	9	13	9	5 1/2	4	26
18	17	14	28	13	9	13	9	7 1/2	4	28
24	17	14	30	13	9	13	9	8 1/2	4	29
36	17	19	42	13	14	14	13	14	2	42
54	18	25	46	14	20	20	14	13	2	54
72	18	31	58	14	26	26	14	16	2	73
90	26	25	48	22	20	22	20	13	3	65
120	26	31	58	22	26	26	22	16	2	84

Note: All weights and dimensions are nominal.

^(a) Add 6-inch to height for size 72-120 BCVE units for factory-provided leveling legs. Legs are required for seismic installations.

Dimensions and Weights

Table 8. BCHE 12 to 120 and BCVE 72 to 120 discharge attenuator dimensions (inches) and weights (lb)

Unit Size	H ^(a)	L	W	A	B	C	D	E	F	Weight
12	17	23 1/4	16 7/8	13	9	13	9	1.9	4	29
18	17	23 1/4	20 7/8	13	9	13	9	3.9	4	31
24	17	23 1/4	20 3/4	13	9	13	9	3 7/8	4	31
36	17	28 1/4	30 3/4	13	14	14	13	8 3/8	2	44
54	18	34 1/4	34 3/4	14	20	20	14	7 3/8	2	60
72	18	40 1/4	46 3/4	14	26	26	14	10 3/8	2	81
90	26	34 1/4	36 3/4	22	20	22	20	7 3/8	3	72
120	26	40 1/4	46 3/4	22	26	26	22	10 3/8	2	93

Note: All weights and dimensions are nominal.

^(a) Add 6-inch to height for size 72-120 BCVE units for factory-provided leveling legs. Legs are required for seismic installations.

Figure 17. BCVE 24 to 60 attenuator

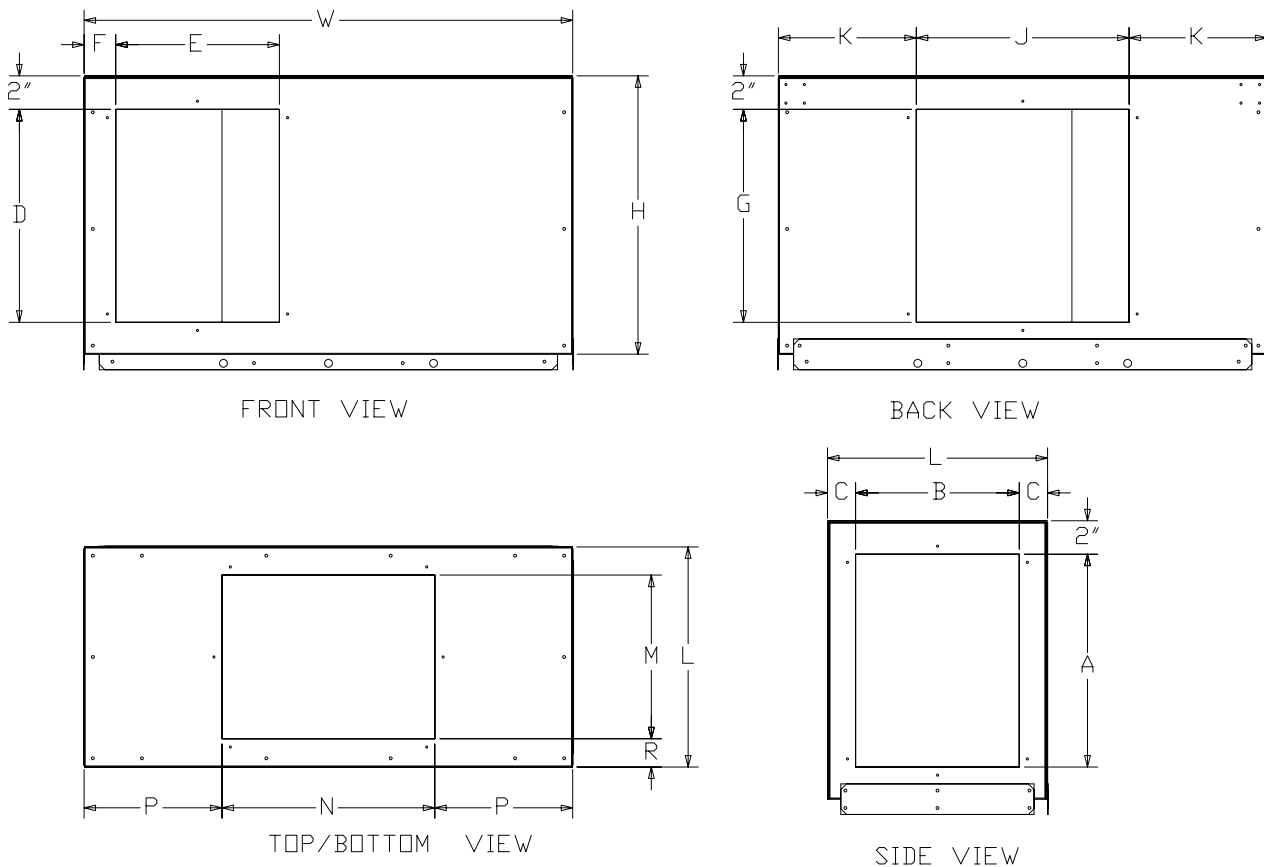


Table 9. BCVE 24 to 60 return attenuator dimensions (inches) and weights (lb)

Unit Size	H	L	W	A	B	C	D	E	F	G	J	K	M	N	P	R	Weight
24	17	19 3/8	29 3/4	13	13	3 1/4	13	13	8 3/8	13	13	8 3/8	13	13	8 3/8	3 1/4	30
36	17	22 7/8	29 3/4	13	13	5	13	13	8 3/8	13	13	8 3/8	13	13	8 3/8	5	32
48	20	24 3/8	34 3/4	16	18	3 1/4	16	18	8 3/8	16	18	8 3/8	16	18	8 3/8	4 1/4	42
60	20	27 3/8	34 3/4	16	18	4 3/4	16	18	8 3/8	16	18	8 3/8	16	18	8 3/8	5 3/4	43

Note: All weights and dimensions are nominal.

Table 10. BCVE 24 to 60 discharge attenuator dimensions (inches) and weights (lb)

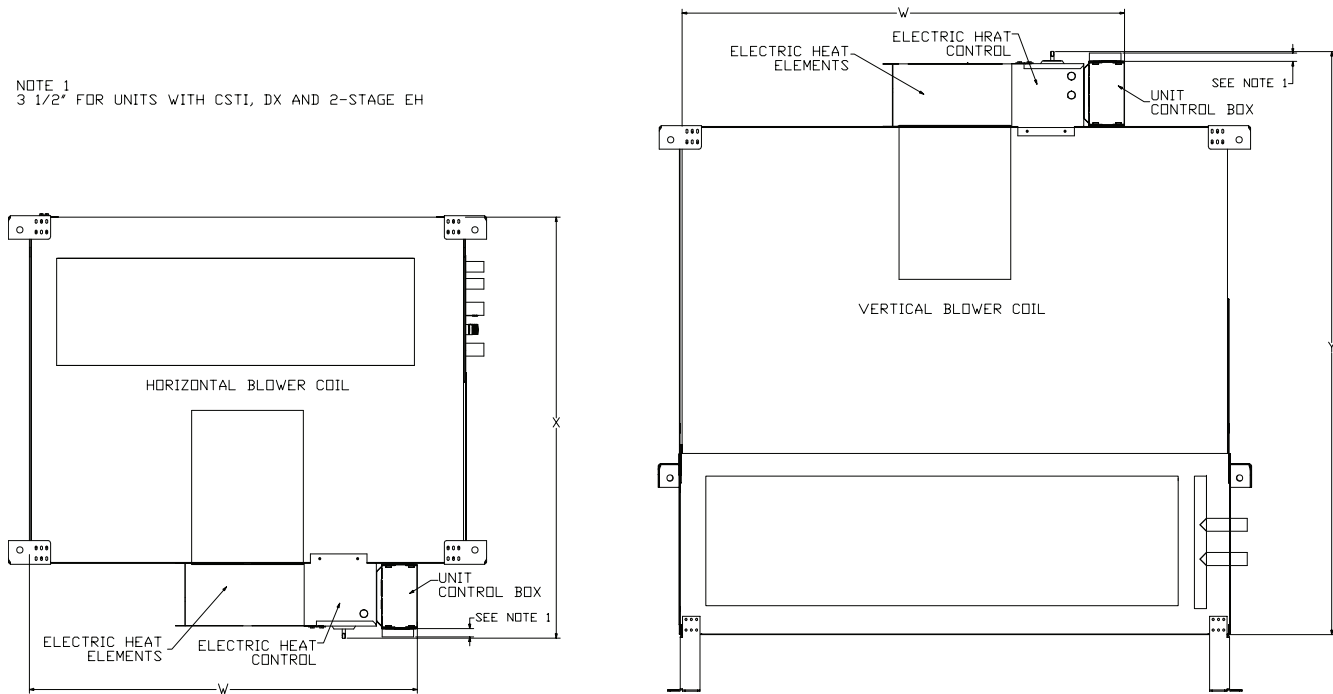
Unit Size	H	L	W	A	B	C	D	E	F	G	J	K	M	N	P	R	Weight
24	17	13 3/8	29 3/4	13	10	1 3/4	13	10	1 7/8	13	13	8 3/8	10	13	8 3/8	1 3/4	26
36	17	16 7/8	29 3/4	13	13	2	13	10	1 7/8	13	13	8 3/8	13	13	8 3/8	2	29
48	20	18 3/8	34 3/4	16	15	1 3/4	16	15	1 7/8	16	18	8 3/8	15	16	9 3/8	1 3/4	37
60	20	21 3/8	34 3/4	16	18	1 3/4	16	15	1 7/8	16	18	8 3/8	18	16	9 3/8	1 3/4	40

Note: All weights and dimensions are nominal.

Electric Heat

Figure 18. BCHE/BCVE Blower Coils with electric heat section

NOTE 1
3 1/2" FOR UNITS WITH CST1, DX AND 2-STAGE EH


Table 11. BCHE/BCVE Blower Coils with electric heat section dimensions (inches)

Unit Size	W	X	Y
12	28	38 1/4	N/A
18	32	38 1/4	N/A
24	33	38 1/4	N/A
36	44 1/8	42 1/4	N/A
54	41	45	N/A
72	47	44	62
90	48 1/4	48 7/8	74 7/8
120	54 3/4	48 7/8	74 7/8

Notes:

1. All weights and dimensions are nominal.
2. The minimum clearance from the appliance to combustible surfaces is 0 inches.

Dimensions and Weights

Figure 19. BCVE 24 to 60 Blower Coil with electric heat section

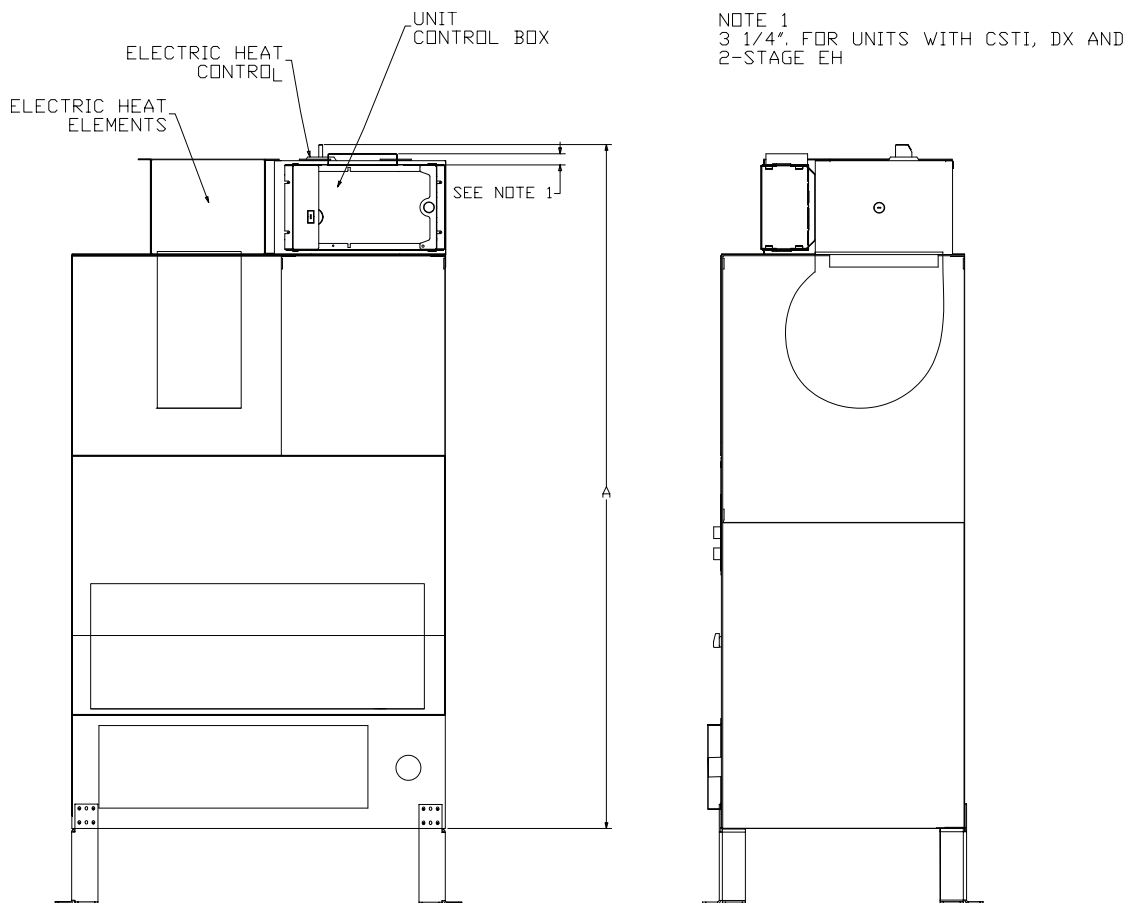


Table 12. BCVE 24 to 60 Blower Coils with electric heat section dimensions (inches)

Unit size	A
24	55
36	59
48	65 3/4
60	67 3/4

Notes:

1. All dimensions are nominal.
2. The minimum clearance from the appliance to combustible surfaces is 0 inches.

Figure 20. Electric heat section for BCHE/BCVE

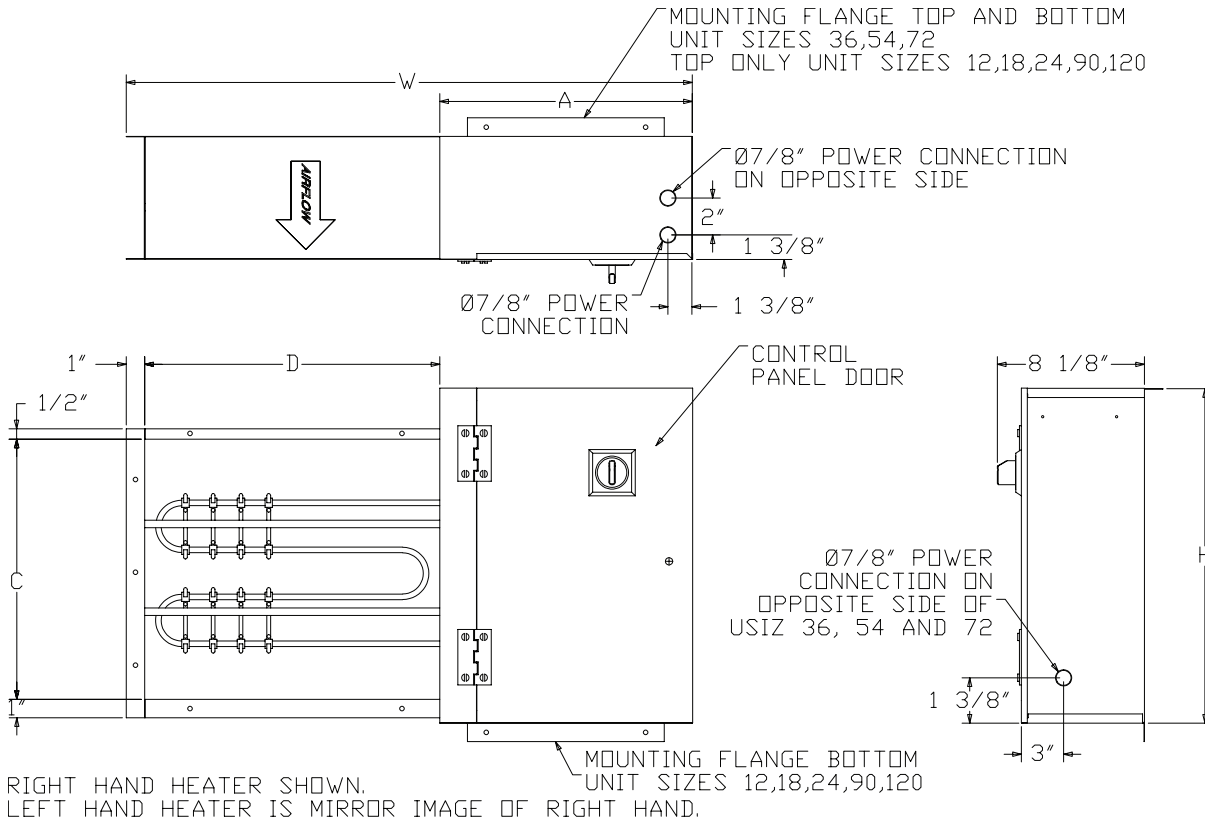


Table 13. Electric heat section for size BCHE 12 to 120 and BCVE 72 to 120 dimensions (inches) and weights (lb)

Unit Size	W	H	A	C	D	Min Weight	Max Weight
12	17 7/8	14 1/8	8 1/8	10 1/2	8 3/4	14	23
18	19 7/8	14 1/8	10 1/8	10 1/2	8 3/4	15	25
24	19 7/8	14 1/8	10 1/8	10 1/2	8 3/4	15	25
36	24 5/8	17 1/8	14 1/2	13 1/2	9 1/8	20	30
54	21 1/4	18 1/8	7 5/8	13 1/2	12 5/8	17	28
72	21 1/4	18 1/8	7 5/8	13 1/2	12 5/8	17	28
90	21 1/4	18 1/8	13 5/8	13 1/2	12 5/8	22	32
120	30 5/8	18 1/8	13 5/8	14	16	23	34

Notes:

1. Electric heater is factory mounted on unit discharge face and wired to unit control box.
2. Heater may be mounted with horizontal or vertical up airflow.
3. Electric heat may need field-supplied externally-wrapped insulation if the unit is installed in an unconditioned space or if sweating is an issue.
4. All weights and dimensions are nominal.

Dimensions and Weights

Figure 21. Electric heat section for BCVE size 24 to 36

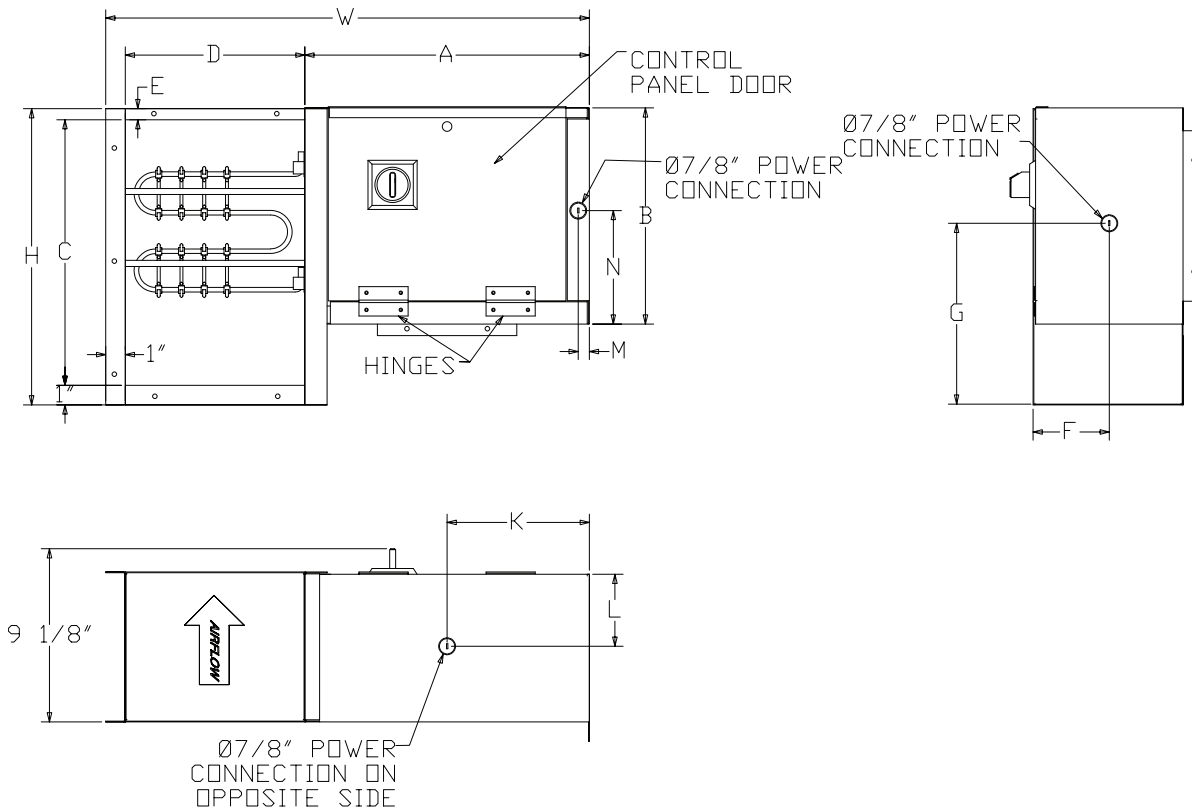


Figure 22. Electric heat section for BCVE size 48 to 60

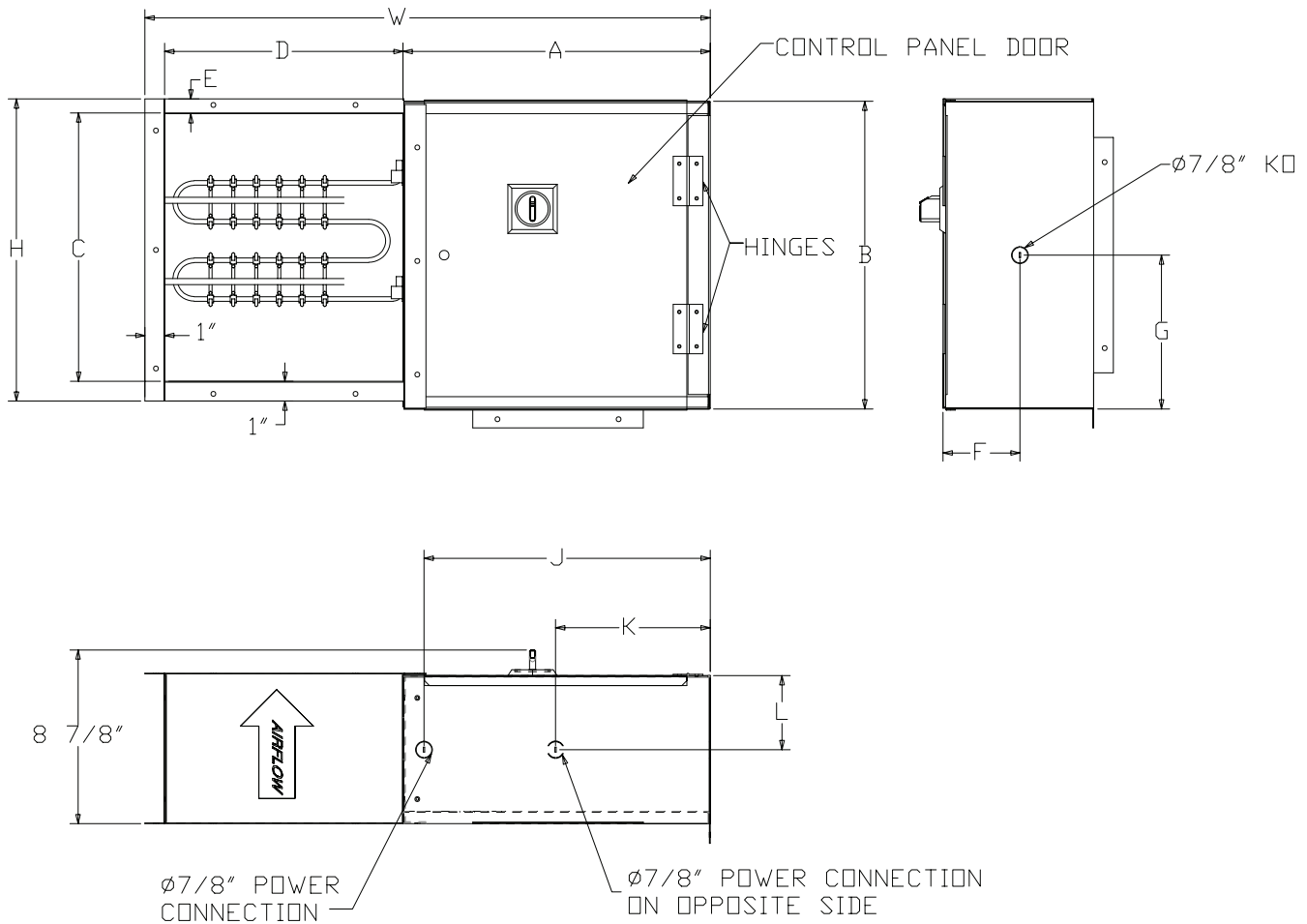


Table 14. Electric heat section for size BCVE 24 to 60 dimensions (inches) and weights (lb)

Unit Size	W	H	A	B	C	D	E	F
24	24 5/8	15 1/8	14 1/2	11	13 1/2	9 1/8	5/8	3 7/8
26	24 5/8	15 1/8	14 1/2	13 1/2	13 1/2	9 1/8	5/8	4 1/4
48	28 3/4	15 1/4	15 1/2	15 5/8	13 1/2	12 1/8	3/4	3 7/8
60	28 3/4	18 1/2	15 1/2	18 1/2	13 1/2	12 1/8	7/8	3 7/8
Unit Size	G	J	K	L	M	N	Min Weight	Max Weight
24	9 1/4	N/A	7 1/4	3 5/8	1/2	5 3/4	18	28
26	8	N/A	7 3/4	3 3/4	5/8	7 1/8	19	29
48	7 3/8	14 1/2	7 7/8	3 3/4	N/A	N/A	23	33
60	9 1/4	14 3/8	7 3/4	3 7/8	N/A	N/A	25	35

Notes:

1. Electric heater is factory mounted on unit discharge face and wired to unit control box.
2. Electric heat may need field-supplied externally-wrapped insulation if the unit is installed in an unconditioned space or if sweating is an issue.
3. All weights and dimensions are nominal.



Dimensions and Weights

Coil Connections

Table 15. BCHE hydronic coil connection sizes, OD (inches)

Unit Size	1-Row	2-Row	4-Row	6-Row	8-Row
12	5/8	5/8	3/4	3/4	3/4
18	5/8	5/8	3/4	3/4	1-1/8
24	3/4	7/8	7/8	7/8	7/8
36	3/4	3/4	7/8	1-3/8	1-3/8
54	1-1/8	1-1/8	1-3/8	1-3/8	1-3/8
72	1-1/8	1-3/8	1-3/8	1-3/8	1-3/8
90	1-1/8	1-3/8	1-5/8	1-5/8	1-5/8
120	1-1/8	1-3/8	1-5/8	1-5/8	1-5/8

Table 16. BCVE hydronic coil connection sizes, OD (inches)

Unit Size	1-Row	2-Row	4-Row	6-Row	8-Row
24	7/8	7/8	1-1/8	1-1/8	-
36	7/8	7/8	1-1/8	1-1/8	-
48	7/8	7/8	1-3/8	1-3/8	-
60	7/8	7/8	1-3/8	1-3/8	-
72	1-1/8	1-3/8	1-3/8	1-3/8	1-3/8
90	1-1/8	1-3/8	1-5/8	1-5/8	1-5/8
120	1-1/8	1-3/8	1-5/8	1-5/8	1-5/8

Table 17. BCHE DX coil connection sizes, OD (inches)

Unit Size	3-Row		4-Row		6-Row	
	Suction	Liquid	Suction	Liquid	Suction	Liquid
12	5/8	5/8	5/8	5/8	5/8	5/8
18	5/8	5/8	5/8	5/8	5/8	5/8
24	5/8	5/8	5/8	5/8	7/8	7/8
36	7/8	5/8	7/8	7/8	7/8	7/8
54	1-1/8	7/8	1-1/8	7/8	1-1/8	5/8
72	1-1/8	7/8	1-1/8	7/8	1-3/8	7/8
90	1-3/8	1-1/8	1-3/8	1-1/8	1-3/8	1-1/8
120	1-3/8	1-1/8	1-3/8	1-1/8	1-3/8	1-1/8

Table 18. BCVE DX coil connection sizes, OD (inches)

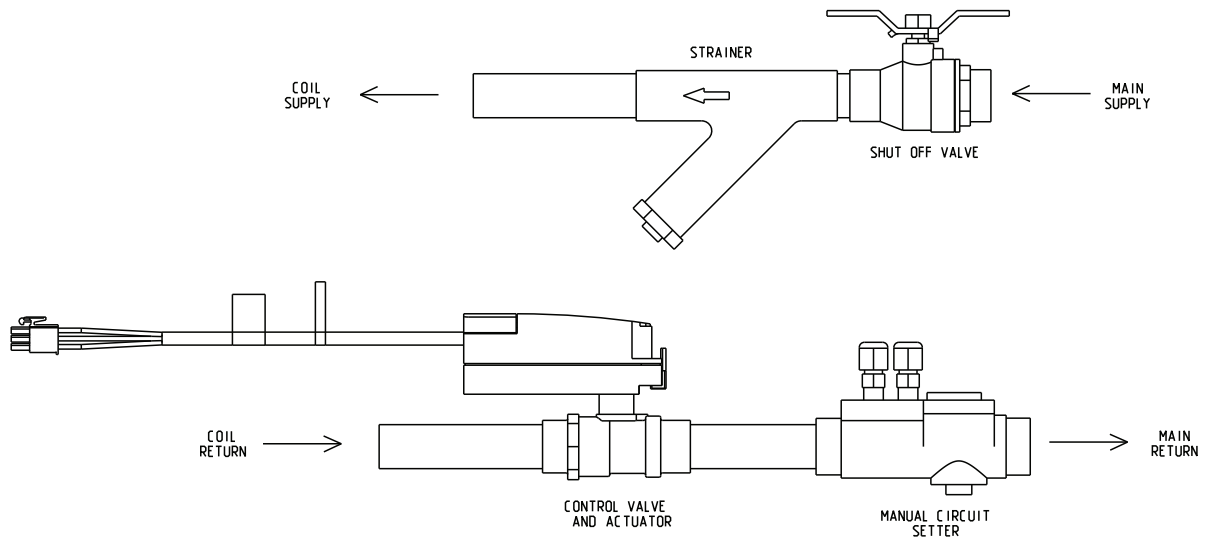
Unit Size	3-Row		4-Row		6-Row	
	Suction	Liquid	Suction	Liquid	Suction	Liquid
24	7/8	5/8	7/8	5/8	7/8	5/8
36	7/8	5/8	7/8	5/8	7/8	5/8
48	1-1/8	7/8	1-1/8	7/8	1-1/8	7/8
60	1-1/8	7/8	1-1/8	7/8	1-1/8	7/8
72	1-1/8	7/8	1-1/8	7/8	1-3/8	7/8

Table 18. BCVE DX coil connection sizes, OD (inches) (continued)

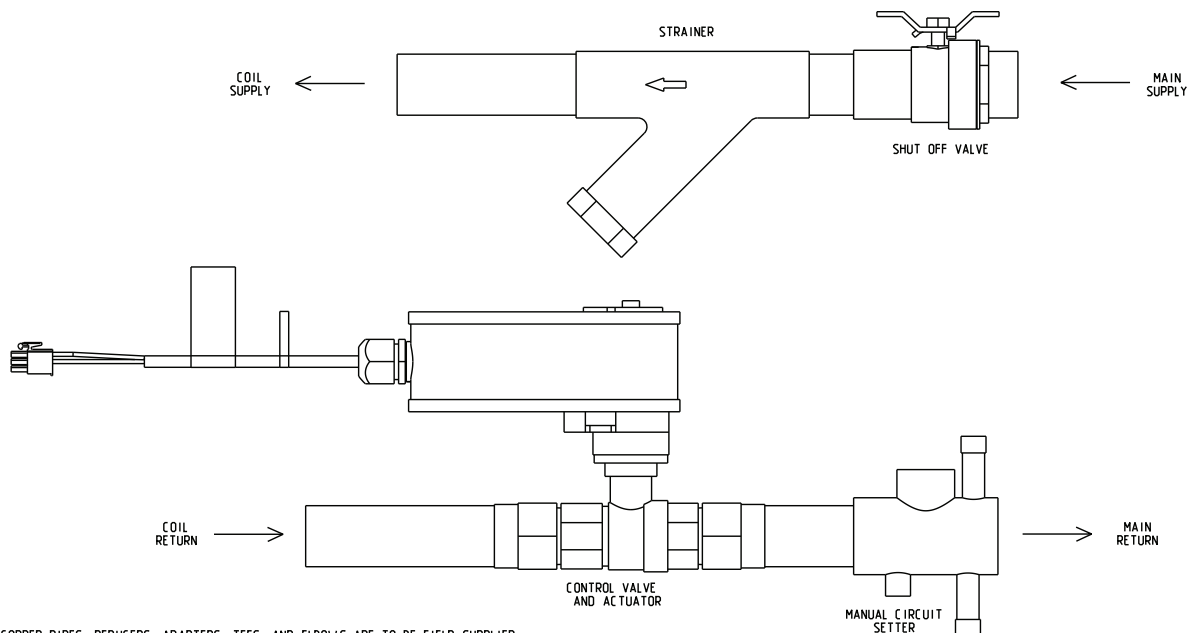
Unit Size	3-Row		4-Row		6-Row	
	Suction	Liquid	Suction	Liquid	Suction	Liquid
90	1-3/8	1-1/8	1-3/8	1-1/8	1-3/8	1-1/8
120	1-3/8	1-1/8	1-3/8	1-1/8	1-3/8	1-1/8

Sample Piping Schematics

Note: Parts are representative and may slightly change based on vendor components.

Figure 23. 2 way valve 2.3, 3.3, and 4.6 CV


NOTES:
 1. ALL COPPER PIPES, REDUCERS, ADAPTERS, TEES, AND ELBOWS ARE TO BE FIELD SUPPLIED.
 2. REMOVE ACTUATOR BEFORE SOLDERING PIPES.

Figure 24. 2 way valve 7.4 and 10.0 CV


NOTES:
 1. ALL COPPER PIPES, REDUCERS, ADAPTERS, TEES, AND ELBOWS ARE TO BE FIELD SUPPLIED.

Figure 25. 3 way valve 1.0 and 2.7 CV

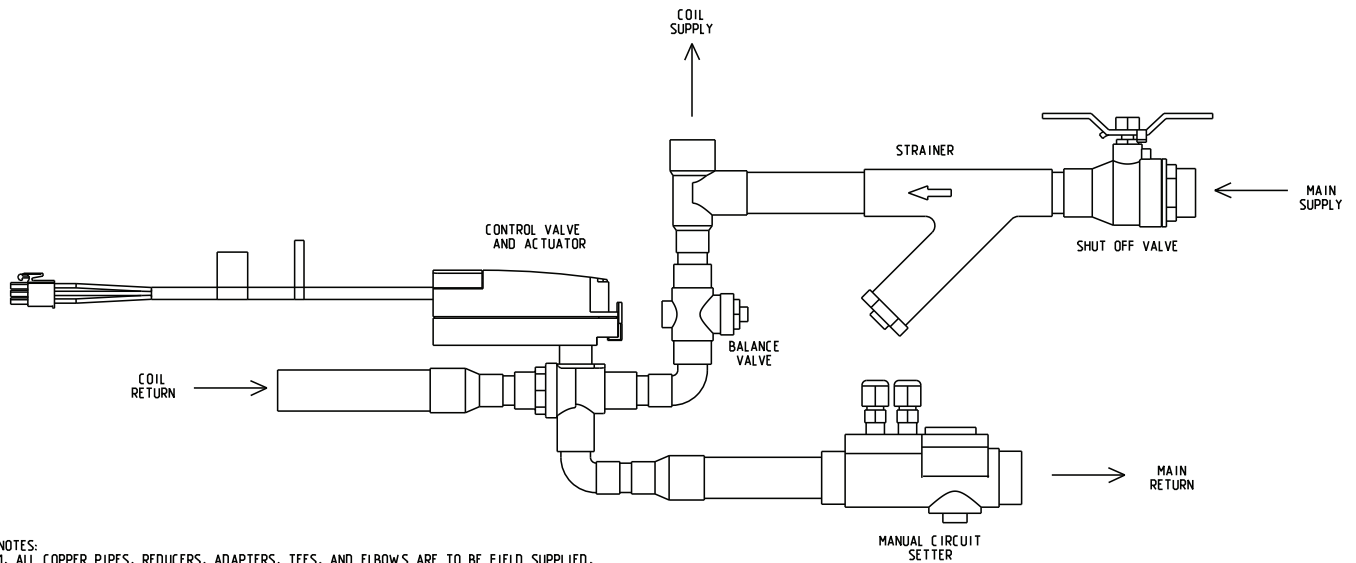


Figure 26. 3 way valve 4.6 CV

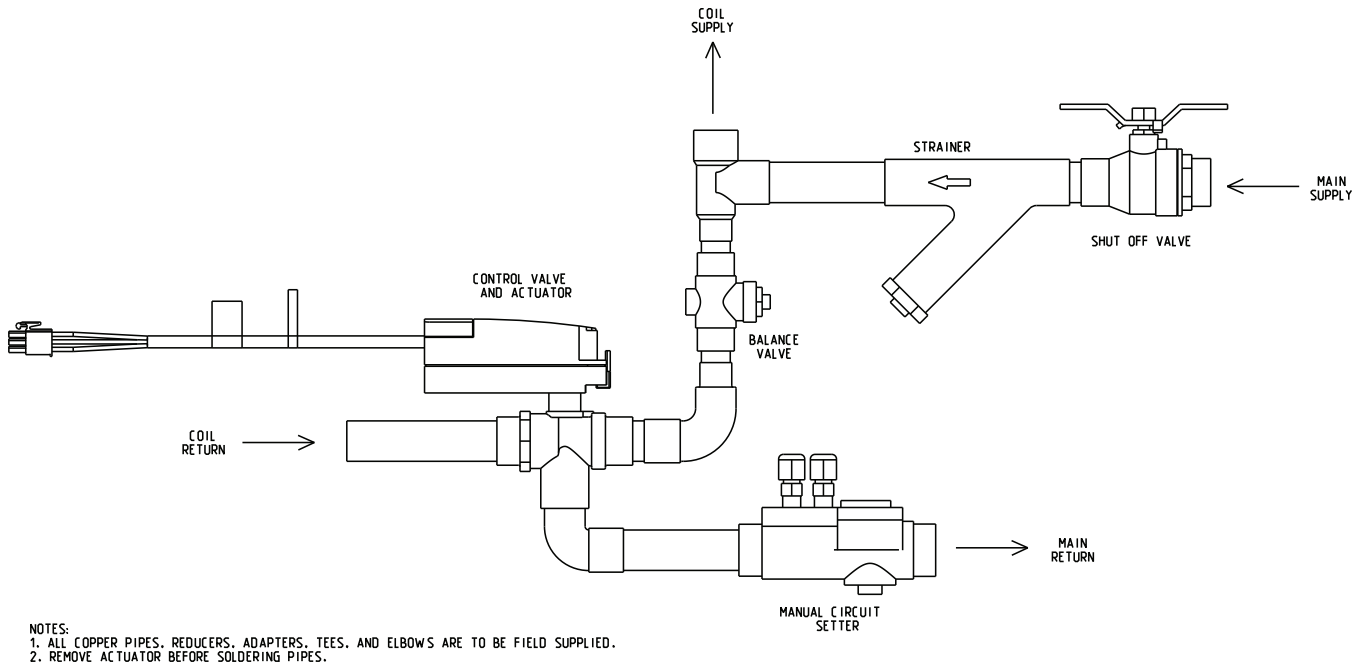
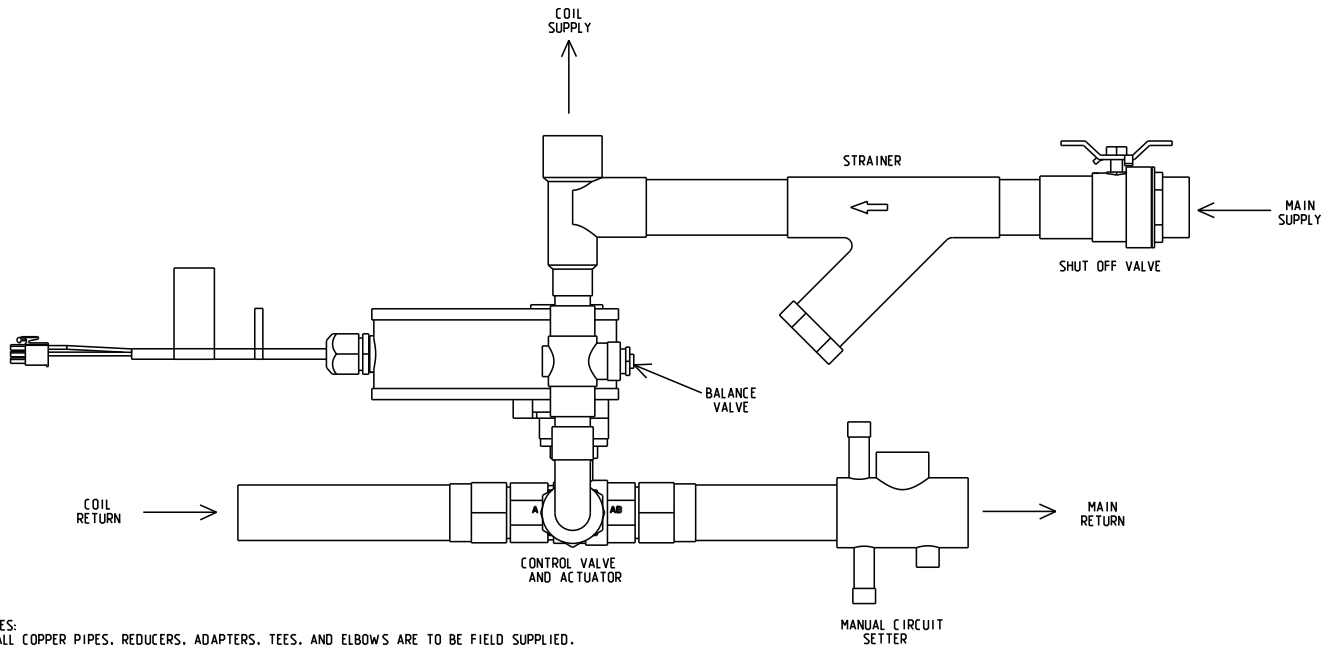
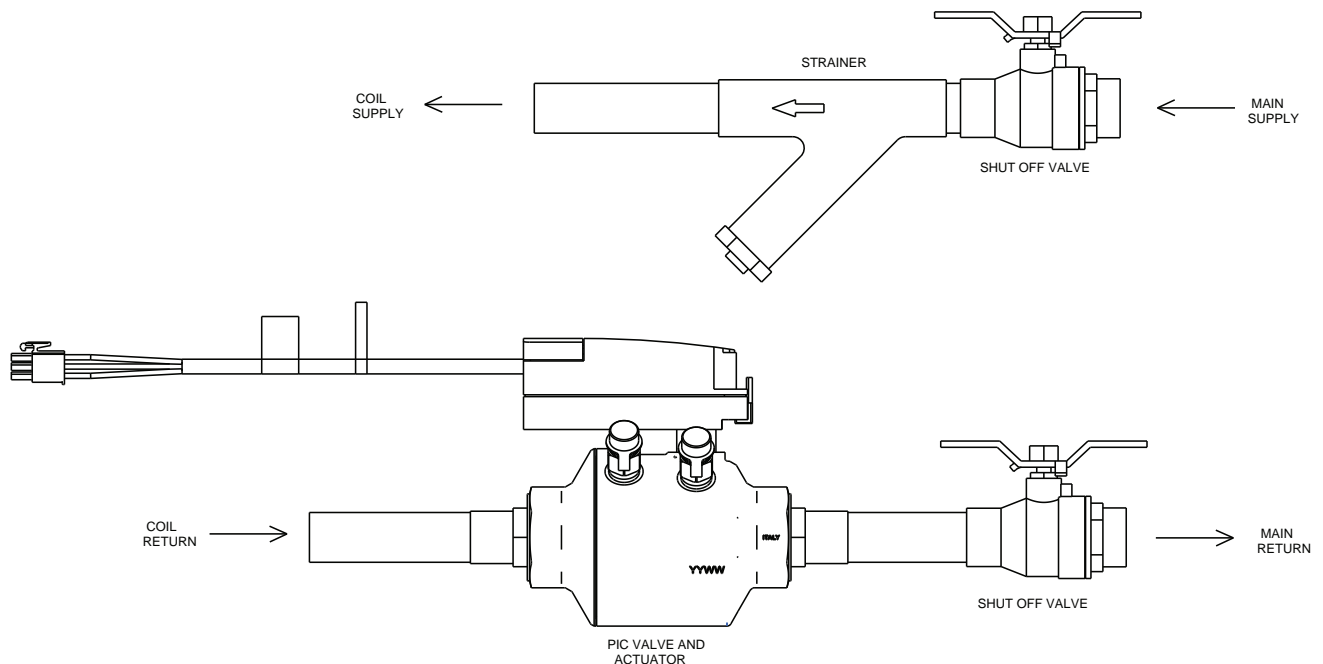


Figure 27. 3 way valve 7.4 and 10.0 CV

Figure 28. 2-way PIQCV valve


Valve and Actuator Operation (All valves except for 7.4 Cv and 10.0 Cv)

- Two position actuators, normally open (N.O.) or normally closed (N.C.), are capacitor discharge return.
- Modulating actuators are fail in place.

- All actuators are clockwise to close, counterclockwise to open as seen from the top wire harness side of the actuator.

Dimensions and Weights

Valve Stroke Time

Table 19. Valve stroke time

Valve Selection	Clip Position	Stroke Time (seconds)
2.3 Cv, 3/4 in. 2-way valve	4	49
3.3 Cv, 3/4 in. 2-way valve	5	55
4.6 Cv, 3/4 in. 2-way valve	6	62
1.0 Cv, 1/2 in. 3-way valve	No end stop	75
2.7 Cv, 1/2 in. 3-way valve	No end stop	75
4.6 Cv, 3/4 in. 3-way valve	No end stop	75
7.4 Cv, 1 in. 2-way and 3-way valve isolation	N/A	75
10.0 Cv, 1 in. 2-way and 3-way valve isolation	N/A	75
7.4 Cv, 1 in. 2-way and 3-way valve modulating	N/A	90
10.0 Cv, 1 in. 2-way and 3-way valve modulating	N/A	90
0.9, 2.0, 4.3, and 9.0 GPM 2-way PIC valve	N/A	75

Field-Set Flow Capacity Adjustment (All valves except for 7.4 Cv and 10.0 Cv)

- If a different Cv is required, locate the new Cv in [Table 20, p. 38](#) and move the clip to the corresponding setting.
- For 3-point floating, control signals adjust the controller stroke time parameter to match the stroke time of the of the final clip position.
- For all 3-way valves, the stroke time is 75 seconds and there is no end stop on the actuator.
- The Cv cannot be changed for 3-way valves.

Figure 29. Cv adjustments



Table 20. Actuator clip settings

2-way Valve Body	1	2	3-	3	4	4+	5	5+	6	N	No Clip
1/2 in. Z2050QS-F Cv	0.1		0.2			0.4		0.6	0.8	1.2	1.4
1/2 in. Z2050QS-J Cv	0.5	0.7		1.2	1.7		2.4		3.4	4.8	5.9
3/4 in. Z2075QS-K Cv	0.5	1		1.5	2.3 ^(a)		3.3 ^(a)		4.6 ^(a)	6.6	9.8
Stroke Time (seconds)	30	37	41	43	49	51	55	58	62	68	75

^(a) This Cv shows the standard Cv offering for 2-way valves.

Table 21. PIC with GPM settings

	Clip Position for Flow Adjustment (GPM)																			
	1	1+	2-	2	2+	3-	3	3+	4-	4	4+	5-	5	5+	6-	6	6+	N-	N	No Clip
1/2in. Z2050QPT-B			0.1					0.2			0.3		0.4		0.5		0.6	0.7	0.8	0.9
1/2in. Z2050QPT-D	0.2			0.3			0.4	0.5		0.6	0.7	0.8	0.9	1	1.2	1.3	1.5	1.6	1.8	2.0
1/2in. Z2050QPT-F				0.6		0.7	0.8	0.9	1	1.3	1.5	1.7	1.9	2.2	2.5	2.8	3.1	3.3	3.6	4.3
3/4in. Z2075QPT-G			1.6	1.8	2.1	2.4	2.7	3	3.3	3.7	4	4.4	4.9	5.3	5.8	6.3	6.7	7.2	7.7	9.0
Stroke Time (sec)	30	33	35	37	39	41	43	45	47	49	51	53	55	58	60	62	64	66	68	75



A2L Information and Installation Requirements

Installation/Code Compliance Requirements

Building level controls may need to be upgraded/modified to demand leak mitigation actions as described in “[Leak Detection System](#) (Refrigerant charge greater than 3.91 lb of R-454B or 4.04 lb of R-32 per circuit),” p. 45. Those actions include, but are not limited to, fully opening damper and VAV boxes (if present), and disabling electric heat in VAV boxes (if present).

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

Ensure that there are labels on the equipment stating it contains a flammable refrigerant.

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 or R-32 refrigerant. Use ONLY R-454B or R-32 rated service equipment or components with these units. For specific handling concerns with R-454B or R-32 refrigerant, 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 CO₂ 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.



A2L Information and Installation Requirements

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.) Verify 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

A2L Information and Installation Requirements

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 requires a unit refrigerant leak detection system.

For equipment with less than or equal to 3.91 lb of R-454B or 4.04 lb of R-32 refrigerant charge 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 of R-454B per circuit)

Equipment with R-454B refrigerant charge amounts greater than 3.91 lb per circuit may require additional circulation or ventilation airflow mitigation strategies. In this case, there are 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 needed.

- 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. See equipment nameplate and table below for minimum room area.

Split systems minimum room area requirements need to be determined after final field charging. Use the following figures and the largest final circuit charge to determine the systems A_{min} value. Record the final charge value on the label provided on the condensing unit.

Minimum Room Area Limits (Refrigerant charge greater than 4.04 lb of R-32 per circuit)

Equipment with refrigerant charge amounts greater than 4.04 lb of R-32 per circuit may require additional circulation or ventilation airflow mitigation strategies. In this case, there are 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 4.04 lb of R-32. As a result, no further leak detection system evaluation is needed.
- 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. See equipment nameplate and table below for minimum room area.

Split systems minimum room area requirements need to be determined after final field charging. Use the following figures and the largest final circuit charge to determine the systems A_{min} value. Record the final charge value on the label provided on the condensing unit.

Figure 30. Charge vs min room area (IP) – R-454B refrigerant

Charge vs Min Room Area (IP)

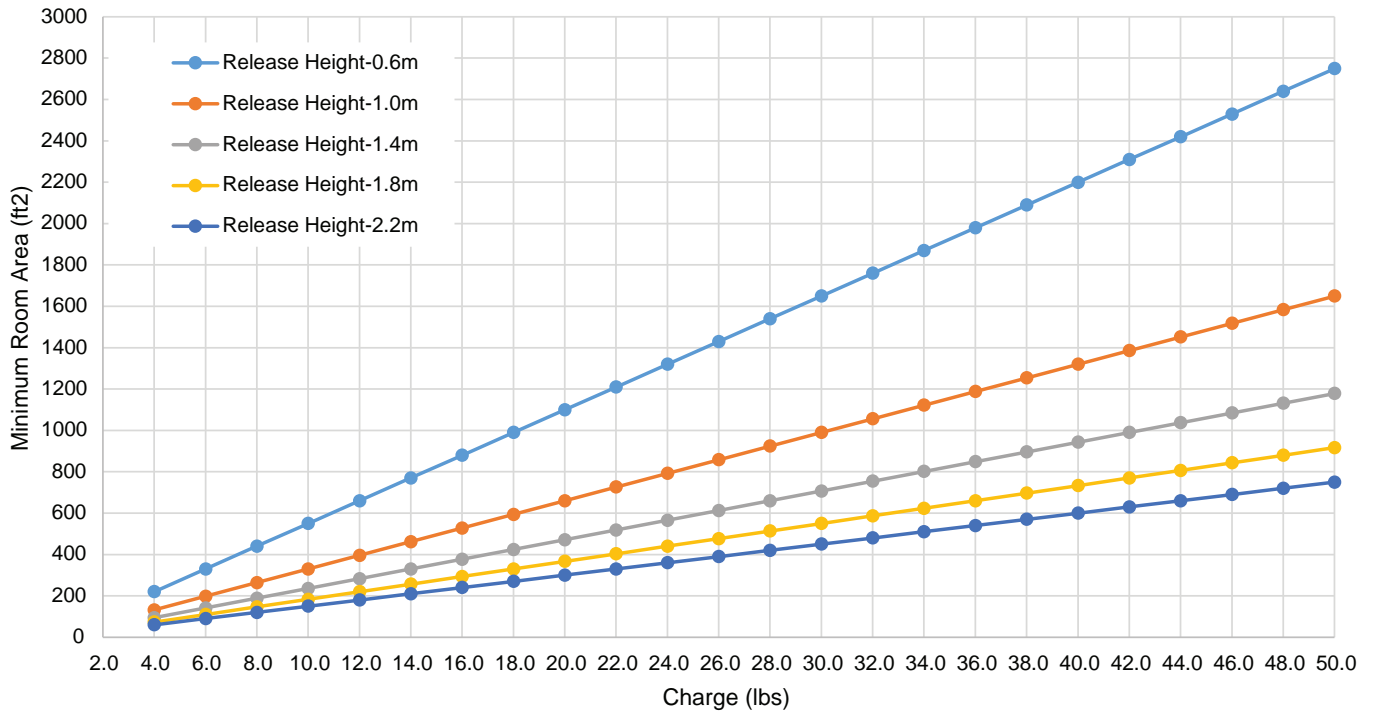
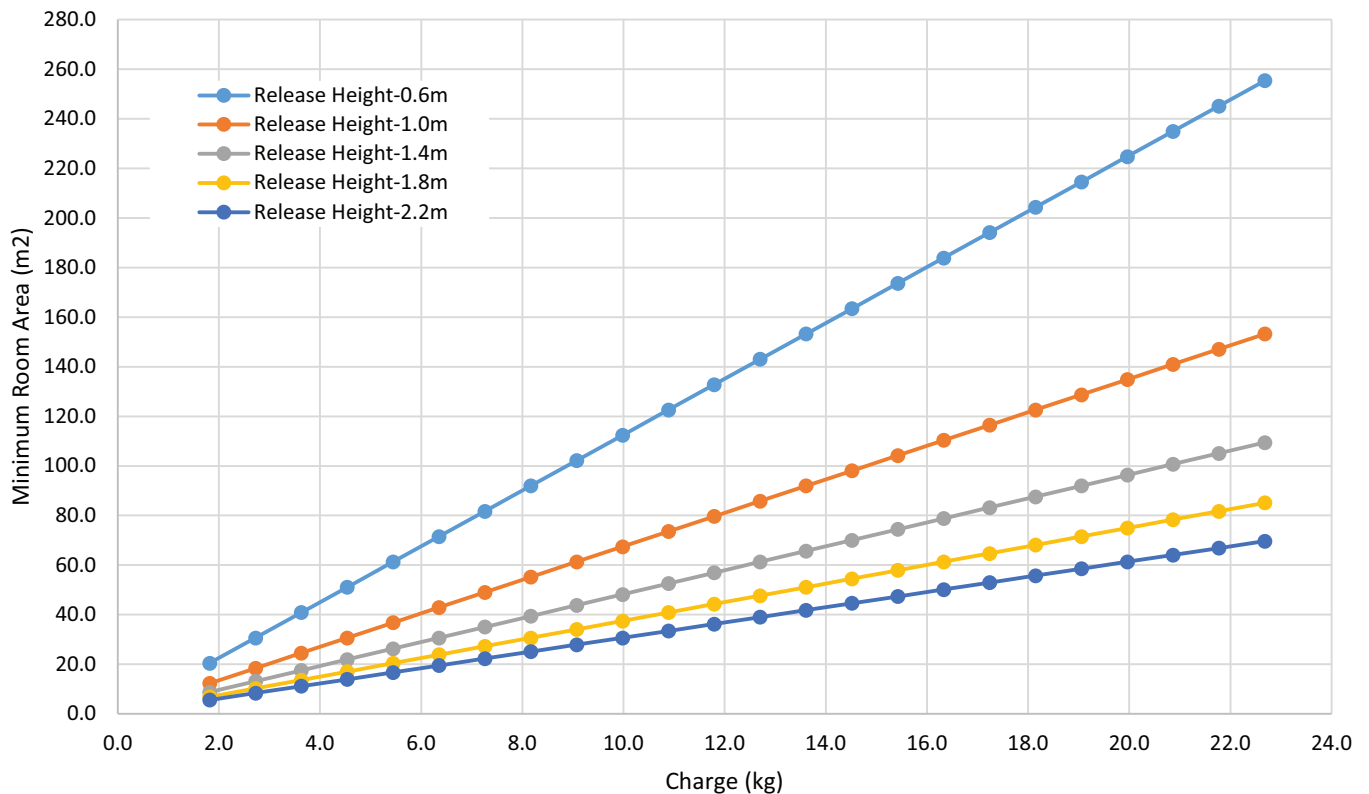


Figure 31. Charge vs min room area (SI) – R-454B refrigerant

Charge vs Min Room Area (SI)





A2L Information and Installation Requirements

Release height is the vertical distance from the floor to the lowest point in a space refrigerant would leak from first. The minimum value is 0.6 m from the floor. This point is

typically the bottom of free return openings or supply diffusers. For fully ducted units, the release height is 2.2 meters.

Figure 32. Charge vs min room area (IP) – R-32 refrigerant

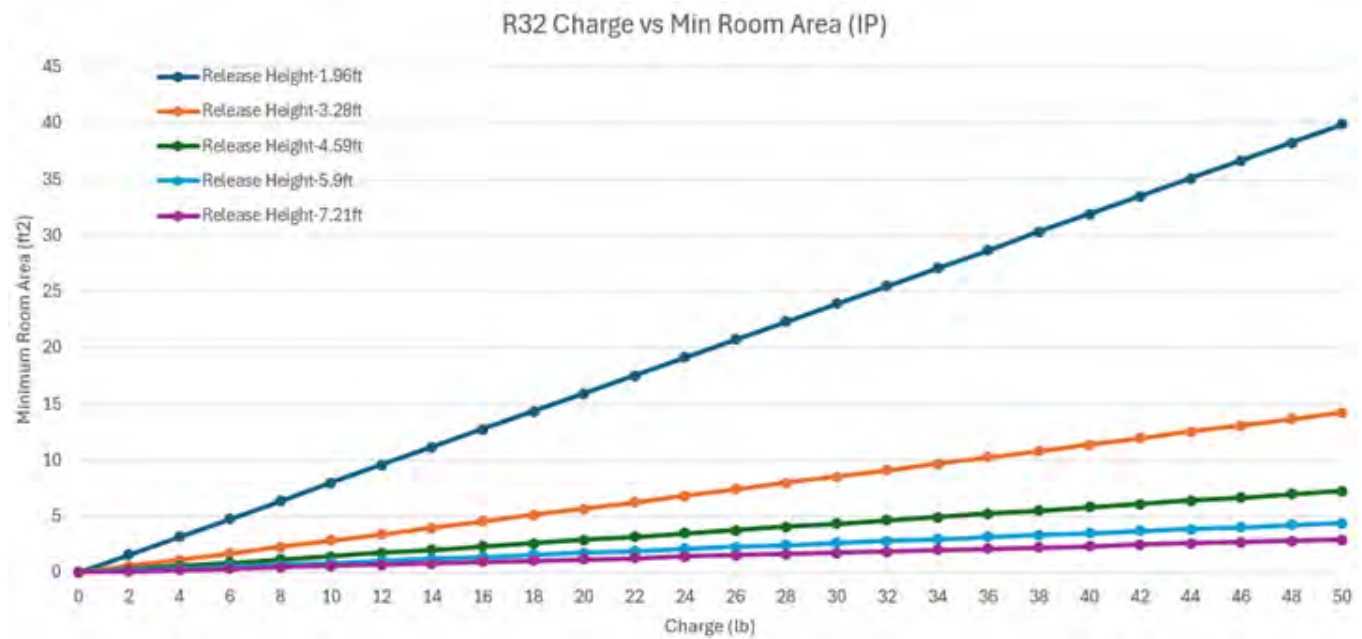
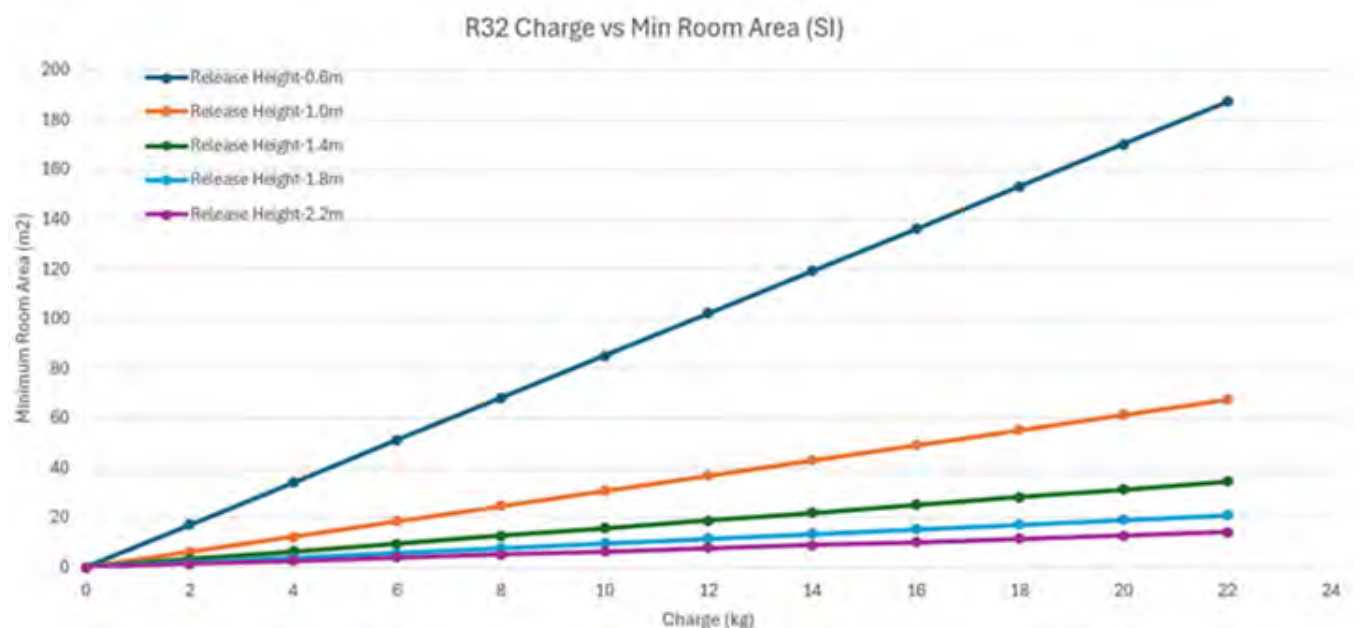


Figure 33. Charge vs min room area (SI) – R-32 refrigerant



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 22. 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 ft.² of a nursing home located at an altitude 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 ft.² with a 2.2 m release height.

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

No additional ventilation is required.

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

The split system serves a 1500 ft.² 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 ft.².

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

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 ANSIASHRAE 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 ANSIASHRAE Standard 15-2022, Section 7.6.4.

**Leak Detection System
(Refrigerant charge greater than 3.91 lb of R-454B or 4.04 lb of R-32 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 to fully open all zoning dampers, such as VAV boxes.
- Provide an output 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.

Field Piping Installation and Charging

When refrigerant piping is routed indoors, protect from physical damage in operation or service, and verify installation complies with national and local codes. All joints must be accessible for inspection prior to being covered.



A2L Information and Installation Requirements

Follow the Refrigerant Charging procedure. Prior to refrigerant charging, check field-made indoor joints for leaks using an instrument with a sensitivity of 5 grams per year refrigerant. Pressurize the system to 25% of the maximum allowable pressure. Verify no leaks are detected.

Installation Mechanical

Lifting and Rigging

⚠ WARNING

Improper Unit Lift!

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

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

NOTICE

Equipment Damage!

Premature skid removal could result in equipment damage.

Keep skid in place until unit is ready to set. Do not move the unit or subassembly without the skid in place as shipped from the factory.

⚠ WARNING

Heavy Object!

Inadequate structural support could result in unit falling, which could result in death or serious injury. Verify floor structure can support the unit weight. Consult the structural plans, and have a structural engineer confirm floor rating is sufficient.

General Lifting Considerations

Before preparing the unit for lifting, estimate the approximate center of gravity for lifting safety. Because of the placement of internal components, the unit weight may be unevenly distributed, with more weight in the coil and fan areas. Refer to the unit submittals for actual section weights.

Before hoisting the unit into position, use a proper rigging method such as straps, slings, or spreader bars for protection and safety. Always test-lift the unit to determine the exact unit balance and stability before hoisting it to the installation location.

If unit is lifted with accessories attached, a support must be used beneath the length of the entire unit. Unit with accessories must be lifted from the bottom and lugs cannot be used.

If main unit is lifted alone, use either the top or bottom lugs and a spreader bar. When lifting unit using lugs, the minimum chain or strap angle is 60 degrees. See Angles less than this could result in lug or unit damage.

Accessories lifted alone must be lifted from the bottom. Accessory lugs are only to be used for suspending it from ceiling, not lifting.

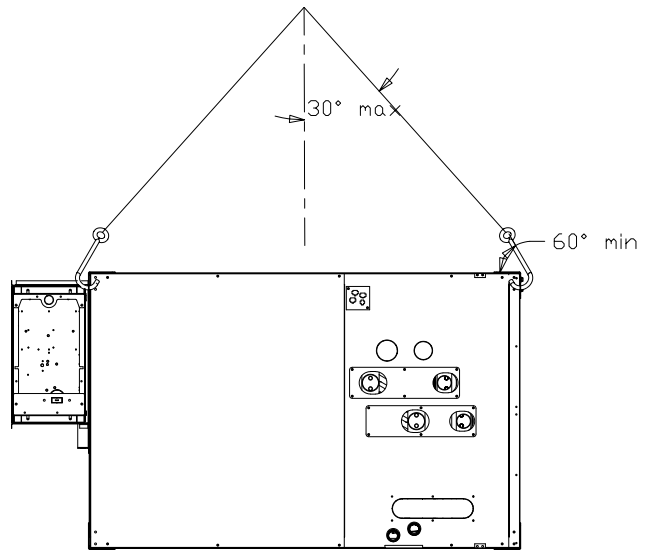
⚠ WARNING

Heavy Object!

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

1. Position rigging sling under wood skid using spreader bars to avoid unit damage.
2. Use a forklift with caution to prevent unit damage. The fork length must be at least 68 inches long to safely fork the unit from front or back.

Figure 34. Lifting



Installation Procedure

Horizontal Unit (Model BCHE) Installation

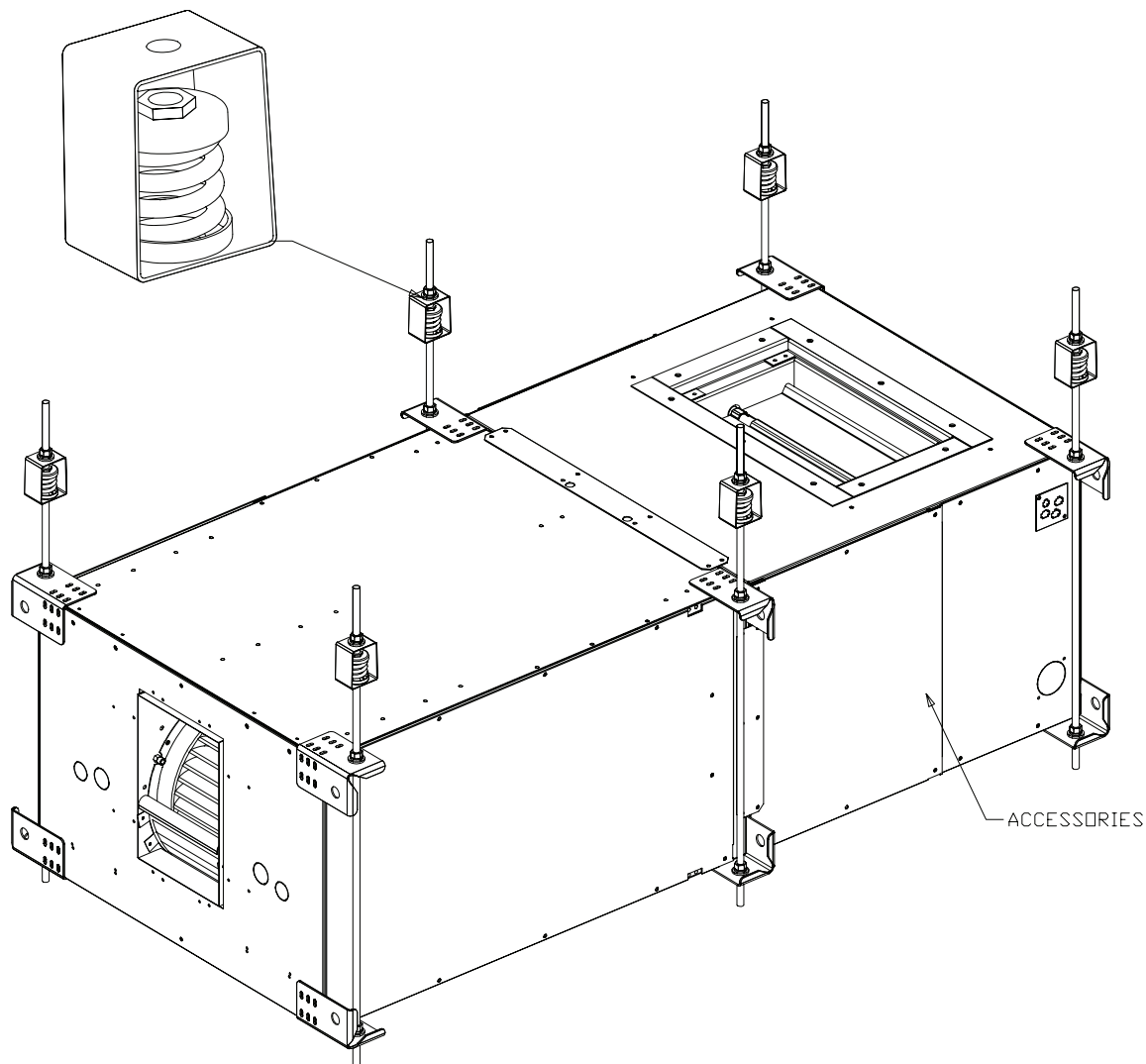
Follow the procedures below to install the Blower Coil unit.

Install horizontal units suspended from the ceiling with 5/8-in. threaded rods that are field-provided. There are lugs on each corner of the unit (8 total) for installation of the threaded rods. Ensure the ceiling opening is large enough for unit installation and maintenance requirements.

Materials Needed

Figure 35. Ceiling mounted horizontal unit

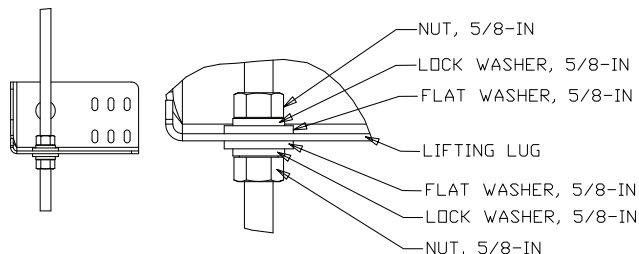
OPTIONAL: VIBRATION ISOLATION HANGER USE 5/8". DIA. HANGER ROD



- Washers: 5/8-in flat and 5/8-in lock (16 each)
 - Threaded rods, 5/8-in. (4 per unit and 2 per accessory section)
 - Nuts (16)
 - Optional vibration isolator hangers or turnbuckles (4 per unit and 2 per accessory module)
1. Prepare the field provided hanger rod isolator assemblies and install them in the ceiling.

2. Guide the threaded rod through the top lug, along the side of the unit and down through the bottom lug.
3. Secure the threaded rods to each lug with a flat washer, lock washer and nut on both the top and bottom surface of the lug. (See [Figure 36, p. 49](#)).
4. Hoist the unit to the suspension rods and thread the top

of the rod into the optional isolator or turnbuckle.

Figure 36. Add nut and flat washers to threaded rod


- Level the unit for proper coil drainage and condensate removal from the drain pan.
- Connect the ductwork to the unit.
- Refer to OSP-0761 and VMA-54357-01 for seismic installations.

Vertical Unit (Model BCVE) Installation

Materials needed:

- #10 screws to fasten vertical fan section to coil section.
 - Eight #10 screws to fasten leg to unit, 32 per unit.
 - Four 5/16-inch bolts, washers, and nuts per leg, 16 per unit.
- Remove outer lugs on bottom of vertical fan section. Install field supplied gasket around opening on coil section and fasten to the bottom of the fan section with #10 screws. (See Figure 38, p. 49).
 - Install vertical units on the floor. Vertical units size 72 to 120 come with factory-supplied mounting legs that are

field-installed to accommodate a P-Trap on the drain connection, if necessary. Legs are required for seismic applications.

- For leg installation, remove the four outer lugs on the bottom of the coil section and fasten the legs to the bottom of the unit with #10 screws. (See Figure 39, p. 50).
- Secure the legs to the floor with 5/16-inch bolts, washers and nuts. (See Figure 39, p. 50).
- Seismic units can be installed with or without neoprene pads. Refer to OSP-0761 and VMA-54357-01 for seismic installations.

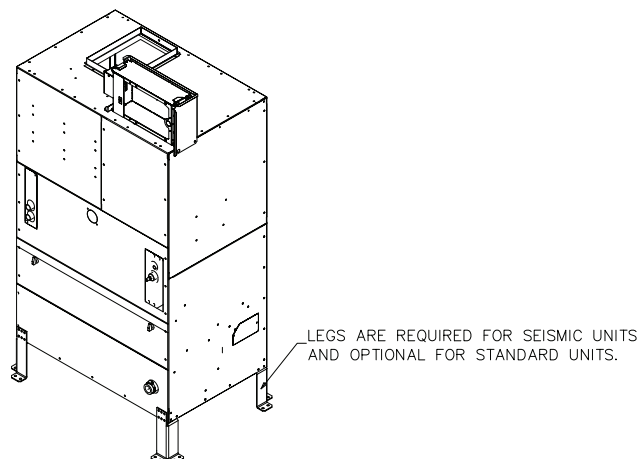
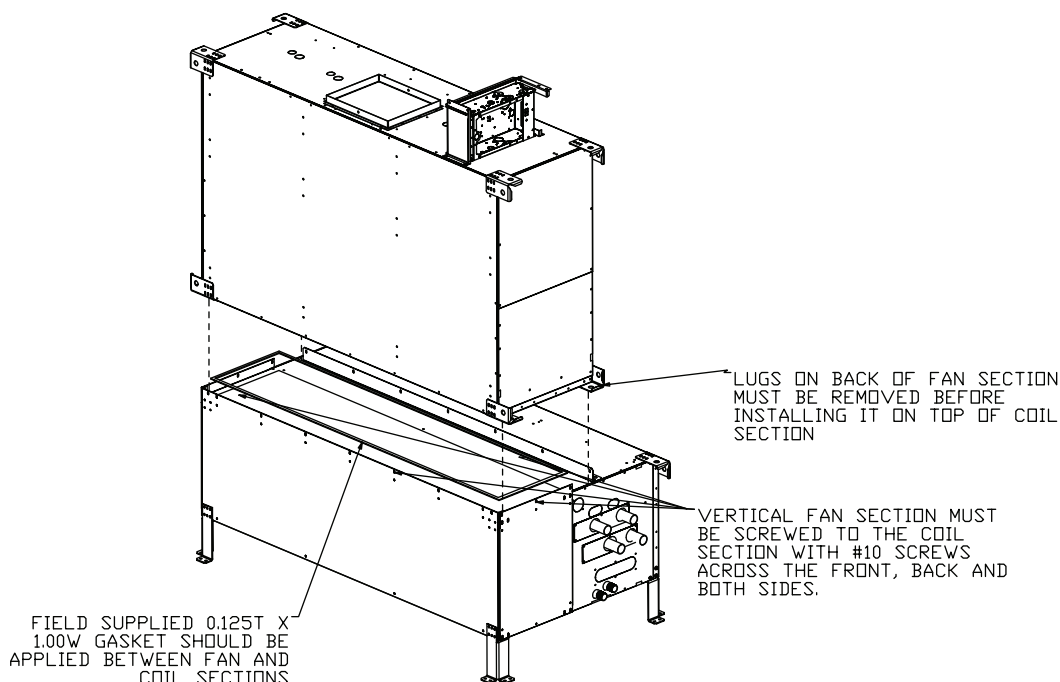
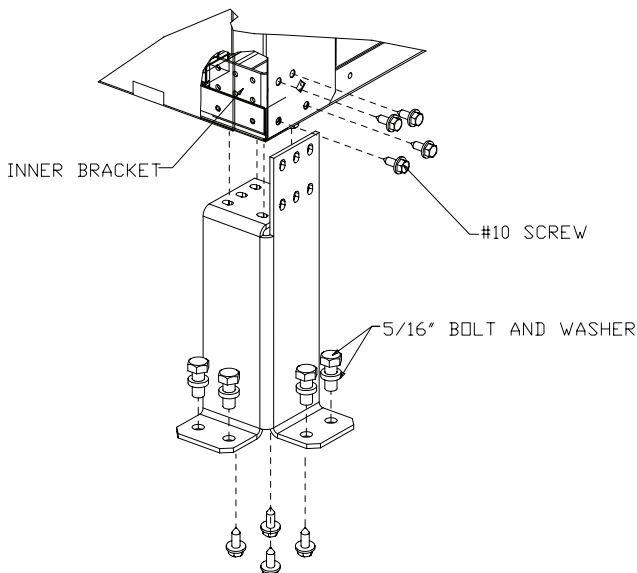
Figure 37. Typical vertical unit installation — BCCE

Figure 38. Typical vertical unit installation — BCVE


Figure 39. Mounting leg installation for vertical units and accessories



- Two mounting legs for vertical units size 24 to 60.
- Accessory module and damper actuator cross over harness (Mix Box)

Material Needed:

- #10 screws, for installing accessories to unit
- Eight #10 screws for mounting vertical legs to accessory module. (16 Per Accessory)
- Four 5/16-inch bolts, nuts and washers for mounting vertical legs to floor. (8 Per Accessory)
- Two 5/8-inch nuts, washers and lock washers for installing accessory horizontally in the ceiling with threaded rod. (4 Sets Per Accessory)

All accessories ship separate for field installation. Lugs are provided to suspend the accessories from the ceiling horizontally.

Accessory Installation Procedure

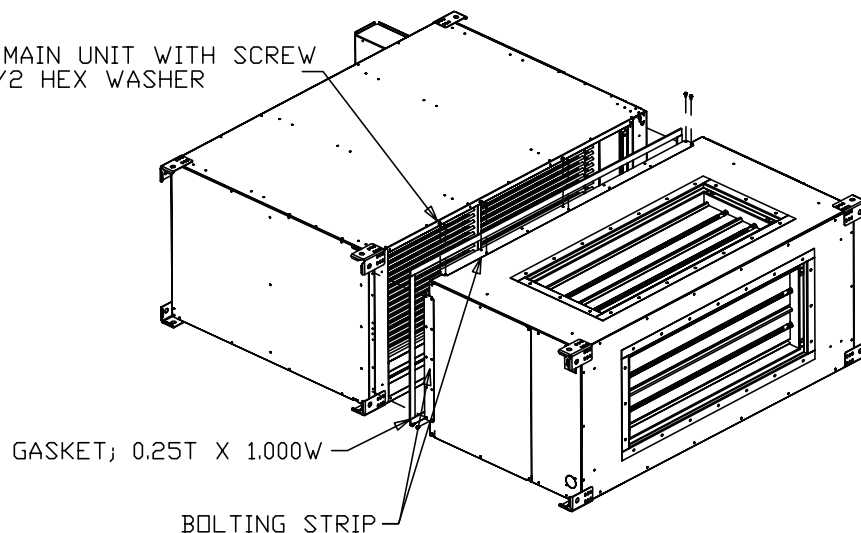
1. Support the accessory independent of the unit in the horizontal position.

Accessory Installation — Mix Box, Angle Filter, Bottom Access Filter, and Attenuators

Materials Provided:

Figure 40. Mix box install

FASTEN BOLTING STRIP TO MAIN UNIT WITH SCREW
SELF-DRILLING, #10-16 X 1/2 HEX WASHER



2. Verify that the factory supplied gasket is installed around the perimeter of the accessory where it connects to the unit. Connect the accessory with self drilling screws to the unit with the bolting strips on all four sides. For the control box side of discharge attenuators, fasten the panel flange to fan discharge panel. See [Figure 41, p. 51](#) and [Figure 42, p. 51](#).
3. Plug damper crossover harness into plug plate on coil panel. Run harness across top of unit and plug other end into plug plate on mix box. Ensure the harness is secured to the top of the unit to avoid interference with the filter access panel. See [Figure 43, p. 52](#).

Figure 41. Size 24 to 60 BCVE unit with return and discharge attenuator

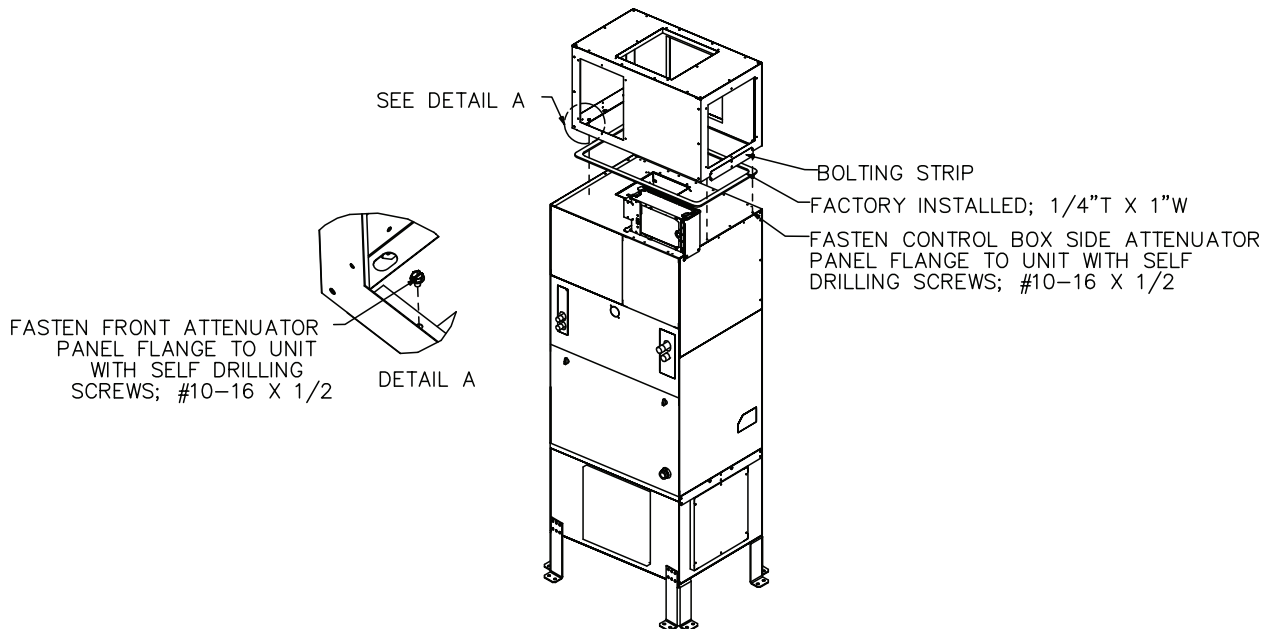
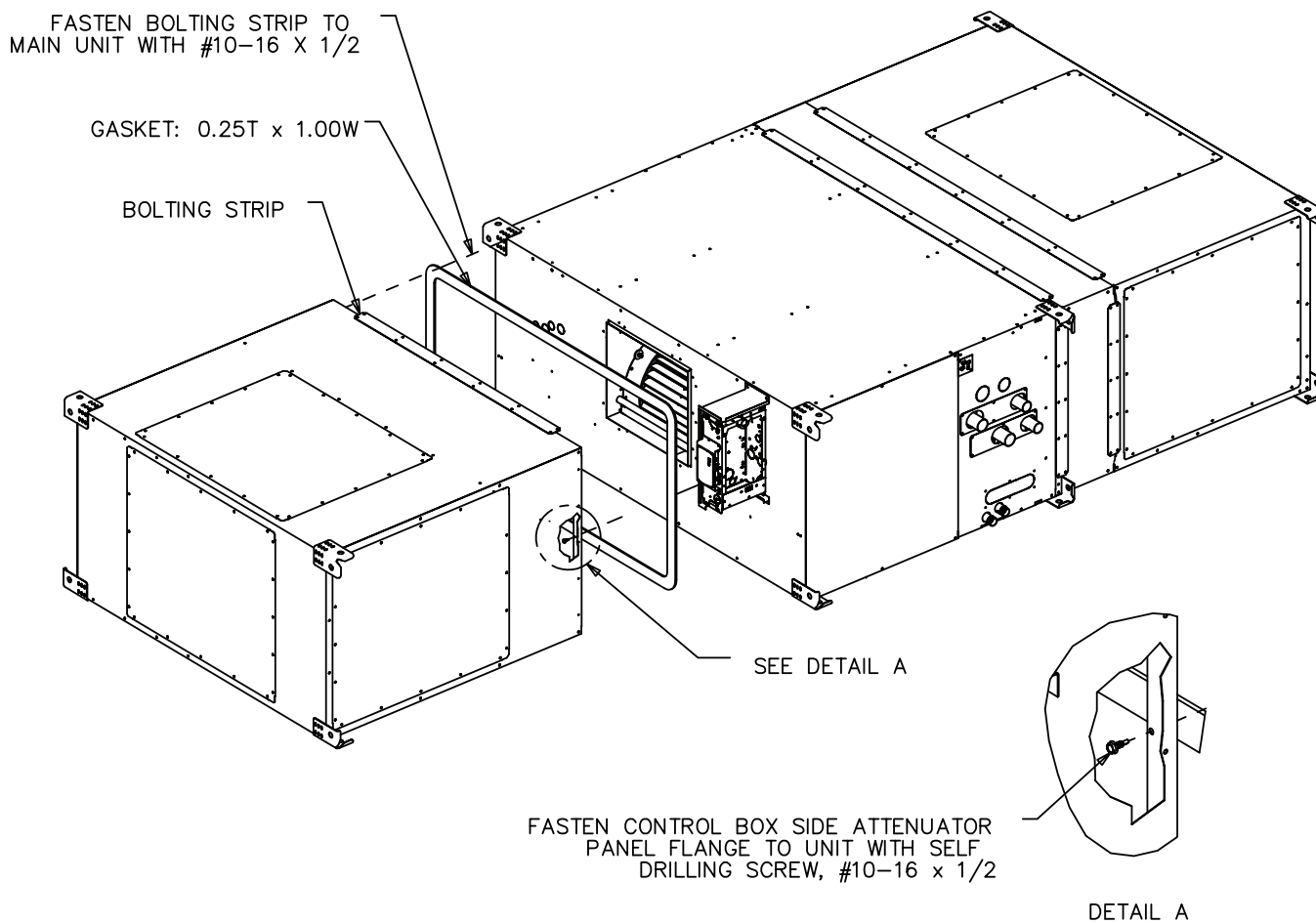
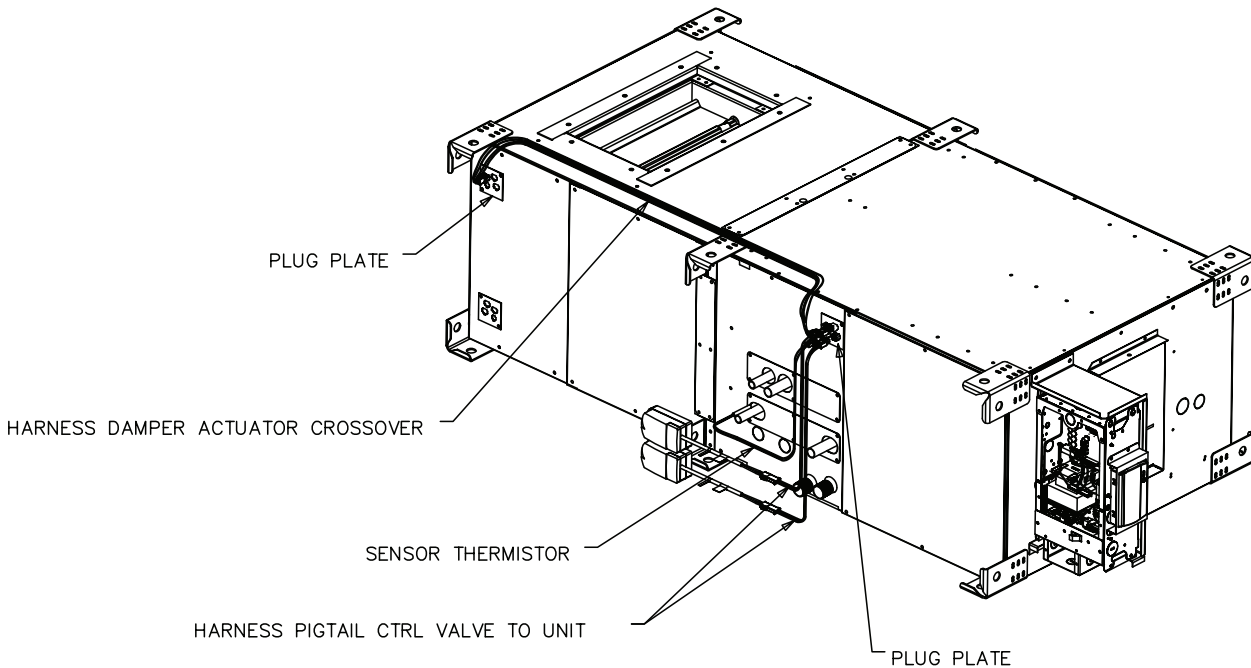


Figure 42. Size 12 to 120 BCHE unit with return and discharge attenuator



4. For horizontal units, install threaded rod and secure it to the accessory lugs with washers and nuts. For vertical units, replace bottom accessory lugs with mounting feet and secure them to the floor. Legs are required on accessories for seismic applications.
5. Refer to OSP-0761 and VMA-54357-01 for seismic installations.

Figure 43. Crossover harness installation



Duct Connections

All duct connections should be installed in accordance with the standards of the National Fire Protection Association (NFPA);

- Installation of Air Conditioning and Ventilation Systems other than Residence Type (NFPA 90A)
- 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 to help minimize noise and vibration. If a fire hazard exists, Trane recommends using Flexweave 1000, type FW30 or equivalent canvas. Use three inches for the return duct and three inches for the discharge duct. Keep the material loose to absorb fan vibration.

Run the ductwork straight from the opening for a minimum of 1 1/2 fan diameters. 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. Avoid sharp turns and

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 duct noise levels and increase fan performance. 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.

Mix Box Damper Linkage

1. Verify bearing bracket on back damper is biased to the floor and the bearing bracket on the top damper is biased to the end of unit wall.
2. Confirm the crank arms and actuator are setup according to [Figure 44, p. 53](#) and [Figure 45, p. 54](#).
3. Verify crank arm bolts and linkage rod set screws are tightened.

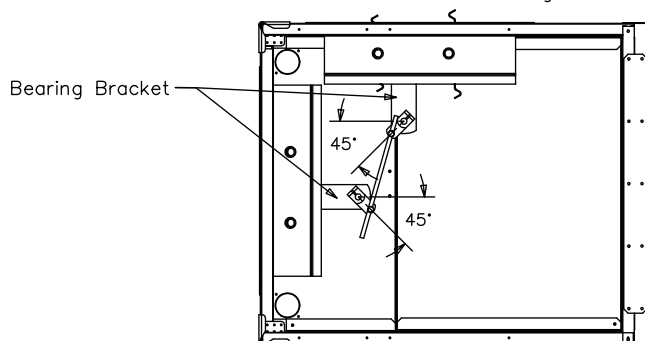
Figure 44. Mix box or mix box w/angle filter linkage orientation (size 12 to 72)

Mix box or mix box w/angle filter
linkage orientation (size 12-72)

Linkage Orientation
Size 12-72

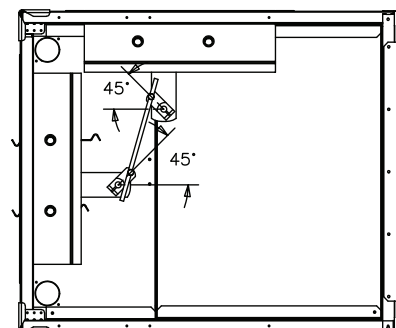
Normally Closed LH Unit
Left View

- *Back damper closed, top damper open
- *Back crank arm at 4:30, top crank arm at 7:30
- *CCW face of actuator facing out



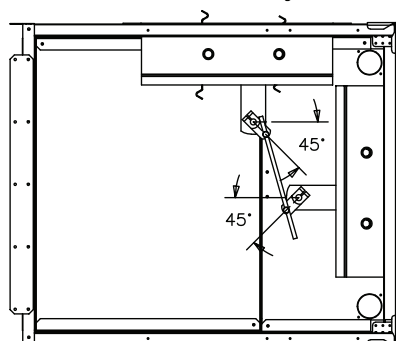
Normally Open LH Unit
Left View

- *Back damper open, top damper closed
- *Back crank arm at 1:30, top crank arm at 10:30
- *CW face of actuator facing out



Normally Closed RH Unit
Right View

- *Back damper closed, top damper open
- *Back crank arm at 7:30, top crank arm at 4:30
- *CW face of actuator facing out



Normally Open RH Unit
Right View

- *Back damper open, top damper closed
- *Back crank arm at 10:30, top crank arm at 1:30
- *CCW face of actuator facing out

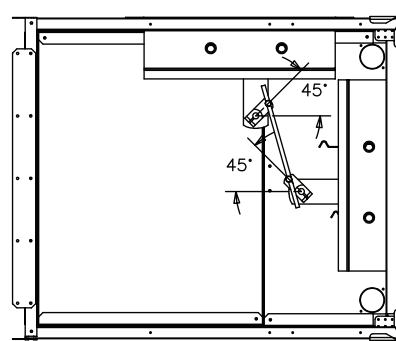


Figure 45. Mix box or mix box w/angle filter linkage orientation (size 90 to 120)

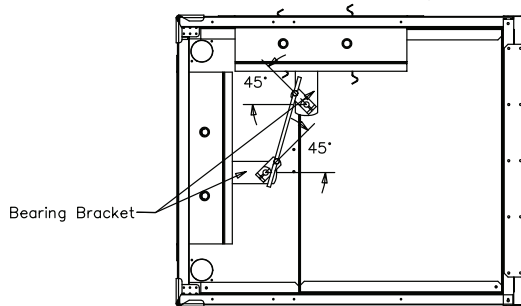
Mix box or mix box w/angle filter
linkage orientation (size 90–120)

Linkage Orientation
Size 90–120

Normally Closed LH Unit

Left View

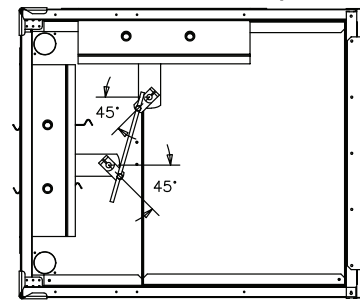
- *Back damper closed, top damper open
- *Back crank arm at 1:30, top crank arm at 10:30
- *CW face of actuator facing out



Normally Open LH Unit

Left View

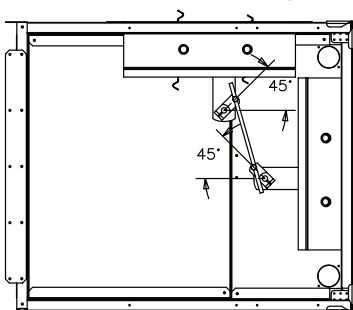
- *Back damper open, top damper closed
- *Back crank arm at 4:30, top crank arm at 7:30
- *CCW face of actuator facing out



Normally Closed RH Unit

Right View

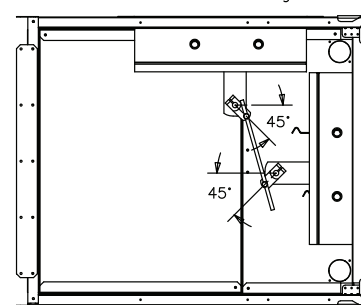
- *Back damper closed, top damper open
- *Back crank arm at 10:30, top crank arm at 1:30
- *CCW face of actuator facing out



Normally Open RH Unit

Right View

- *Back damper open, top damper closed
- *Back crank arm at 7:30, top crank arm at 4:30
- *CW face of actuator facing out



Condensate Drain Connections

Note: It is the installer's responsibility to provide adequate condensate piping to prevent potential water damage to the equipment and/or building.

Size the main drain lines and trap them the same size as the drain connection, which is 3/4-inch schedule 40 PVC, 1.050 inch O.D. on BCHE/BCVE Blower Coils. The size 24 to 60 BCVE Blower Coils have a rubber internal trap that has a 1.050 inch I.D. that can be connected to 3/4-inch schedule 40 PVC.

If drain pan removal is required, make the main and auxiliary drain connections with compression fittings. Follow the procedure below to remove the drain pan.

1. Remove the opposite side coil access panel.
2. Disconnect drain lines.
3. Remove the sheet metal screw.
4. Remove screws that attach coil gusset to Z-bracket. See [Figure 46, p. 55](#) and [Figure 47, p. 55](#).
5. Pull out drain pan through the opposite side.

Figure 46. BCXE drain pan removal

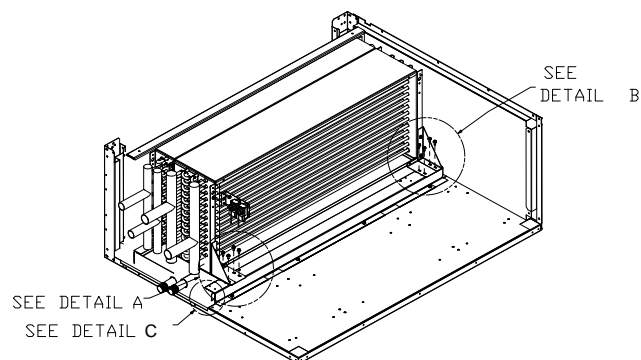
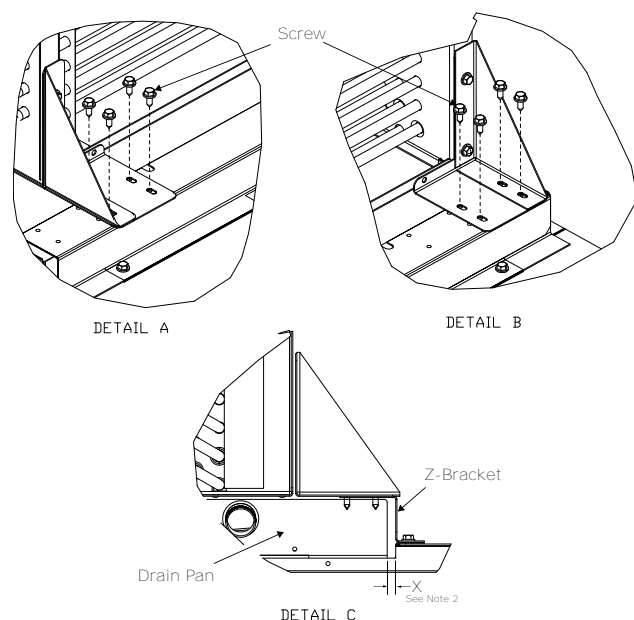


Figure 47. BCXE drain pan removal



Note: Prime drain traps to prevent the drain pan overflow.

Plug or trap the auxiliary connection to prevent air from being drawn in and causing carryover.

All drain lines downstream of the trap must flow continuously downhill. If segments of the line are routed uphill, this can cause the drain line to become pressurized. A pressurized drain line may cause the trap to back up into the drain pan, causing overflow.

Piping and Connections

NOTICE

Connection Leaks!

Failure to follow instructions below could result in damage to the coil header and cause connection leaks.

Use a backup wrench when attaching piping to coils with copper headers. Do not use brass connectors because they distort easily.

NOTICE

Overtightening!

Failure to follow instructions below could result in damage to the coil header.

Do not use teflon-based products for any field connections because their high lubricity could allow connections to be overtightened.

NOTICE

Leakage!

Failure to follow instructions below could result in equipment damage.

Properly seal all penetrations in unit casing from inner to outer panel in order to prevent unconditioned air from entering the module, as well as prevent water from infiltrating the insulation.

General Recommendations

Proper installation, piping, and trapping is necessary to ensure satisfactory coil operation and to prevent operational damage:

- Support all piping independently of the coils.
- Provide swing joints or flexible fittings on all connections that are adjacent to heating coils to absorb thermal expansion and contraction strains.
- If the coil was ordered with factory-mounted controls, install the control valves. The valves ship separately.

Note: The contractor is responsible for supplying the installation hardware.

- For best results, use a short pipe nipple on the coil headers prior to making any welded flange or welded elbow type connections.
- Pipe coils counterflow to airflow.
- When attaching the piping to the coil header, make the connection only tight enough to prevent leaks.

Note: Do not exceed 200 foot-pounds of torque on supply and return connections. Do not exceed 25 foot-pounds of torque on drain and vent connections.

- Use pipe sealer on all thread connections.

- After completing the piping connections, seal around pipe from inner panel to outer panel.

Grommet Installation

Grommets for piping headers ship loose in an accessory bag.

Figure 48. Grommets in accessory bag



Clean oil from panel before installing grommet onto headers to ensure good grommet adhesion.

Figure 49. Clean panel before installing grommets



To avoid heat damage:

1. Place grommet on the unit stub-outs without removing the adhesive backing.
2. Connect the incoming and outgoing pipe connections and before brazing, slide the grommets over the unbrazed joint away from the unit to avoid heat damage.

3. Braze the connections and allow to cool.
4. Slide the grommets back toward the unit. Trim any excess if grommets overlap.
5. Remove the adhesive backing and apply the grommets against the unit panel.

Drain Pan Trapping (Models BCHE/BCVE)

Note: Size 24-60 BCVE units are internally trapped.

⚠ WARNING

No Step Surface!

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

Do not walk on the sheet metal drain pan. Walking on the drain pan could cause the supporting metal to collapse and result in the operator/technician falling.

NOTICE

Water Damage!

Failure to follow instructions below could result in equipment and property damage.

Non-factory penetrations through the base of this unit are not allowed. Any penetration in the base of the unit may affect the water tight integrity of the unit and lead to water leaks into the conditioned space.

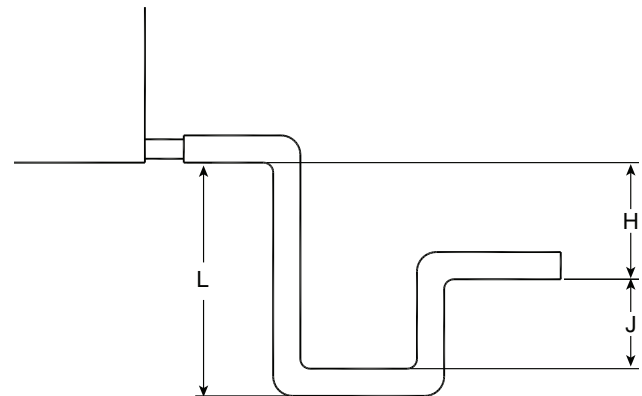
Size 24-60 BCVE are internally trapped. Pull P-trap end out of front panel of unit before securing to piping to reduce risk of kinking.

Condensate drain connections are provided on only one side of the coil section. Pitch the connection lines horizontal or downward toward an open drain. Trane recommends installing a plug to facilitate cleaning of the trap. The drain connection sizes are:

Unit size	NPT (national pipe thread) external connection
12-120	3/4-inch

The following figure illustrates the proper trapping, piping, and operation of the trap. Use the formula under the figure to determine the correct minimum depth for the condensate trap. If a section has a drain pan for cleaning purposes only, it does not need a trap; however, a cap or shutoff valve should be installed on the drain connection. Only sections handling condensate, such as a cooling coil section or moisture eliminator section, require a trap.

Figure 50. Drain pan trapping for negative pressure applications



Negative pressure

Drain pan trapping for section under negative pressure

$L = H + J + \text{pipe diameter}$ where:
 $H = 1 \text{ inch for each inch of negative pressure plus } 1 \text{ inch}$
 $J = 1/2 H$

Water Coil Piping

Water coils are self-venting only if the water velocity exceeds the minimum required velocity.

Table 23. Operating limits

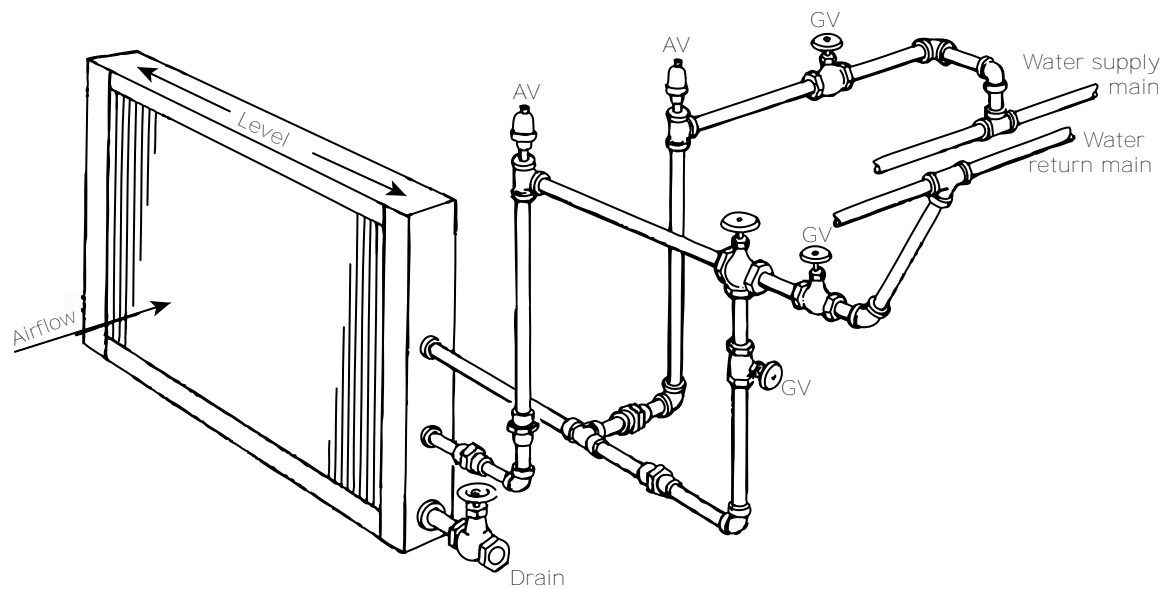
Desription	Minimum	Maximum
Operating Pressure (psi)	10	400
Fluid Temperature (°F)	0	200

The following combinations of unit size and number of rows have a coil with a minimum self-venting velocity of 1 feet per second (fps).

Unit Size	# Rows
18	8
36	6,8
54	4,6,8
72	2,4,6,8
90	2,4,6,8
120	2,4,6,8

All other unit size and coil combinations have a minimum self-venting velocity of 1.5 feet per second (fps).

Figure 51. Typical piping for one-row water coil

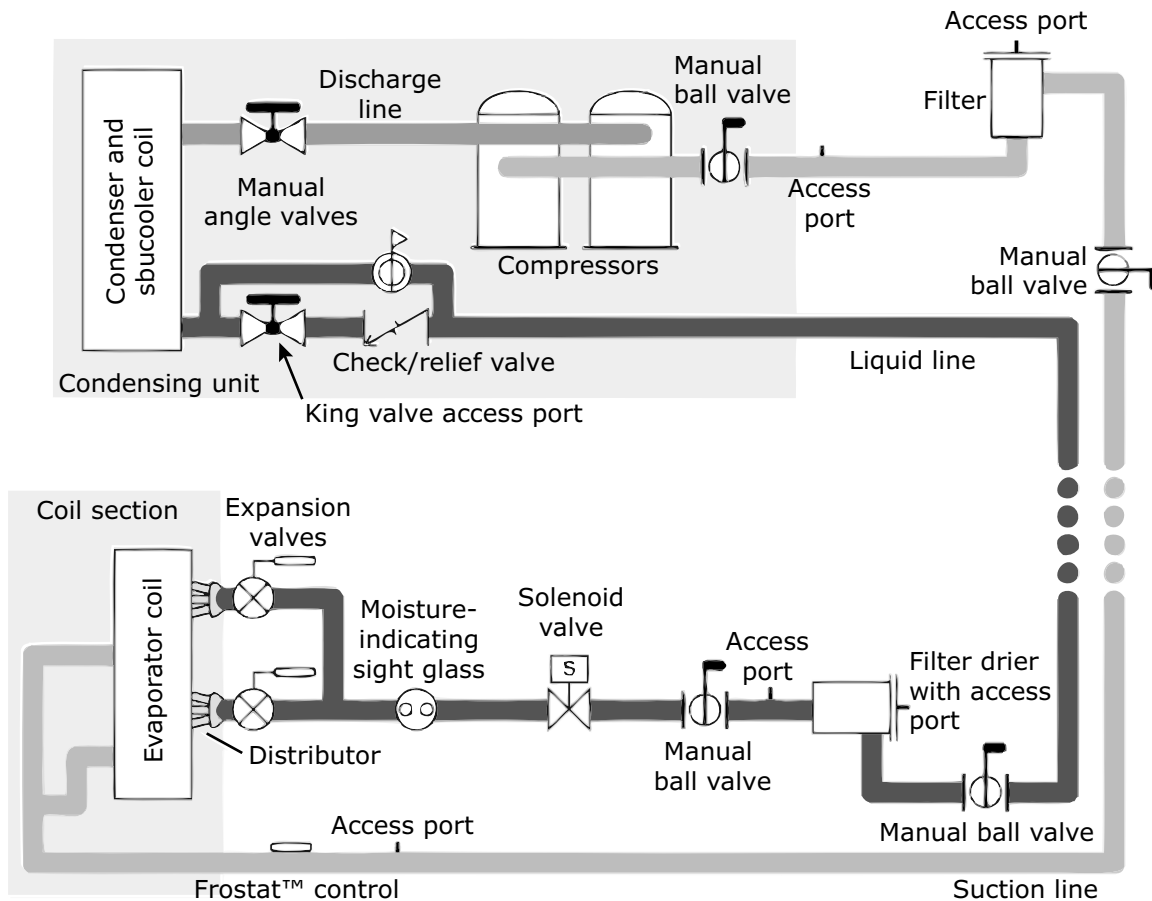


Refrigerant Coil Piping

Note: Refer to for information on handling refrigerants.

Figure 52, p. 59 illustrates an example of a split-system component arrangement. Use it to determine the proper, relative sequence of the components in the refrigerant lines that connect the condensing unit to an evaporator coil.

Figure 52. Example of placement for split-system components



Liquid Lines

Line Sizing

Properly sizing the liquid line is critical to a successful split-system application. The selected tube diameter must provide at least 5°F [2.7°C] of subcooling at the expansion valve throughout the operating envelope. Increasing the size of the liquid line will not increase the available subcooling.

Routing

Install the liquid line with a slight slope in the direction of flow so that it can be routed with the suction line. Minimize tube bends and reducers because these items tend to increase pressure drop and to reduce subcooling at the expansion valve. Liquid line receivers, other than those that are factory-installed, are not recommended.

Insulation

The liquid line is generally warmer than the surrounding air, so it does not require insulation. In fact, heat loss from the liquid line improves system capacity because it provides additional subcooling. However, if the liquid line is routed through a high-temperature area, such as an attic or a mechanical room, insulation would be required.

Components

Liquid-line refrigerant components necessary for a successful job include a filter drier, access port, solenoid valve, moisture-indicating sight glass, expansion valve(s), and ball shutoff valves. [Figure 52, p. 59](#) illustrates the proper sequence for positioning them in the liquid line. Position the components as close to the evaporator as possible.

Filter drier

There is no substitute for cleanliness during system installation. The filter drier prevents residual contaminants, introduced during installation, from entering the expansion valve and solenoid valve.

Access port:

The access port allows the unit to be charged with liquid refrigerant and is used to determine subcooling. This port is usually a Schraeder® valve with a core.

Solenoid valve:

In split systems, solenoid valves isolate the refrigerant from the evaporator during off cycles; under certain conditions, they may also trim the amount of active evaporator as compressors unload. Generally, the “trim” solenoid valve is unnecessary for VAV comfort-cooling applications, and is

Piping and Connections

only required for constant-volume applications when dehumidification is a concern.

In split systems with micro-channel heat exchanger condensers (MCHE), solenoid valves isolate the refrigerant from the evaporator during the off cycles. Trim solenoids cannot be used with MCHE.

Note: *Trane condensing units with MCHE no longer employ pump-down, but isolation solenoids are required. The suggested solenoid uses a 120-volt service and requires code-compliant wiring to the condensing unit.*

Moisture-indicating sight glass

Be sure to install one moisture-indicating sight glass in the main liquid line. The only value of the sight glass is its moisture indication ability. Use actual measurements of temperature and pressure—not the sight glass—to determine subcooling and whether the system is properly charged. The moisture indicator/sight glass must be sized to match the size of the liquid line at the thermal expansion valve.

NOTICE

Valve Damage!

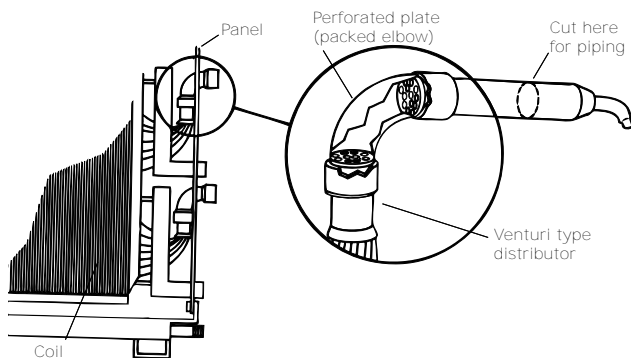
Failure to protect the valve from high temperatures could result in damage to internal components.

Disassemble the thermal expansion valve before completing the brazing connections. If necessary, wrap the valve in a cool, wet cloth while brazing.

Thermal expansion valve:

The expansion valve is the throttling device that meters the refrigerant into the evaporator coil. Metering too much refrigerant floods the compressor; metering too little elevates the compressor temperature. Choosing the correct size and type of expansion valve is critical to assure it will correctly meter refrigerant into the evaporator coil throughout the entire operating envelope of the system.

Figure 53. Type F refrigerant coil with packed elbow



Ball shut-off valves:

Adding manual, ball-type shutoff valves upstream and downstream of the filter simplifies replacement of the filter core.

Suction Lines

Line sizing

Proper line sizing is required to guarantee the oil returns to the compressor throughout the system's operating envelope. At the same time, the line must be sized so that the pressure drop does not excessively affect capacity or efficiency. To accomplish both objectives, it may be necessary to use two different line diameters: one for the horizontal run and for the vertical drops, and another for the vertical lifts (risers).

Routing

To prevent residual or condensed refrigerant from "free-flowing" toward the compressor during the off cycle, install the suction line so it slopes by ¼ inch to 1 inch per 10 feet of run toward the evaporator.

When the application includes a suction riser, oil must be forced to travel the height of the riser. Riser traps are unnecessary in the suction line. They will add pressure drop. Double risers must not be used. They not only add pressure drop, but can hold great amounts of oil - oil better used in the compressor.

If a suction riser is properly sized, oil will return to the compressor regardless of whether a trap is present. If a suction riser is oversized, adding a trap will not restore proper oil entrainment.

Avoid Underground Refrigerant Lines

Refrigerant condensation during the off cycle, installation debris inside the line (including condensed ambient moisture), service access, and abrasion/corrosion can quickly impair reliability.

Insulation

Any heat that transfers from the surrounding air to the cooler suction lines increases the load on the condenser (reducing the system's air-conditioning capacity) and promotes condensate formation. After operating the system and testing all fittings and joints to verify that the system is leak-free, insulate suction lines to prevent heat gain and unwanted condensation.

Components

Installing the suction line requires field installation of these components: a filter, access port, and a Froststat™ control when the refrigerant coil is used with Trane condensing units. Position them as close to the compressor as possible.

Note: *Placement of the Froststat control is illustrated in Figure 52, p. 59.*

- **Filter:** The suction filter prevents contaminants, introduced during installation, from entering the compressor. For this reason, the suction filter should be the replaceable-core type, and a clean core should be installed after the system is cleaned up.
- **Access port:** The access port is used to determine suction pressure. This port is usually a Schraeder valve with a core.

- **Frostat™ coil frost protection:** The Frostat control is the preferred method for protecting evaporator coils from freezing when the refrigerant coil is used with Trane condensing units. It senses the suction-line temperature and temporarily disables mechanical cooling if it detects frost conditions. The control is mechanically attached to the outside of the refrigerant line, near the evaporator, and wired to the unit control panel.
- **Ball shutoff valve:** Adding manual, ball-type shutoff valves upstream and downstream of the filter simplifies replacement of the filter core.

Expansion Valves

Expansion valves meter refrigerant into the evaporator under controlled conditions. If there is too much refrigerant, the refrigerant will not completely vaporize and the remaining liquid will slug the compressor. If there is too little refrigerant, there may not be enough cooling for the compressor.

Expansion valve requirements vary based on condensing unit design. Consult the product literature for the condensing unit to be used for proper valve selection.

Remodel, Retrofit, or Replacement

Inevitably, older condensing units and evaporator systems need to be replaced or retrofitted. Due to the phase-out of many of these older refrigerants, the major components for those older units or systems may no longer be available. The only option will be to convert the system to R-410A, POE oil, and R-410A components.

When upgrading an existing refrigerant split system due to remodel, retrofit, or replacement, the entire system must be reviewed for compatibility with R-410A and POE oil. Each and every part of the split HVAC system **MUST** be compatible with the properties of R-410A refrigerant and POE oil. In addition, ensure the existing electrical service is adequate for the product being installed.

⚠ 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.

Every part of an existing split system needs to be analyzed to determine if it can be reused in an R-410A and POE oil system:

- R-22 condensing units will not work with R-410A; they must be replaced.
- Most older evaporator coils were not pressure- and cycle-rated for R-410A pressures. If they weren't, they will need to be replaced. If they were properly pressure-rated for R-410A, existing coils must be modeled to determine if they will meet capacity requirements, are properly circuited, have correctly sized distributor tubes, and employ acceptable distributors and orifices.
- The required R-410A line sizes may be different than the existing line sizes. The lines need to be re-sized and compared to existing lines for reusability.
- Suction lines 2-5/8 OD and smaller of type L copper are suitable for use with R-410A. Suction lines 3-1/8 OD must use type K or thicker wall.
- Discharge lines, liquid lines, heat pump vapor lines, and hot gas bypass lines 1-3/8 OD and smaller of type L copper are suitable for use with R-410A. These same lines sized at 1-5/8 OD or 2-1/8 OD must use type K or thicker wall.
- Expansion valves need to be reselected. Expansion valves are refrigerant specific.
- Any gasket or O-ring should be replaced. Shrinkage of the original seal may occur after an HFC conversion, potentially causing a refrigerant leak. Components commonly affected are Schraeder cores, solenoid valves, ball valves, and flange seals. But *all* external seals in contact with refrigerant should be viewed as potential leak sources after a retrofit.
- All other valves, filters, valve packing, pressure controls, and refrigeration accessories must be researched through their manufacturer for compatibility with the pressures of an R-410A system, and for their compatibility with the newer POE oil.
- For the best performance and operation, the original mineral oil should be removed from the components of the system that are not being replaced. Any component of the system that is suspected of trapping oil (piping, traps, and coil), should be dismantled, drained, and reassembled. After all components have been drained, the amount of residual mineral oil will have a negligible effect on performance and reliability.

NOTICE

Compressor Damage!

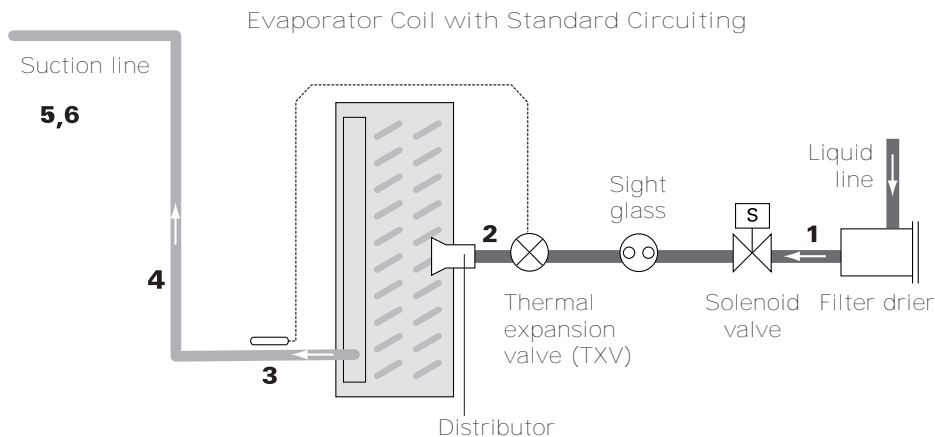
POE oil is hygroscopic – it absorbs water directly from the air. This water is nearly impossible to remove from the compressor oil and can result in compressor failures.

To prevent POE oil from absorbing water, the system should not remain open for longer than necessary. When open, dry nitrogen should flow through the piping. Only new oil containers should be used for service and maintenance. Always use the smallest container size required for the job requirements. Always leave the oil container tightly sealed until time of use. Do not reuse oil that has been opened.

All Codes take precedence over anything written here.

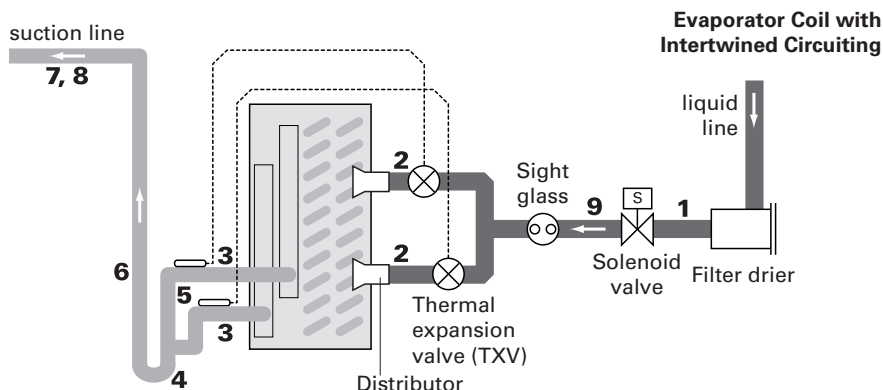
Field-Installed Evaporator Piping

Figure 54. Typical single-circuit condensing unit: evaporator coil with one distributor



1. Pitch the liquid line slightly—1 inch/10 feet—so that the refrigerant drains toward the evaporator.
2. Provide one expansion valve per distributor.
3. Slightly pitch the outlet line from the suction header toward the suction riser—that is, 1 inch/10 feet in the direction of flow. Use the tube diameter that matches the suction-header connection.
4. Use the tube diameter recommended in the condensing unit application manual for a vertical rise. Ensure that the top of the riser is higher than the evaporator coil.
5. Pitch the suction line slightly—1 inch/10 feet—so the refrigerant drains toward the evaporator.
6. Insulate the suction line.

Figure 55. Typical single-circuit condensing unit: evaporator coil with two distributors



1. Pitch the liquid line slightly—1 inch/10 feet—so the refrigerant drains toward the evaporator.
 2. Provide one expansion valve per distributor.
 3. Slightly pitch the outlet line from the suction header toward the suction riser— 1 inch/10 feet in the direction of flow. Use the tube diameter that matches the suction-header connection. Use a double-elbow configuration to isolate the TXV bulb from other suction headers.
 4. This looks like a trap, but is actually due to the requirement that the refrigerant gas leaving the coil flows downward, past the lowest suction-header outlet, before turning upward.
 5. Use the “horizontal” tube diameter as specified in the condensing unit application manual.
 6. Use the tube diameter recommended for a vertical rise as specified in the condensing unit application manual. Assure the top of the riser is higher than the evaporator coil.
 7. Pitch the suction line slightly—1 inch/10 feet—so that the refrigerant drains toward the evaporator.
 8. Insulate the suction line.
 9. Only use a “trim” solenoid valve for constant-volume, humidity-sensitive applications. For all other applications, install a single solenoid valve (the “pumpdown” solenoid valve) between the liquid-line filter drier and the sight glass.
- Note:** *Due to reduced coil volume in condensing units with micro-channel heat exchanger condenser, do not use trim solenoid valves for these units.*

Installation - Controls

Control Options

Available control options are:

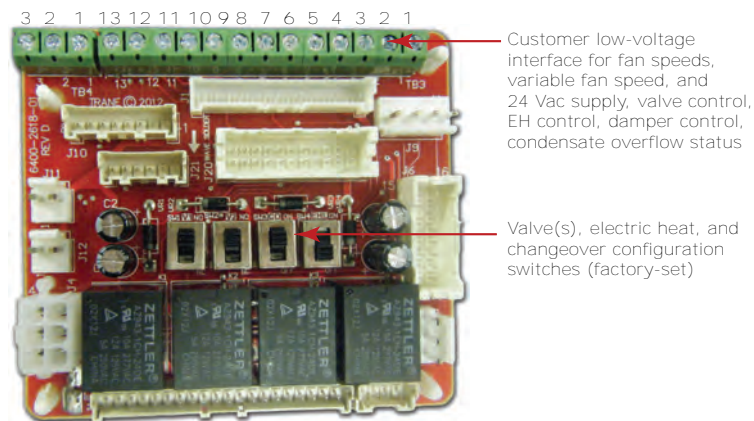
- Customer-supplied terminal interface (CSTI)
- Symbio™ controller with Air-Fi® Wireless Communications Interface

Customer Supplied Terminal Interface (CSTI)

The control interface is intended to be used with a field-supplied, low-voltage thermostat or controller. The control

box contains a relay board which includes a line voltage to 24-volt transformer, quiet contactors (for electric heat units), and an optional disconnect switch. All end devices are wired to a low-voltage terminal block and are run-tested, so the only a power connection and thermostat connection is needed to commission the unit. Changeover sensors and controls are provided whenever a change-over coil is selected. When N.O. valves are selected, inverting relays are provided for use with standard thermostats.

Figure 56. CSTI adapter board and field connections



1. VSP 10V
2. VSP 0–10V
3. VSP DC COM
1. 24 Vac B (hot)
2. 24 Vac Y (gnd)
3. High
4. Medium
5. Low
6. V1Op/Cooling
7. V1Cl (not std)
8. Not used
9. Not used
10. V2Op/EH1St/Heating
11. V2Cl/EH2St (not std)
12. Damper Open
13. Dmp Cl (not std)

The CSTI adapter board provides all the hookups as the standard adapter board, but in addition, provides hookups for valve control (main and auxiliary coils), electric heat control, and damper control. Screw terminal blocks provide convenient access to fan controls and to end device control. In addition, a courtesy 10 Vdc supply is provided for use with an external potentiometer or rheostat. The 10 Vdc supply supports up to 10 mA draw.

TB3 (right 13 positions) is normally used to provide:

- 24 Vac supply to a wall fan speed switch or
- 24 Vac supply to a field-installed unit-mounted controller, or a wall-mounted controller or thermostat
- Inputs (returns) for thermostatic fan control: High, Medium, and Low
- Inputs (returns) for cooling/heating requests
- Inputs (returns) for electric heat requests
- Inputs (returns) for damper operation requests

TB4 (left three positions) is normally used to control the system with a 0–10 Vdc input from a thermostat/controller with a variable speed output, or a fan control rheostat.

The terminal block functional assignments and polarity are shown for reference only, and the schematics that ship with each unit should be consulted before wiring. Wiring assignments are configured for each unit.

CSTI Adapter Board Configuration

⚠ CAUTION

Burn Hazard!

Failure to follow this instruction could result in the unit overheating and becoming hot to the touch, which could result in minor or moderate injury, and/or equipment damage.

On electric heat units, certain parameter values are locked out to prevent overheating of the unit. These functions will appear to be saved; however, they will not be accepted if the Electric Heat Protection setting is “On”. Do not change the Electric Heat Protection setting to “Off” and make changes to the protected settings unless you are programming an unconfigured service replacement board to match the unit settings on a ECM configuration label.

For CSTI units, the board mounted switches have to be set appropriately to enable the desired functionality.

Figure 57. CSTI board-mounted switches



Table 24. CSTI adapter board: switch functions

Switch (L-R)	SW1	SW2	SW3	SW4
Function	Valve one operation logic	Valve two operation logic	Changeover Function	Electric Heat / Fan Proving Function
UP position (towards terminal strip)	Normally Open Valve	Normally Open Valve	Changeover Function ON	Electric Heat / Fan Proving Function
DOWN position (towards black relays)	Normally Closed Valve	Normally Closed Valve	Changeover Function OFF	Electric Heat / Fan Proving Function

- All switches are factory-set based on customer configuration of the unit model number. The unit will function correctly as shipped; however, the switch functions and positions are depicted for customer convenience and for service and troubleshooting aids.
- SW3 and SW4 work in conjunction with settings on the motor control board controller. Simple activation of changeover and electric heat lockout function may not work correctly unless the motor control board is configured to perform these functions.
- Customers are advised to locate the changeover coil temperature sensor on the bypass line if possible, to avoid measuring standing water temperature.
- If a 4-pipe unit with changeover function is selected, the heating input will drive the main coil if hot water is detected, but will always drive the auxiliary coil or electric heat (where available).
- Where electric heat is available with a changeover coil, the electric heat is factory-configured to be deactivated if there is hot water available and if there is a fan failure.

The CSTI board comes with courtesy valve inversion relays that allow both normally open and normally closed two-position valves to be used with simple thermostats that do not have the configurability to adapt to the customer choice of valves. Independent switches, SW1 and SW2, are provided for 2pipe or 4pipe units, or 2-pipe units with an optional reheat coil. The functions of SW1 and SW2 is downstream of the changeover function (SW3 and motor control board). Decisions made by the changeover circuits will be flowed to the inversion circuits, if they are selected.

SW3 enables or disables the changeover function for 2-pipe changeover coil units, or 4pipe units where the coil has both a heating/cooling circuit and a heating circuit piped internally. If SW3 is turned off, the changeover function will be disabled, and the unit will then be configured as a cooling only coil, a heating only coil, or a combination of cooling only/heating only coil. Thus, customer cooling requests will drive the main valve, and heating requests will drive the auxiliary valve.

The changeover function is designed to work with customer controllers that request heating or cooling (based on

customer request), but have coil water temperatures that are “changed over” from heating to cooling (or cooling to heating) depending on the season and the building equipment available. Customer thermostats **MUST** be hooked to the correct terminal strip locations (V1 and V2) for the changeover function to work.

Cooling

In general, the (CSTI) changeover function will provide cooling if:

- A unit is factory configured with a changeover coil (cooling/heating) as the only coil or as the main coil portion.
- SW3 on the CSTI adapter board is turned on, and the *FPRU* parameter set to *EHL* or *EhF5* to use the changeover functions.
 - *EHL* parameter should be chosen if the unit has a changeover coil without electric heat.
 - *EhF5* parameter should be chosen if the unit has a changeover coil with electric heat. Generally, this will perform the same as the *EHL* parameter but will in addition, disable the heating function on electric heat and on the changeover coil heat if there are fan failures. The auxiliary heating coil valve will continue to respond to customer heating requests.
- The motor control board has sensed that there is cold water available on the supply/bypass line for the changeover coil. In this case, “cold” water is inferred by the motor control board if:
 - A 10K NTC thermistor (similar to Trane part number X13790374010) is wired properly to the motor control board, through the crossover cables and CSTI adapter boards.
 - The input impedance of the thermistor circuit must be set correctly (the *RPUI* parameter should be set to *in* for CSTI units).
 - The temperature sensed is lower than the *RT1* parameter.

- The R_{2b} parameter is higher than the R_{2i} parameter.
- The temperature is not in the dead-band between the R_{2b} parameter and the R_{2i} parameter (in this case, previous state will be retained).
- The customer thermostat is properly hooked up the input strip 1TB3, and is requesting cooling input (V1) based on the customer cooling setpoint being lower than the space temperature.

Heating

In general, the (CSTI) changeover function will provide heating if:

- A unit is factory-configured with a changeover coil (cooling/heating) as the only coil or as the main coil portion.
- SW3 on the CSTI adapter board is turned on, and the FP_{ru} parameter set to EH_L or $EHF5$ to use the changeover functions.
 - EH_L parameter should be chosen if the unit has a changeover coil without electric heat.
 - $EHF5$ parameter should be chosen if the unit has a changeover coil with electric heat. Generally, this will perform the same as the EH_L parameter but will in addition, disable the heating function on electric heat and on the changeover coil heat if there are fan failures. The auxiliary heating coil valve will continue to respond to customer heating requests.
- The motor control board has sensed that there is hot water available on the supply/bypass line for the changeover coil. In this case, “hot” water is determined if:
 - A 10K NTC thermistor (similar to Trane part number X13790374010) is wired properly to the motor control board, through the crossover cables and CSTI adapter boards.
 - The input impedance of the thermistor circuit must be set correctly (the R_{PU} parameter should be set to in for CSTI units).
 - The temperature sensed is higher than the R_{2b} parameter.
 - The $Ai2b$ parameter is higher than the R_{2i} parameter.
 - The temperature is not in the dead-band between the R_{2b} parameter and the R_{2i} parameter (in this case, previous state will be retained).
- The customer thermostat is properly hooked up the input strip 1TB3, and is requesting heating input (V2) based on the customer heating set point being higher than the space temperature.
- The heating input on 1TB3 will drive the main changeover coil IF conditions 1–4 are satisfied, but will always drive the auxiliary coil valve (if present). Electric heat will be locked out (where present) if hot water is

available since SW4 will be factory set to “ON” in these units.

SW4 selects the electric heat lockout function, where we will lock out the electric heat circuit based on either:

- The presence of hot water in the changeover coil section (if the FP_{ru} parameter is set to EH_L).
- Abnormal behavior of the fan/s (if the FP_{ru} parameter is set to $Fn5E$).
- Or a combination of both the presence of hot water or abnormal behavior of the fan/s (if the FP_{ru} parameter is set to $EHF5$).

The preceding three examples depend on the inference of the motor control board that hot water is present. In this case, “hot” water is determined if:

- The temperature sensed is higher than the R_{2b} parameter.
- The R_{2b} parameter is higher than the R_{2i} parameter.
- The temperature is not in the dead-band between the R_{2b} parameter and the R_{2i} parameter (in this case, previous state will be retained).
- The input impedance of the thermistor circuit must be set correctly (the R_{PU} parameter should be set to in for CSTI units).

Symbio™ 400-B Controller

The Tracer® UC400-B single-zone VAV controller can be used in a stand-alone application or as part of a Tracer control system.

The Symbio™ 400/Symbio 400-B is a multi-purpose, programmable (or application-specific controller) that provides direct-digital zone temperature control. The controller can operate as a stand-alone device or as part of a building automation system (BAS). Communication between the controller and a BAS occurs on an open standard with inter-operable protocols used in Building Automation and Control Networks (BACnet®). Programming is done by means of the Tracer TU service tool. The Symbio 400-B is designed to be a one for one replacement for the UC400-B.

In the stand-alone configuration, Symbio 400-B receives operation commands from the zone sensor and/or the auto changeover sensor (on auto changeover units). The entering water temperature is read from the auto changeover sensor and determines if the unit is capable of cooling or heating. The zone sensor module is capable of transmitting the following information to the controller:

- Timed override on/cancel request
- Zone setpoint
- Current zone temperature
- Fan mode selection (off-auto-high-med-low)

For optimal system performance, units can operate as part of a Tracer® SC building automation system. The controller is linked directly to the Tracer SC via a twisted pair communication wire, requiring no additional interface device (i.e., a command unit). The Tracer control system can monitor or override Symbio 400-B control points. This includes such points as temperature and output positions.

Note: For more detailed information, refer to *Symbio 400–B/500 Programmable Controllers For Blower Coil, Fan Coil, and Unit Ventilator Installation, Operation, and Maintenance (BAS-SVX093*EN)*.

Communication Wire Specifications

All wiring must comply with the National Electrical Code (NEC™) and local electrical codes.

Field-supplied BACnet MS/TP link wiring must be installed in compliance with NEC and local codes. The wire must be low-capacitance, 18-gauge, stranded, tinned-copper, shielded, twisted-pair.

Note: For more details, refer to *Wiring Guide: Unit Controller Wiring for the Tracer® SC System Controller (BAS-SVN03*EN, or the most recent revision)*.

General Wiring Guidelines

Figure 58. Connecting wires to terminal



To connect wires to the UC400-B controller or the expansion modules:

1. Strip the wires to expose 0.28 inch (7 mm) of bare wire.
2. Insert the wire into a terminal connector.
3. Tighten the terminal screw to 0.5 to 0.6 N-m (71 to 85 ozf-in. or 4.4 to 5.3 lbf-in.).
4. Tug on the wires after tightening the screws to ensure all wires are secure as shown on the right.

Setting the Address

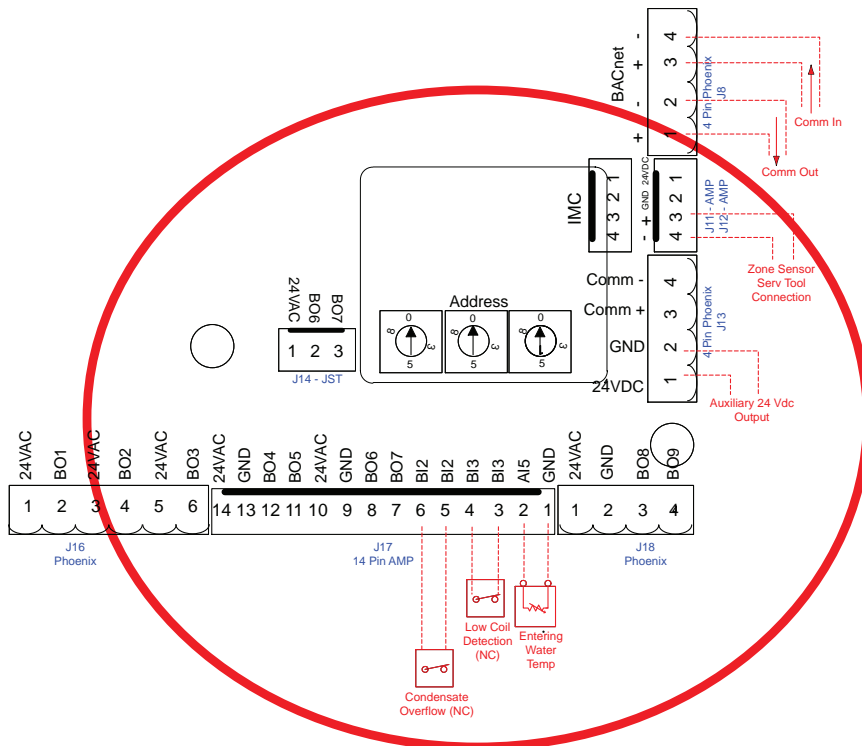
The rotary address dials on the Symbio™ 400-B controller serve one or two purposes depending upon the network: they are always used for the MAC Address, which is sometimes all or part of the BACnet® Device ID as shown in [Figure 59, p. 68](#).

Units with a Symbio™ 400-B WCI controller can be addressed in the factory. Check with the controls contractor for more information.

Use a 1/8 inch (3.2 mm) flathead screwdriver to set rotary address dials. Dials rotate in either direction.

Final addresses are subject to change based on final job requirements. For pre-addressed controllers and WCI's from the factory, it is recommended to verify that addresses are set correctly prior to powering the device.

Figure 59. Setting rotary address dials



MAC Address

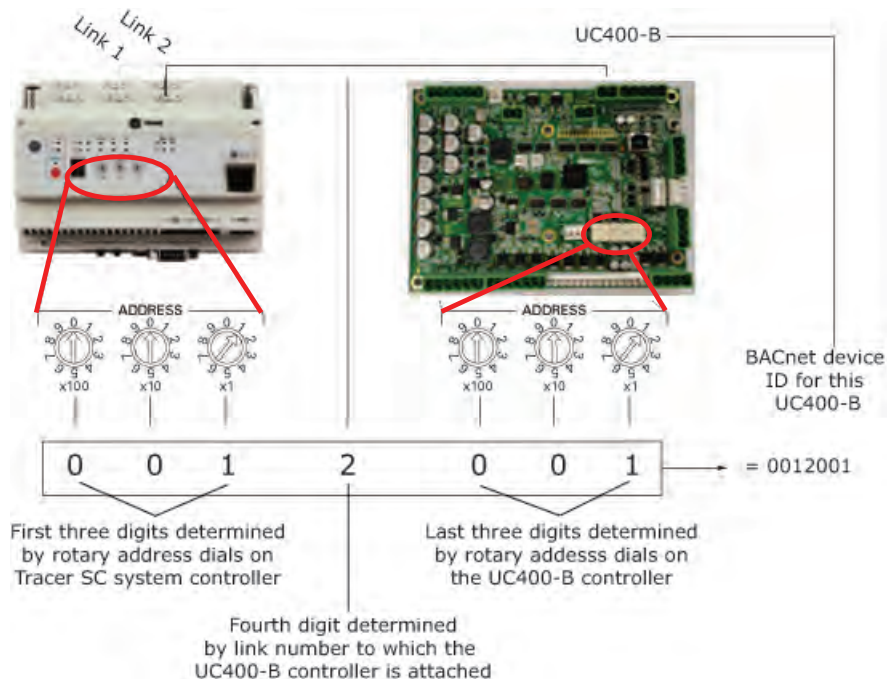
The MAC Address is required by the RS-485 communication protocol on which BACnet® operates. A Symbio™ 400-B controller can use a MAC Address from 001 to 120.

Important: Each device on the link must have a unique MAC Address/Device ID. The controller rotary addresses should be sequentially set, with no gaps in the numbering, starting with 001 on each link (for example 001, 002, 003, 004 and so on). A duplicate address or a 000 address setting will interrupt communications and cause the Tracer® SC device installation process to fail.

BACnet Device ID

The BACnet Device ID is required by the BACnet network. Each device must have a unique number from 001 to 4094302. See the following figure.

Figure 60. BACnet device ID



BACnet networks without a Tracer® SC system controller

On BACnet networks without a Tracer SC system controller, the Device ID can be assigned one of two ways:

- It can be the same number as the MAC Address, determined by the rotary address dials on the Symbio™ 400-B controller. For example, if the rotary address dials are set to 042, both the MAC Address and the BACnet Device ID are 042.
- It can be soft set using the Tracer TU service tool. If the BACnet Device ID is set using the Tracer TU service

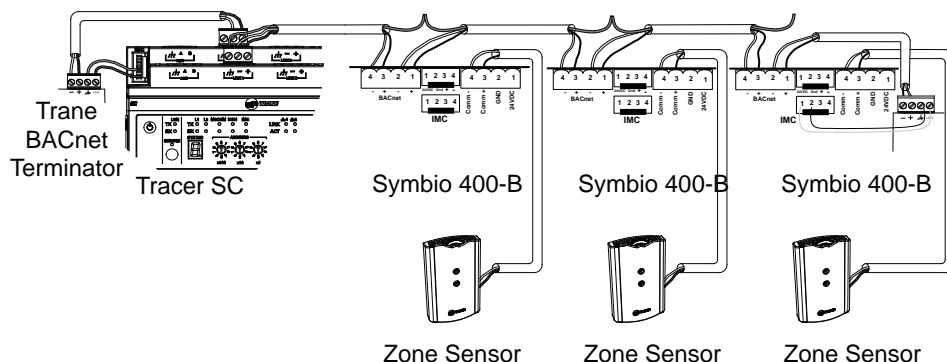
tool, the rotary address dials *only* affect the MAC Address, they do not affect the BACnet Device ID.

BACnet networks with a Tracer® SC system controller

On BACnet networks with a Tracer SC system controller, the Device ID for the Symbio 400-B controller is always soft set by the system controller using the following scheme illustrated below.

Note: The BACnet Device ID is displayed as the Software Device ID on the Tracer TU Controller Settings page in the **Protocol** group.

Figure 61. Example of BACnet link wiring with multiple Symbio-B controllers





Read all of the warnings, cautions, and notices below before proceeding with this section.

Hazardous Voltage!

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.

Proper Ground Connection Required!

After installation, ensure that the 24 Vac transformer is grounded through the controller. Measure the voltage between chassis ground and any ground terminal on the controller. Expected result: Vac <4.0 volt.

Equipment Damage!

Sharing 24 Vac power between controllers could result in equipment damage.

- The transformer must have sufficient capacity.
- Polarity must be maintained for every controller powered by the transformer.

- *Partial or full loss of communication on the entire BACnet MS/TP link*
- *Improper function of the controller outputs*
- *Damage to the transformer or a blown transformer fuse*

A 24 Vac power supply must be used for proper operation of the binary inputs, which requires 24 Vac detection. In addition, the spare 24 Vac outputs may be used to power relays and TRIACS.

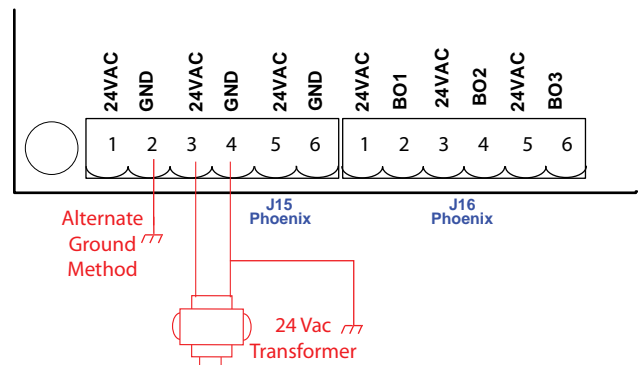
- AC transformer requirements: *UL listed, Class 2 power transformer, 24 Vac \pm 15%, device max load 24VA. The transformer must be sized to provide adequate power to the controller (12VA) and outputs (maximum 12VA per binary output).*
- CE-compliant installations: *The transformer must be CE marked and SELV compliant per IEC standards.*

To ensure proper operation of the Symbio™ 400-B controller, install the power supply circuit in accordance with the following guidelines:

- A dedicated power circuit disconnect switch must be near the controller, easily accessible by the operator, and marked as the *disconnecting device* for the controller.
- 18 AWG (0.823 mm²) copper wire is recommended for the circuit between the transformer and the controller.

Important: The controller must receive AC power from a dedicated power circuit; failure to comply may cause the controller to malfunction. DO NOT run AC power wires in the same wire bundle with input/output wires; failure to comply may cause the controller to malfunction due to electrical noise.

Figure 62. Grounding the controller



1. Disconnect power to the transformer.
2. Connect the 24 Vac secondary wires from the transformer to the 24 Vac and terminals on the Symbio 400-B controller (refer to the illustration above).
3. Do one of the following to ensure the controller is adequately grounded:

Connect a grounding pigtail at some point along the secondary wire that runs between the controller terminal and the transformer.

Note: A pigtail connection may be necessary between earth ground and/or enclosure ground if the device is not grounded through one leg of the transformer wiring.

Power ON Check

To perform a **Power ON** check:

1. Verify that the 24 Vac connector and the chassis ground are properly wired.
2. Remove the lockout/tagout from the line voltage power to the electrical cabinet.
3. Energize the transformer to apply power to the Symbio 400-B controller.
4. Observe the controller when power is applied to verify the power check sequence as follows:
 - a. The power LED lights red for 1 second
 - b. The power LED lights green

If the sequence above is completed as described, the controller is properly booted and ready for the application code.

If the power LED flashes red, a fault condition exists.

Air-Fi® Wireless Communications Systems

For more detailed information on Air-Fi® Wireless Communications systems and devices, see:

- *Air-Fi® Wireless Installation, Operation, and Maintenance manual* (BAS-SVX40*-EN)
- *Air-Fi® Wireless Product Data Sheet* (BAS-PRD021*-EN)
- *Air-Fi® Wireless Network Design Installation, Operation, and Maintenance* (BAS-SVX55*-EN)

Air-Fi® Wireless Communications Interface (WCI)



A factory-installed Air-Fi® Wireless Communications Interface (WCI) provides wireless communication between the Tracer® SC and Tracer® unit controllers. The Air-Fi® WCI is the perfect alternative to a Trane BACnet® wired communication link. Eliminating the communication wire between terminal products, space sensors, and system controllers has substantial benefits:

- Reduced installation time and associated risks.
- Completion of projects with fewer disruptions.
- Easier and more cost-effective re-configurations, expansions, and upgrades.

Wireless Zone Sensor (WZS) Set



A wireless zone sensor (WZS) set (sensor and receiver) communicates wirelessly to a Tracer® unit controller. A wireless zone sensor set is an alternative to a wired sensor when access and routing of communication cable are issues. The sensor allows flexible mounting and relocation.

Note: A wireless zone sensor set is not compatible with an Air-Fi® wireless system.

The Wireless Comm Interface (WCI) enables wireless communication between system controls, unit controls, and wireless sensors for the new generation of Trane control products. The WCI replaces the need for communication wire in all system applications.

Notes: For more detailed information, refer to:

- *Air-Fi® Wireless Installation, Operation, and Maintenance manual* (BAS-SVX40*-EN)
- *Air-Fi® Wireless Network Design Installation, Operation, and Maintenance* (BAS-SVX55*-EN)

Quantity of WCIs per Network

Each Trane wireless network can have a total of 31 WCIs (30 member WCIs plus one coordinator WCI). Each network requires one WCI to function as network coordinator.

Quantity of Networks per Tracer® SC

A Tracer® SC can support up to eight wireless networks.



Installation - Controls

Automatic Network Formation

When a WCI is connected to a Tracer® SC, it is auto-assigned as the coordinator. To enable the coordinator, Tracer® SC must be configured for wireless communication. The coordinator WCI opens the network to allow all WCIs having matching addresses to automatically join the network. If no Tracer® SC is present, a centrally located WCI must be designated to act as the coordinator. You can manually set the coordinator WCI so all WCIs having matching addresses automatically join the network.

Wireless Zone Sensors

The WCI also communicates with Trane wireless zone sensors, eliminating the need for analog receivers.

Wired Zone Sensors

Systems using WCI can also use wired zone sensors.

Specifications

Operating Temperature: -40 to 158°F (-40 to 70°C)

Storage temperature: -40 to 185°F (-40 to 85°C)

Storage and operating humidity range: 5 percent to 95 percent relative humidity (RH), non-condensing

Voltage: 24 Vac/VDC nominal \pm 10 percent. If using 24 Vac, polarity must be maintained.

Receiver power consumption: <2.5 VA

Housing material: Polycarbonate/ABS (suitable for plenum mounting), UV protected, UL 94: 5VA flammability rating

Mounting: Snaps into sheet metal opening.

Range: Open range: 2,500 ft (762 m) with packet error rate of 2 percent.

Indoor: Typical range is 200 ft (61 m); actual range is dependent on the environment. See *Air-Fi® Wireless Network Design Installation, Operation, and Maintenance* (BAS-SVX55*-EN) for more detail.

Note: *Range values are estimated transmission distances for satisfactory operation. Actual distance is job specific and must be determined during site evaluation. Placement of WCI is critical to proper system operation. In most general office space installations, distance is not the limiting factor for proper signal quality. Signal quality is affected by walls, barriers, and general clutter. For more information see available at www.trane.com.*

Output power: North America: 100 mW

Radio frequency: 2.4 GHz (IEEE Std 802.15.4-2003 compliant) (2405–2480 MHz, 5 MHz spacing)

Radio channels: 16

Address range: Group 0–8, Network 1–9

Mounting

Fits a standard 2x4 in. junction box (vertical mount only). Mounting holes are spaced 3.2 in. (83 mm) apart on vertical center line. Includes mounting screws for junction box or wall anchors for sheet-rock walls.

Overall dimensions: 2.9 in. (74 mm) x 4.7 in. (119 mm)

Wireless Protocol

ZigBee® PRO—ZigBee Building Automation Profile, ANSI/ASHRAE Standard 135-2008 Addendum q (BACnet®/ZigBee®)

Zone Sensor Options

A variety of wall-mounted zone sensors are available for design flexibility. Zone sensors have an internal thermistor

and operate on 24 Vac. Options with setpoint knobs are available in Fahrenheit or Celsius.

Figure 63. Wall-mounted zone sensor with occupied/unoccupied, COMM (Digit 38 = A)



Figure 64. Wall-mounted zone sensor with setpoint dial, OALMH, occupied/unoccupied, COMM (Digit 38 = C)



Figure 65. Wall-mounted wired display sensor (WDS) with setpoint adjustment, OALMH (Digit 38 = D)



Figure 66. Air-Fi Wireless Communications Sensor (WCS) with setpoint, OALMH (Symbio 400-B only) (Digit 38 = E)



Figure 67. Wall-mounted fan speed switch (Digit 38 = F)



Zone Sensor Installation

Location Considerations

When selecting a location for the zone sensor, avoid the following:

- Dead spots, such as behind doors, projection screens, or in corners that do not allow free air circulation.
- Air drafts from stairwells, outside doors, or unsectioned hollow walls.
- Airflow from adjacent zones or other units.
- Unheated or uncooled spaces behind the controller, such as outside walls or unoccupied spaces.
- Concealed pipes, air ducts, or chimneys in partition spaces behind the controller.
- Areas in the direct airstream of air diffusers.
- Exterior walls and other walls that have a temperature differential between the two sides.
- Areas that are close to heat sources such as sunlight, appliances, concealed pipes, chimneys, or other heat-generating equipment.
- Walls that are subject to high vibration.
- Areas with high humidity.
- High traffic areas (to reduce accidental damage or tampering).
- Metal barriers between the receiver and the sensor (for example, plastered walls with metal lathe or metal roof decks).
- Thick, solid concrete walls between the receiver and the sensor.

Location Considerations for Wireless Zone Sensors

Placement of the sensor is critical to proper operation (the receiver is factory mounted). For most installations, barriers limit proper radio signal strength more than distance. For best radio transmission range and reliability, mount the receiver and sensor in line of sight. Where this is not possible, try to minimize the number of barriers between the pair of devices. In general, sheetrock walls and ceiling tiles offer little restriction to the transmission range for the sensor is as follows:

- Open range: 2,500 ft (packet error rate = 2%)
- Usable range: 200 ft
- Typical range: 75 ft

Height Requirements

It is recommended that you mount the back plate a maximum distance of 54 inches above the floor. If a parallel approach by a person in a wheelchair is required, reduce the maximum height to 48 inches.

Note: Consult section 4.27.3 of the 2002 ADA (Americans with Disability Act) guideline, and local building codes, for further details regarding wheelchair requirements.

Mounting Surfaces

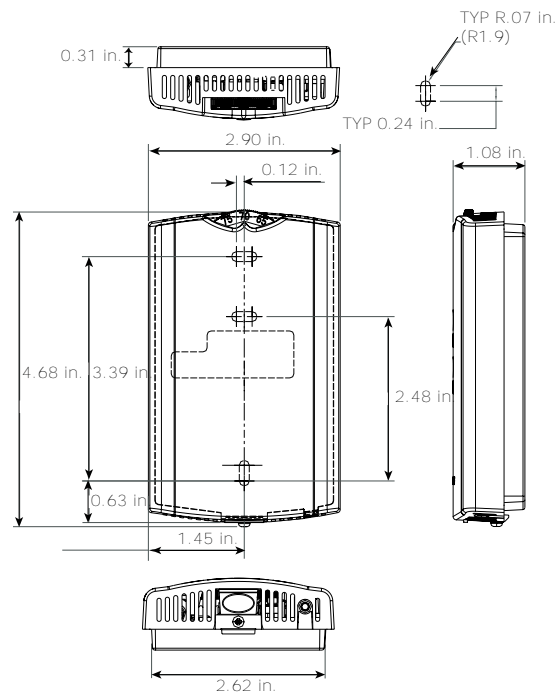
Using the hardware provided, mount the back plate of the sensor to a flat surface such as sheetrock or plaster, or an electrical junction box. The sensor must be mounted plumb for accurate temperature control and to ensure proper air movement through the sensor.

- If mounting onto sheetrock or plaster, use the plastic threaded anchors (pre-drilling holes is not usually necessary) and the two M3.5 x 20 mm mounting screws.
- For mounting onto an electrical junction box, use the two 6-32 x 3/4 in. screws.

Zone Sensor Dimensions

Refer the wall-mounted zone sensor dimensions in the following figure. Position the sensor on an inside wall three to five feet above the floor and at least 18 inches from the nearest outside wall. Installing the sensor at a lower height may give the advantage of monitoring the temperature closer to the zone, but it also exposes the sensor to airflow obstructions. Ensure that air flows freely over the sensor.

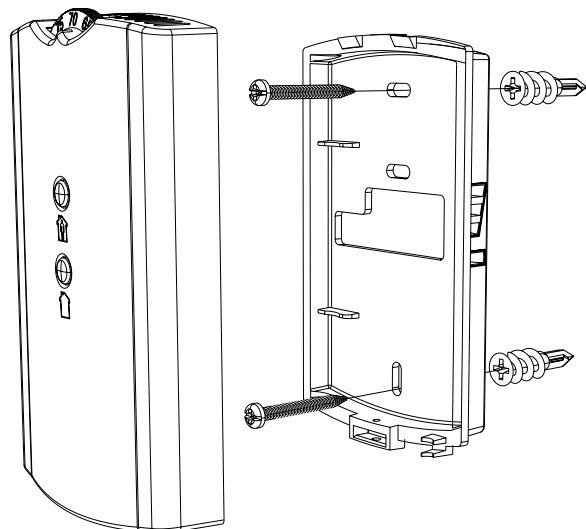
Figure 68. Wall-mounted wired and wireless zone sensor dimensions



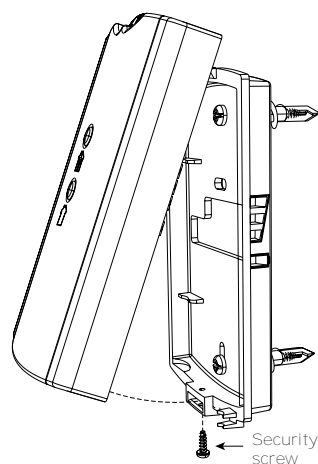
Wired Zone Sensor

Refer to the unit wiring schematic for specific wiring details and point connections.

1. Note the position of the setpoint adjustment knob and gently pry the adjustment knob from the cover using the blade of a small screwdriver.
2. Insert the screwdriver blade behind the cover at the top of the module and carefully pry the cover away from the base.
3. To mount the sensor back plate: (see the [Figure 69, p. 75](#)).
 - a. Hold the back plate against the mounting surface and mark the screw locations.
 - b. Secure the back plate against the mounting surface using included hardware.

Figure 69. Mounting zone sensor base plate


4. To install the zone sensor module to a standard junction box:
 - a. Level and install a 2 x 4in. junction box (installer supplied) vertically on the wall.
 - b. Pull the control wires through the cutout. Attach the module to the wall using the screws provided.
5. Strip the insulation on the interconnection wires back 0.25-inch and connect to TB1 (for wired sensors).
6. Screw down the terminal blocks (for wired sensors).
7. To replace the cover:
 - a. Hook the cover over the top of the back plate. Apply light pressure to the bottom of the cover until it snaps in place.
 - b. Install the security screw into the bottom of the cover if desired (see [Figure 70, p. 75](#)).

Figure 70. Mounting zone sensor security screw


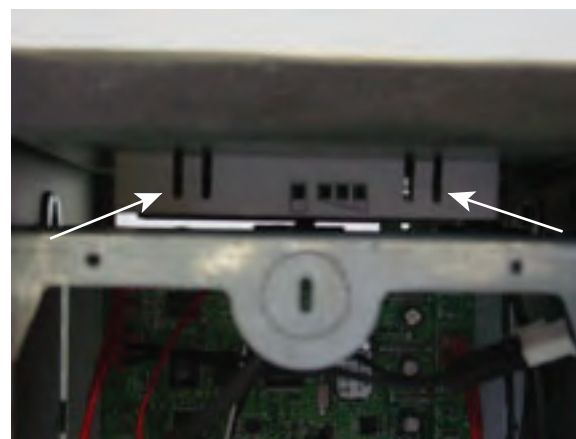
Wireless Zone Sensors

1. Note the position of the setpoint adjustment knob and gently pry the adjustment knob from the cover using the blade of a small screwdriver.
2. Insert the screwdriver blade behind the cover at the top of the module and carefully pry the cover away from the base.
3. To mount the sensor back plate: (see [Figure 69, p. 75](#))
 - a. Hold the back plate against the mounting surface and mark the screw locations
 - b. Secure the back plate against the mounting surface using included hardware.
4. To replace the cover:
 - a. Hook the cover over the top of the back plate. Apply light pressure to the bottom of the cover until it snaps in place.
 - b. Install the security screw into the bottom of the cover if desired (see [Figure 70, p. 75](#)).

Note: For more detailed information for wireless sensors, please see *Air-Fi® Wireless System Installation, Operation, and Maintenance (BAS-SVX40*-EN)*.

Receivers

Receivers ship installed on the unit. To remove the receiver, press in the retention tabs on the underside of the receiver enclosure (see [Figure 71, p. 75](#)) and push upward.

Figure 71. Retention tabs on underside of receiver enclosure


Zone Sensor Settings

Address Setting

The process of establishing communication between a receiver and sensor is referred to as *association*. The following limitations apply:

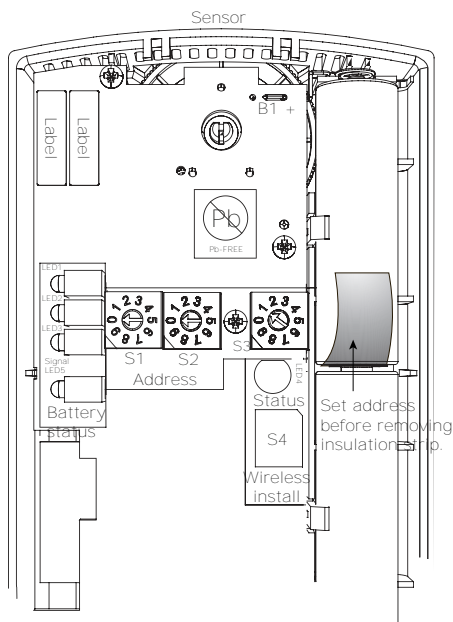
- Each associated receiver/sensor set that communicates within the reception range of the wireless system must have a unique address.

Installation - Controls

- It is not possible to associate more than one sensor to a receiver, nor is it possible to associate more than one receiver to a sensor.
- To associate a receiver and sensor, the two devices must have their rotary address switches set to the same address.

Important: Set the addresses before applying power to the receiver and before removing the insulation strip (Figure 72, p. 76) from the sensor.

Figure 72. Set address before removing insulation strip from the sensor

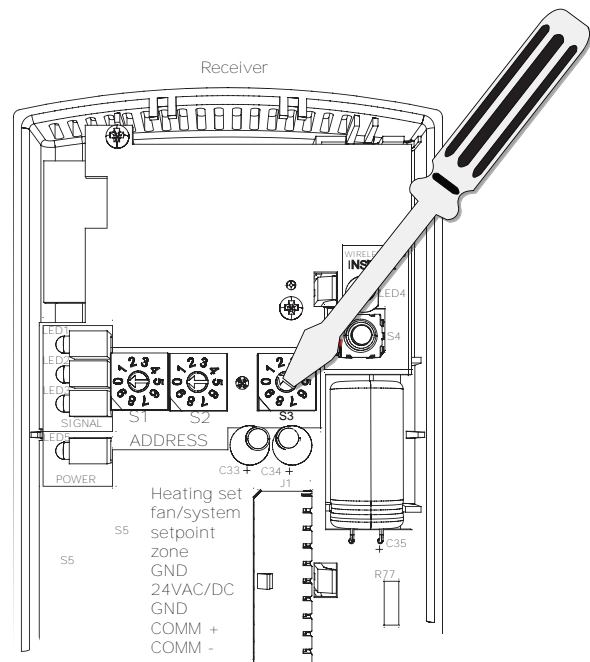


To set the receiver and sensor addresses:

1. Using a small screwdriver, set the three rotary address switches (locations S1, S2, S3) on the receiver to an address between 001 and 999 (see the following figure). You do not have to remove the covers to access the rotary address switches.

Note: Do not use 000 as an address. An address of 000 returns the receiver outputs to their factory defaults (zone temperature and setpoint outputs: 72.5°F, removes all association knowledge, and prevents association with a sensor.

Figure 73. Set the rotary address switches on the receiver



2. Set the three rotary address switches (locations S1, S2, S3) on the sensor to the same address as the receiver (see Figure 73, p. 76).

Note: Do not use 000 as an address. An address of 000 removes all association knowledge, reverts the sensor to a low-power hibernation mode, and sends a disassociation request to the receiver.

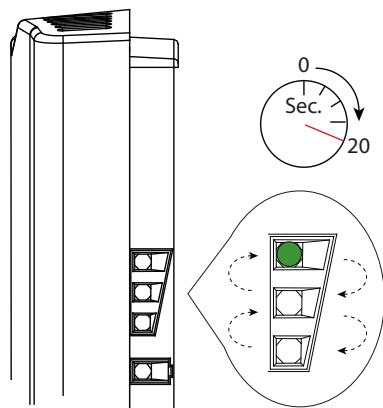
3. Record the address and location of the receiver and sensor pair.

Observing Receiver for Readiness

After initial power up, the receiver conducts a channel scan for 20 seconds. See Figure 74, p. 77. During this time, the receiver selects from 16 available channels the clearest channel on which to operate. LED1, LED2, and LED3 flash rapidly in succession (round-robin style) while the channel scan is in progress.

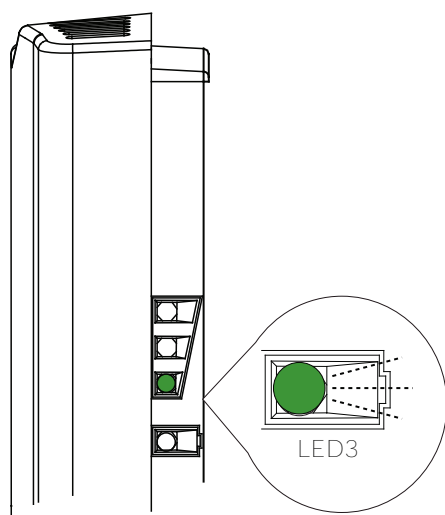
Important: Do not attempt association (leave the insulation strip in place) until the channel scan is finished.

Figure 74. Receiver conducts 20 second channel scan



After the channel scan is finished, LED3 begins blinking (one-blink pattern) to show that the receiver is ready to be associated with a sensor. (See [Figure 75, p. 77](#))

Figure 75. LED3 blinks after channel scan to show receiver is ready

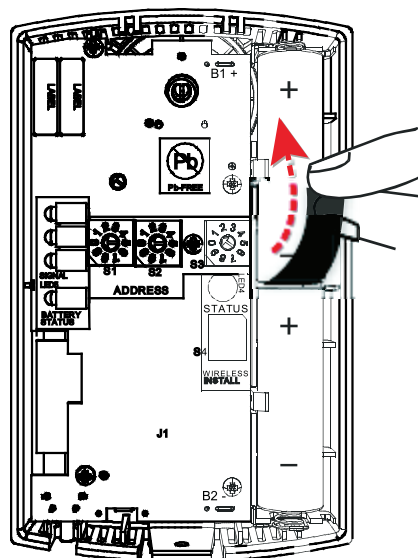


Associating Sensor to Receiver

To associate the sensor to the receiver:

1. Remove the sensor cover by firmly pressing the thumb tab at the bottom of the cover and pulling the cover away from the back plate.
2. Verify that the sensor is set to the same address as the receiver it is to be associated with.
3. Power the sensor by removing the insulation strip from between the two batteries. See the following figure.

Figure 76. Power sensor by removing insulation strip



Association is automatically initiated between the sensor and the receiver. When LED3 on the receiver stops blinking, association has been established.

If the first association attempt is unsuccessful, the sensor automatically re-attempts association with the receiver every 10 minutes.

Note: An associated sensor that has lost communication with the receiver will transmit an association request every 50 minutes. You can manually initiate association (see ["Manual Association," p. 131](#)).

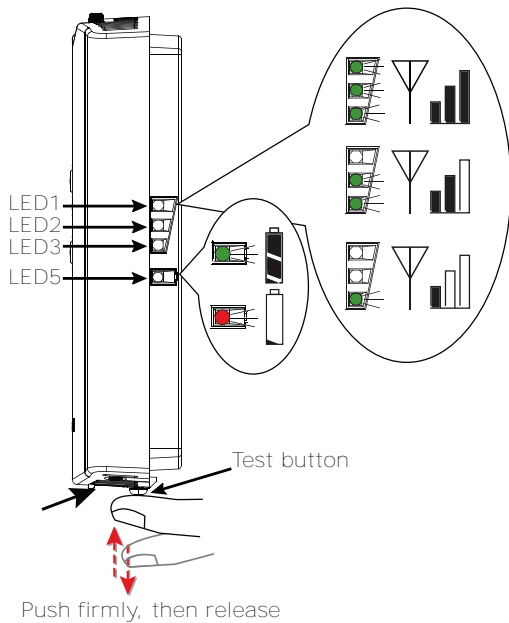
Testing Signal Strength and Battery

To verify that the association process was successful and that the batteries have adequate charge:

1. Firmly press and release the Test button on the bottom of the sensor as illustrated in [Figure 77, p. 78](#).
2. For model WZS, view LED1, LED2, and LED3 to determine the signal strength. View LED5 to determine the battery status (see [Figure 77, p. 78](#) for model WZS sensors).

Note: The LEDs will turn Off after 5 seconds to conserve battery strength.

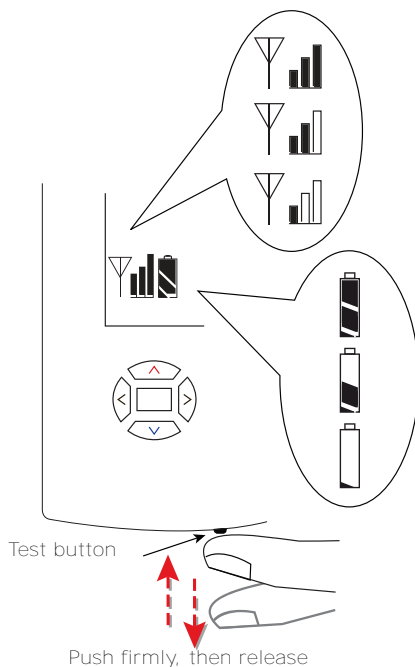
Figure 77. Wireless Zone Sensor (WZS) with LED lights to test for battery strength



For model WDS, determine the signal strength and battery status by viewing the symbols on the sensor display (see [Figure 78, p. 78](#) for model WDS sensors).

- Record the results in your commissioning statement.

Figure 78. Wireless Display Sensor (WDS) showing battery strength



Sensor Operations

Temporary Occupancy (Timed Override)

Temporary occupancy (timed override) is available on model WDS. Temporary occupancy is selected for after-business-hours adjustment of temperature setting, fan settings, or heat/cool settings, when the system has changed to unoccupied mode. System control will revert to unoccupied after a pre-determined time period.

Note: Not all systems support the occupancy function.

To request and cancel temporary occupancy on a model WDS sensor, see [“Requesting Temporary Occupancy,” p. 83.](#)

End-of-Range Temperature Values

Receiver: The end-of-range temperature limits of the receiver for *all models* are 32°F to 122°F. The receiver cannot replicate temperature values outside this range. If the sensor transmits a temperature value to the receiver that is out of the receiver replication range, the receiver will “freeze” the output at the end-of-range values. This value will remain frozen until the transmitted temperature moves to between the end-of-range temperature limits.

Sensor: The end-of-range temperature setpoint limits for the WDS is 50°F to 89.6°F.

Receiver Power-up Sequence

When power is applied to the receiver, one of the following sequences occurs. The sequence is dependent on the address setting and the association status of the receiver.

Address set to 000 and receiver is not associated with a sensor

- LED5 is constantly On, indicating power is applied and the receiver is functional.
- All models:* Zone temperature and cooling setpoint default to 72.5°F.

WDS only: The heating setpoint defaults to 70.5°F and the fan/system output will be 2230 Ω.

- Status LED3 will display a 2-blink pattern diagnostic ([Table 50, p. 130](#)).

Address set from 001 to 999 and receiver is not associated with a sensor

- LED5 is constantly On, indicating power is applied and the receiver is functional.
- All models:* Zone temperature and cooling setpoint default to 72.5°F.

WDS only: The heating setpoint defaults to 70.5°F and the fan/system output will be 2230 Ω.

- The receiver conducts an energy scan for 20 seconds to determine the clearest channel on which to operate.
- LED3 flashes on every 2 seconds when it is ready to accept a sensor association request. When an association request is made by a sensor, the receiver instructs the sensor on which power level to operate.

Then the receiver and sensor begin operation at the appropriate channel and power level (see “[Observing Receiver for Readiness](#),” p. 76).

Address set from 001 to 999 (and not changed since most recent power-up) and receiver is associated with a sensor

- LED5 is constantly On, indicating power is applied and the receiver is functional.
- Zone temperature and setpoint default to 72.5°F. WDS only: Heating setpoint defaults to 70.5°F, Fan = Auto, System = Off.
- The receiver waits for a broadcast transmission from its associated sensor. When a transmission is received, the receiver positions its zone temperature and setpoint outputs appropriately.
- If the receiver does not receive a communicated signal from its associated sensor within 35 minutes, zone temperature and setpoint outputs fail, generating a unit controller alarm.

Note: Once a receiver communicates to a WZS sensor, the receiver disables (opens) its zone setpoint output indefinitely.

- The maximum time between sensor temperature transmissions is 15 minutes.
- The minimum time between sensor temperature transmissions is 30 seconds.
- The minimum time for transmitting temperature setpoint changes is 10 seconds.

Note: If a sensor transmits a message to the receiver and the receiver does not reply, the sensor will retransmit the message to the receiver every 30 seconds until communication to the receiver is re-established.

Sensor temperature time variables are as follows:

- The minimum change in zone temperature required to force a sensor transmission is:
 - 0.2°F when the temperature range is between 60°F and 80°F
 - 0.5°F when the temperature range is between 32°F and 60°F or between 80°F and 122°F
- The minimum change in temperature setpoint required to force a sensor transmission is: 0.1°C for a model WDS sensor

Transmission Variables

Sensor transmission time variables are as follows:

Wireless Sensor Specifications

Table 25. Wireless sensor specifications

Component	Type
Sensor operating temperature	32°F to 122°F
Receiver operating temperature	-40°F to 158°F
Storage temperature	-40°F to 185°F
Storage and operating humidity range	5% to 95%, non-condensing
Accuracy	0.5°F over a range of 55°F to 85°F
Resolution	0.125°F over a range of 60°F to 80°F. 0.25°F when outside this range
Setpoint functional range (WDS only)	50°F to 89.6°F
Receiver voltage	24 V nominal ac/dc $\pm 10\%$
Receiver power consumption	<1 VA
Housing	Polycarbonate/ABS blend, UV protected, UL 94-5VA flammability rating, suitable for application in a plenum
Mounting	3.24 in (8.26 cm) for 2 mounting screws (supplied)
Sensor battery	(2) AA, 1.5 V, 2800 mAh, lithium, 5-year life, UL listed
Range ^(a)	Open range: 2,500 ft (762 m) (packet error rate = 2 percent) Usable: 200 ft (61 m) Typical: 75 ft (23 m)
Output power	100 mW
Radio frequency	2.4 GHz (IEEE Std 802.15.4-2003 compliant) (2405 to 2480 MHz, 5 MHz spacing)

Table 25. Wireless sensor specifications (continued)

Component	Type
Radio channels	16
Address range	000 to 999
Minimum time between transmissions	30 seconds
Maximum time between transmissions	15 minutes

(a) Range values are estimated transmission distances for satisfactory operation. Actual distance is job specific and must be determined during site evaluation.

Agency Compliance

The European Union (EU) Declaration of Conformity is available from your local Trane® office.

Wireless Display Sensor (WDS)

Configuration Procedure

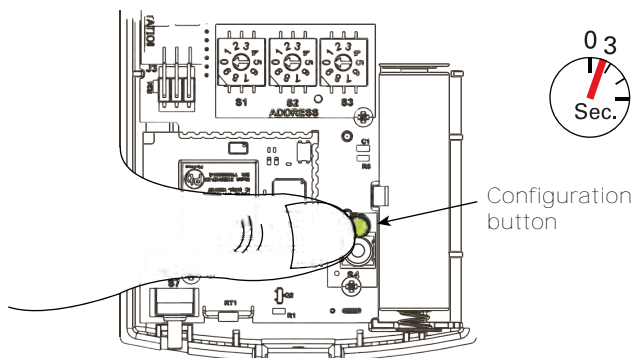
Note: Sensors shipped with the fan coil are pre-configured for three speeds.

The configuration of the sensor determines which system features can be accessed and changes can be made by the tenant (for example, changes to cooling/heating mode, setpoint, or fan speed). Verify system and associated unit features before configuring the sensor.

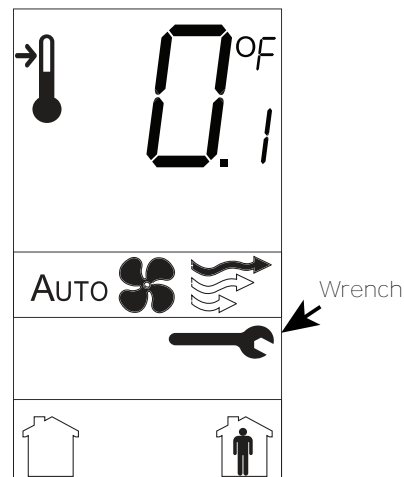
The building owner or operator may choose to limit tenant access to certain features. This can be done through configuration. Or, if a sensor is configured to match all control capabilities of the building automation system, the locking feature can be used to restrict the tenant from making changes.

To configure settings on the wireless display sensor (WDS), follow this procedure in the order presented.

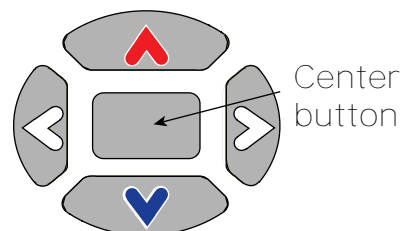
1. Press the configuration button for three seconds.

Figure 79. Configuration button


The display will change to configuration mode. When the sensor is in configuration mode, a wrench symbol appears on the display and the menus are separated by lines, as shown in [Figure 80, p. 80](#).

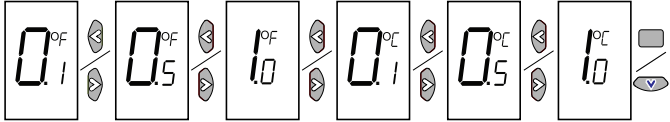
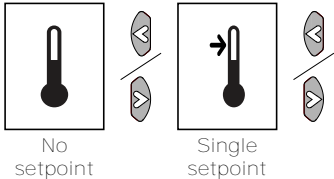

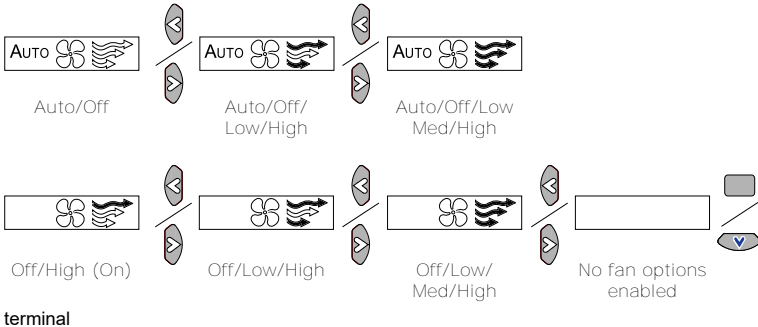
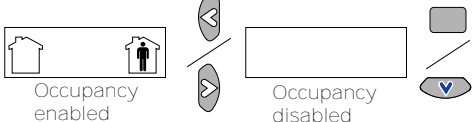
Figure 80. Wrench is shown in configuration mode


2. Press the center button on the keypad to begin the configuration process.



3. Configure the sensor options in the order shown in the table.
 - a. Press right or left arrow to scroll to the next selection (as shown above)
 - b. Press center button or down arrow to move to the next menu (as shown in [Table 26, p. 81](#)).
4. Review the display to ensure that you have selected the correct configuration.
5. To return the display to operating mode, press the configuration button (see [Step 1.](#)).

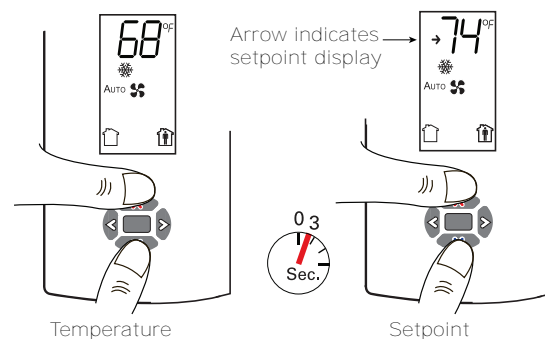
Table 26. Configuration options for wireless display sensors

Setting	Configuration Options
Temperature <ul style="list-style-type: none"> Choose Fahrenheit or Celsius Choose the degree resolution (whole degrees, half degrees, or tenths of degrees). 	
Setpoint	 <div style="display: flex; justify-content: space-around; width: 100%;"> No setpoint Single setpoint </div>
System	 <div style="text-align: center;">No system options enabled</div>
Fan <i>Note: Not all fan options are available for all systems.</i>	 <div style="display: flex; justify-content: space-between; width: 100%;"> terminal Connecting wires to </div>
Occupancy (timed override)	 <div style="display: flex; justify-content: space-around; width: 100%;"> Occupancy enabled Occupancy disabled </div>

Displaying Setpoint or Temperature

You can configure the sensor to display either the temperature (default) or setpoint. To select either option:

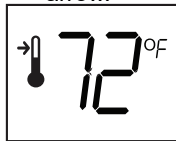
1. Verify that the sensor is in operating mode and at the home screen.
2. Press the up and down arrows for 3 seconds. The arrow indicates setpoint display, as shown in the following figure.

Figure 81. Displaying setpoint or temperature


Locking or Unlocking Settings

You can lock or unlock the setpoint, system, or fan setting to prevent changes. To lock or unlock a setting:

1. Verify that the sensor is in operating mode and at the home screen.
2. Choose a setting to lock or unlock:
 - a. Select the setpoint by pressing the up or down arrow.



Setpoint

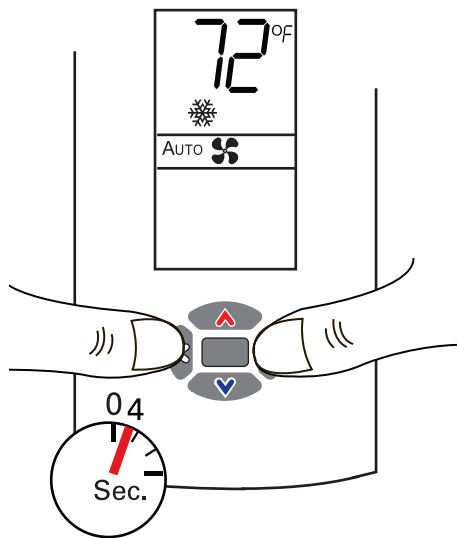
- b. From the system menu press the down arrow to select the fan menu. Use the left or right arrow to choose the setting.



Fan Menu

3. Press the left and right arrows for 4 seconds.

Figure 82. Locking and unlocking settings

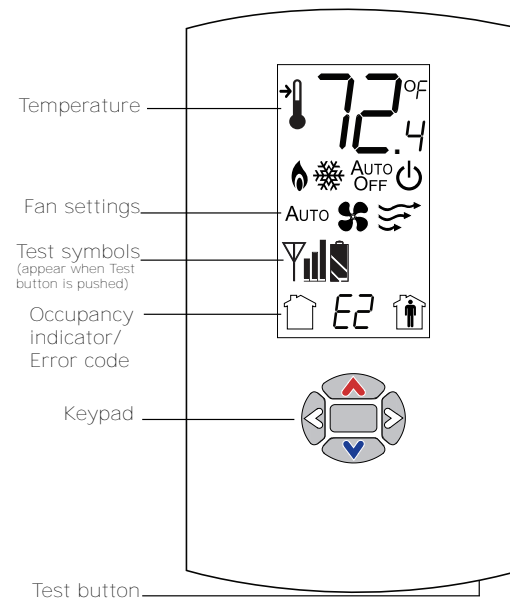


Note: If you try to access a feature that is locked, the locked symbol will appear on the display. If you press a keypad button to try change a locked setting, the locked symbol will flash.



WDS Operating Mode

This section describes how to operate the wireless display sensor (WDS). The following figure shows an example of a WDS that has been configured and is in operating mode.

Figure 83. Wireless display sensor (model WDS) in operating mode



Changing Room Temperature

	<p>This symbol shows the current room temperature, or your setpoint selection while you are making an adjustment.</p>	<ol style="list-style-type: none"> 1. To increase the room temperature, press up arrow. To decrease the room temperature, press down arrow.
	<p>When you select a setpoint, this symbol appears.</p>	<ol style="list-style-type: none"> 2. To confirm, press center button or wait 5 seconds. The display will return to the home screen.

Changing Heating/Cooling Settings

(does not apply to all systems)

	Some systems allow you to select both heating and cooling room temperature settings. If your system has this option, this symbol appears when you adjust the temperature setting.	1. Press up or down arrow to select the heating/cooling setting.
	When you adjust the cooling setting, the top arrow and snowflake flash.	2. If in cooling mode, press left arrow to change to heating mode. If in heating mode, press right arrow to change to cooling mode.
	When you adjust the heating setting, the bottom arrow and flame flash.	3. Press up or down arrow to select the heating/cooling setting.
		4. To confirm, press center button or wait 5 seconds. The home screen will appear.

Changing Fan Settings

	Indicates that the fan will operate as needed to reach the selected temperature.	1. From the home screen, activate the fan setting menu by pressing and then down arrow.
	Indicates that the fan setting is On. The number of arrows indicates fan speed (3: high, 2: medium, 1: low). The example shown indicates a fan on high speed. Not all systems offer all three speeds.	2. Press left or right arrow to choose the desired fan setting.
	Indicates that the fan setting is Off.	3. When the symbol for the desired setting appears, confirm your choice by pressing center button (the home screen will appear).

Requesting Temporary Occupancy

	Select to request occupancy	<ul style="list-style-type: none"> If you need heating or cooling after normal business hours, you can "request" temporary occupancy by pressing or right arrow and holding it for 2 seconds. The occupied symbol remains on the screen and the unoccupied symbol disappears. After 30 seconds, the unoccupied symbol will re-appear. To cancel temporary occupancy, press left arrow and hold for 2 seconds. The unoccupied symbol will remain on the screen and the occupied symbol will disappear. After 30 seconds, the occupied symbol will re-appear.
	Select to cancel occupancy	

Error Codes

	Indicates an error code	If an error code (E0-E7) is displayed, technical assistance may be required.
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Lock Symbol

	Indicates that a setting is locked	The lock symbol appears if you try to adjust a setting that cannot be changed.
--	------------------------------------	--

Testing Signal Strength

Indicates excellent signal strength		Indicates satisfactory signal strength		Indicates poor signal strength	
Press the Test button to display the signal strength symbols.					

Testing Battery Status

Indicates full battery power		Indicates 50 percent of battery life left.		Indicates 25 percent of battery life left. Replace batteries. Flashing symbol indicates that approximately 14 days of operation remain.	
------------------------------	--	--	--	---	--

Press the Test button to display the battery status symbols. Use only UL-listed non-rechargeable 1.5 V lithium AA batteries (Trane p/n X13770035010 or equivalent).



Installation — Electrical

Note: Any modifications, additions or changes to the control box could void the factory warranty and UL certification. Such modification, additions or changes will become the responsibility of the modifying contractor.

Unit Wiring Diagrams

Specific unit wiring diagrams, based on unit options ordered, are provided inside each unit and can be easily removed for reference. Use these diagrams for connections or trouble analysis. Wiring diagrams are attached on the outside of the side panel.

Note: Any modifications, additions or changes to the control box could void the factory warranty and UL certification. Such modification, additions or changes will become the responsibility of the modifying contractor.

Supply Power Wiring

⚠ 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.

Refer to the unit nameplate to obtain the minimum circuit ampacity (MCA) and maximum overcurrent protection (MOP) to properly size field supply wiring and fuses or circuit breakers.

Refer to the unit operating voltage listed on the unit wiring schematic, submittal, or nameplate. Reference the wiring schematic for specific wiring connections.

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: All field wiring should conform to NEC and all applicable state and local code requirements. The control panel box is always on the end opposite the piping connections. Access the control box by removing the two screws that secure the front cover. This will allow the panel to be removed, to provide access to the electrical components.

⚠ WARNING

Fire Hazard!

Failure to follow instructions below could cause a fire which could result in death or serious injury, and property damage.

DO NOT jumper factory wiring! Mis-wiring of safety circuits could cause a fire. For all wiring connections, refer to the wiring diagram shipped with the unit. Should any original wire supplied with the unit have to be replaced, it MUST be replaced with wiring material having a temperature rating of at least 221°F (105°C).

⚠ WARNING

Electrical Short Hazard!

Failure to follow instructions below could cause electrical shorts that could result in death or serious injury.

Insulate all power wire from sheet metal ground.

If the unit does not have a disconnect switch, the power leads and capped ground wire are inside the control panel.

If the unit has a disconnect switch, the power leads are wired to the disconnect switch on the control panel.

⚠ WARNING

Electrical Shock Hazard!

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

Verify disconnect ability incorporated in fixed wiring in accordance with the requirements in NEC and local/state/national electric codes.

Electrical Grounding Restrictions

All sensor and input circuits are normally at or near ground (common) potential. When wiring sensors and other input devices to the Tracer® controller, avoid creating ground loops with grounded conductors external to the unit control circuit. Ground loops can affect the measurement accuracy of the controller.

⚠ WARNING

Electrical Shock Hazard!

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

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

NOTICE

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.

All input/output circuits (except isolated relay contacts and optically isolated inputs) assume a grounded source, either a ground wire at the supply transformer to control panel chassis, or an installer supplied ground.

Interconnection Wiring

The installer must provide interconnection wiring to connect wall-mounted devices such as a fan mode switch or zone sensor module.

Refer to the unit wiring schematic for specific wiring details and point-to-point wiring connections. Dashed lines indicate field wiring on the unit wiring schematics. All interconnection wiring must conform to NEC Class 2 wiring requirements and any state and local requirements.

Refer to the following table for the wire size range and maximum wiring distance for each device.

Table 27. Maximum wiring distances for low voltage controls (ft)

Device	Wire Size	Range
Fan speed control	14–22 AWG	500
Zone sensor	16–22 AWG	200

Recommendation: Do not bundle or run interconnection wiring in parallel with or in the same conduit with any high-voltage wires (110 V or greater). Exposure of interconnection wiring to high voltage wiring, inductive loads, or RF transmitters may cause radio frequency

interference (RFI). In addition, improper separation may cause electrical noise problems. Therefore, use shielded wire (Belden 83559/83562 or equivalent) in applications that require a high degree of noise immunity. Connect the shield to the chassis ground and tape at the other end.

Note: Do not connect any sensor or input circuit to an external ground connection.

MCA and MOP Calculations

Non-Electric Heat Units

Minimum Circuit Ampacity (MCA) and Maximum Overcurrent Protection (MOP) calculations for non-electric heat units

$$\text{MCA} = 1.25 \times \text{motor FLAs}$$

$$\text{MOP} = 2.25 \times \text{motor FLA}$$

Electric Heat Units

MCA and MOP calculations for electric heat units

$$\text{Heater amps} = (\text{heater kW} \times 1000) / \text{heater voltage}$$

Notes:

- Use 120V heater voltage for 115V units.
- Use 240V heater voltage for 230V units.
- Use 208V heater voltage for 208V units.
- Use 277V heater voltage for 277V units.
- Use 480V heater voltage for 460V units.
- Use 600V heater voltage for 575V units.

$$\text{MCA} = 1.25 \times (\text{heater amps} + \text{all motor FLAs})$$

$$\text{MOP} = (2.25 \times \text{motor FLA}) + \text{heater amps}$$

HACR (Heating, Air-Conditioning, and Refrigeration) type circuit breakers are required in the branch circuit wiring for all units with electric heat.

Select a standard fuse size equal to the calculated MOP. Use the next smaller size if the calculated MOP does not equal a standard size.

Standard fuse sizes: 15, 20, 25, 30, 35, 40, 45, 50, 60 amps

Useful Formulas

$$\text{kW} = (\text{cfm} \times \text{DT}) / 3145$$

$$\text{DT} = (\text{kW} \times 3145) / \text{air flow}$$

$$\text{Single phase amps} = (\text{kW} \times 1000) / \text{voltage}$$

$$\text{Electric heat MBh} = (\text{Heater kW}) (3.413)$$

$$\text{Three-phase amps} = (\text{kW} \times 1000) / (\text{voltage} \times 1.73)$$



Installation — Electrical

Table 28. Available motor horsepower

Motor	Unit Voltage	Motor Horse Power						
		0.5	1.0	1.5	2.3	3.0	3.5	5.0
60 Hz	115/1	X	X					
	208/1	X	X					
	230/1	X	X					
	277/1	X	X					
	208/3	X	X	X		X		X
	230/3	X	X	X		X		X
	460/3	X	X	X		X		X
	575/3	X	X		X		X	X
50 Hz	220/1	X	X					
	240/1	X	X					
	380/3	X	X	X		X		X
	415/3	X	X	X		X		X

Table 29. Available electric heat (kW)

	115V/ 60Hz/1P	208V/ 60Hz/1P	220V/ 50Hz/1P	230V/ 60Hz/1P	240V/ 50Hz/1P	277V/ 60Hz/1P	208V/ 60Hz/3P	230V/ 60Hz/3P	380V/ 50Hz/3P	415V/ 50Hz/3P	460V/ 60Hz/3P	575V/ 60Hz/3P
1.0	Size 12-120											Size 36-120
2.0	Size 12-120											
3.0	Size 12-120											
4.0	Size 12-120											
5.0	Size 18-120											Size 36-120
6.0		Size 18-120									Size 36-120	
7.0		Size 18-120							Size 36-120			
8.0		Size 18-120							Size 36-120			
9.0		Size 24-120							Size 36-120			
10.0		Size 24-120					Size 36-120					
12.0						Size 36-120						
15.0							Size 36-120					Size 48 - 120
17.0							Size 48-120					
20.0								Size 48-120				
24.0									Size 60-120			
30.0									Size 90-120			

Notes:

1. Magnetic contactors are standard.
2. Units with electric heat are available with or without door interlocking disconnect switch.
3. Units with electric heat are available with or without line fuses.
4. Units with electric heat must not be run below the minimum cfm listed. Refer to the General Data section for more information.
5. Electric heat is balanced staging: 1 stage = 100 percent, 2 stages = 50 percent/50 percent.

Table 30. Airflow min/max for BCHE/BCVE Blower Coils

Unit Size	12	18	24	36	48	60	72	90	120
Nominal cfm	400	600	800	1200	1600	2000	2400	3000	4000
Airflow									
Minimum cfm	250	375	500	750	1000	1250	1500	1875	2500
Maximum cfm	500	675	1000	1600	2000	2500	3000	4000	5000

Note: Minimum airflow limits apply to units with hot water or electric heat. There is no minimum airflow limit on cooling coil units. Maximum airflow limits are to help prevent moisture carryover.



Installation — Electrical

Table 31. Motor electrical data

Voltage	Voltage Range	Rated HP	Weight (lbs)	FLA
115/60/1	104-127	0.5	14.0	7.46
115/60/1	104-127	1.0	19.0	13.3
208/60/1	187-229	0.5	14.0	4.58
208/60/1	187-229	1.0	19.0	7.73
230/60/1	207-253	0.5	14.0	4.48
230/60/1	207-253	1.0	19.0	7.10
277/60/1	249-305	0.5	14.0	3.76
277/60/1	249-305	1.0	19.0	5.78
220/50/1	198-242	0.5	14.0	4.58
220/50/1	198-242	1.0	19.0	7.10
240/50/1	216-264	0.5	14.0	4.48
240/50/1	216-264	1.0	19.0	7.10
208/60/3	187-229	0.5	13.4	2.40
208/60/3	187-229	1.0	17.1	4.60
208/60/3	187-229	1.5	37.5	7.60
208/60/3	187-229	3.0	53.6	11.20
208/60/3	187-229	5.0	56.0	15.80
230/60/3	207-253	0.5	13.4	2.60
230/60/3	207-253	1.0	17.1	4.80
230/60/3	207-253	1.5	37.5	6.50
230/60/3	207-253	3.0	53.6	11.20
230/60/3	207-253	5.0	56.0	15.30
380/50/3	342-418	0.5	13.4	1.20
380/50/3	342-418	1.0	17.1	2.30
380/50/3	342-418	1.5	37.5	4.20
380/50/3	342-418	3.0	53.6	5.30
380/50/3	342-418	5.0	56.0	8.50
415/50/3	374-457	0.5	13.4	1.30
415/50/3	374-457	1.0	17.1	2.40
415/50/3	374-457	1.5	37.5	4.0
415/50/3	374-457	3.0	53.6	5.50
415/50/3	374-457	5.0	56.0	8.40
460/60/3	414-506	0.5	13.4	1.30
460/60/3	414-506	1.0	17.1	2.50
460/60/3	414-506	1.5	37.5	3.30
460/60/3	414-506	3.0	53.6	5.50
460/60/3	414-506	5.0	56.0	7.80
575/60/3	518 - 633	0.5	13.9	1.10
575/60/3	518 - 633	1.0	18.0	2.10
575/60/3	518 - 633	2.3	28.8	2.80

Table 31. Motor electrical data (continued)

Voltage	Voltage Range	Rated HP	Weight (lbs)	FLA
575/60/3	518 - 633	3.5	53.6	4.60
575/60/3	518 - 633	5.0	56.0	6.50



ECM Overview and Setup

Blower Coil units integrate a Trane electronically commutated motor (ECM) with a VelociTach™ motor control board to deliver outstanding comfort, safety, and performance while greatly reducing energy consumption compared to traditional units with induction AC motors.

This system has a high degree of flexibility and configurability, but with the simplicity of a customized factory configuration appropriate for most installations.

Very little intervention is needed by service and installation personnel in most applications; however, installers must read through the entire document before beginning installation of the new equipment. With proper installation and operation, this unit will have a long service life.

This section focuses on unit motors and controls, including three new circuit modules developed specifically for this series.

Figure 84. Blower Coil with Trane ECM motor



There are four primary components that enable the technology on your product:

- Trane electronically commutated motor (ECM)
- VelociTach motor control board
- Fan speed control (provided when no control package is selected)
- Customer-supplied terminal interface (CSTI)

The motor and control board are combined as a system, and cannot work without each other.

Trane Electronically Commutated Motor (ECM)

Figure 85. Trane ECM motor



- The ECM has integrated electronics, overload protection and short circuit protection. The motor contains no user-serviceable components inside.
- The motor mates to the unit electrically via a single plug that contains both the operating voltage and the control signals that are needed for correct operation.

NOTICE

Equipment Damage!

Failure to follow these instructions could result in equipment damage.

The motor harness attached to the single plug to which the motor mates contains the 115V motor voltage jumper. The motor harness should always be present for 115V units and should not be modified or substituted.

VelociTach™ Motor Control Board

The VelociTach motor control board controls and reports the performance of up to two Trane brushless DC (BLDC) motors.

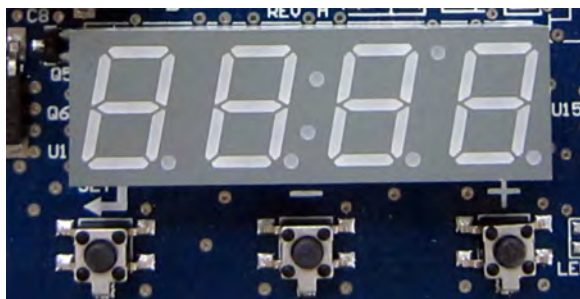
The motor control board also:

- Coordinates the operation of the fan in response to electric heat behavior and electric behavior in response to hydronic heat behavior.
- Incorporates a user interface that allows adjustment of certain unit parameters and provides constant feedback on motor operation.
- Integrates service and troubleshooting tools.
- Integrates a versatile configurable auxiliary temperature sensor.

- Incorporates various safety and lockout features, such as maintaining proper fan speeds if electric heat is called for.

Status Display

Figure 86. Status display



The motor control board contains a four-digit, seven-segment display that is used to present information in a format close to real-world language, while having a small-form factor. Most characters are immediately recognizable; however, please consult figures below for the graphical representation of each alphanumeric character.

Figure 87. Screen representation of alphabetical characters

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
A	b	C	d	E	F	g	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z

Figure 88. Screen representation of numerical characters

1	2	3	4	5	6	7	8	9	0
1	2	3	4	5	6	7	8	9	0

Installation and Initial Setup

⚠ 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.

⚠ 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.



ECM Overview and Setup

Safety Requirements

Follow all recommendations below. Failure to do so could result in death or serious injury.

- The ECM motors contain capacitors which store residual energy. Please keep clear of the fan wheels for 5 minutes after the power has been removed from the system, as a power request with the motor powered off, could result in a very short period of actuation.
- All settings take effect immediately, including fan start-up and enabling of electric heat. Caution should be taken to stay clear of hazardous voltages, moving parts and electric heat elements while making adjustments to the VelociTach motor control board. If it is not practical to stay clear of these areas during adjustment of the motor control board, please contact Trane Global Parts for configuration kit that allows easy powering of the motor control board outside of the unit with a 9V battery.
- Changes to switch settings on the CSTI adapter board take effect immediately. Changes should be made to the CSTI configuration switches with the power off.
- Initial hookups to the CSTI and Standard Adapter board, including low voltage interconnections, must be made with the power off.
- Do not make connections to the motors or the adapter boards while power is ON. Do not remove connections to the motor or the adapter boards while the power is ON.
- Do not free spin the fan wheels with your hands while the unit is powered on. The system is constantly scanning and responding to the operational status of the motors.

Setup

Note: Normally, Trane ECMs are configured for soft ramps and transitions between speeds. However, to aid in commissioning of the unit, for approximately 10–15 minutes, the ramps will be shortened to quickly observe proper unit behavior and response to speeds.

For new installations, all boards and motors are pre-installed and pre-configured according to the unit configuration, indicated by its model number.

Under normal and intended operation, the only required intervention specific to the new ECM units is the wiring of:

- Wall-mounted low-voltage fan speed switch inputs to the adapter boards' terminal strips and 24 Vac tap to field-installed fan speed switch.
- Field-supplied controllers/thermostats to the adapter boards' terminal strips and 24 Vac power tap to field supplied controller/thermostat.
- Adjustment and calibration of the variable speed inputs (VSP/0–10V) on the system.
- Adjustment, calibration or disabling of the optional auto-changeover function on CSTI units.

Otherwise, proceed with the mechanical, electrical and controls installations as defined in other sections of this manual, following all warnings and cautions.

After installation, turn power on.

Note: Specifications subject to change without notice. Consult the unit submittals and unit schematics before determining hookup requirements. Terminal block positions, polarities and assignments are determined for specific unit configurations only. Signal assignments are indicated, for reference only.

Both adapter boards come equipped with integrated terminal blocks to hook up to the field supplied/mounted fan speed switches and external controls. Connections should be made to the screw terminals with wires between 16 AWG and 24 AWG, with a ~4–5mm wire strip length. The terminal blocks have 5mm spacing, and are equipped with 3mm screws. The field-supplied wires should have an insulation rating of 600V.

VelociTach Motor Control Board

⚠ CAUTION

Burn Hazard!

Failure to follow this instruction could result in the unit overheating and becoming hot to the touch, which could result in minor or moderate injury, and/or equipment damage.

On electric heat units, certain parameter values are locked out to prevent overheating of the unit. These functions will appear to be saved; however, they will not be accepted if the Electric Heat Protection setting is "On". Do not change the Electric Heat Protection setting to "Off" and make changes to the protected settings unless you are programming an unconfigured service replacement board to match the unit settings on a ECM configuration label.

The motor control board functions and unit specific settings are summarized on the motor control board configuration label affixed to the back side of the control panel low voltage lid on every unit.

To check status, configuration, or to change settings on the motor control board with the power on the unit, remove the two screws at the top of the low voltage access lid and open. The motor control board will be visible. See the following figure.

Figure 89. VelociTach motor control board


The motor control board features a nested menu integrated user interface (UI) that supports:

- Status display for instant touch-free confirmation of unit operation.
- Configuration parameter and value display and modification changes (using integrated menu/set buttons).
- Error code prioritized reporting.

Note: Characters on the VelociTach motor control board display appear in red, on a black background.

The display contains decimal positions as well that change position with each parameter, as appropriate. Under normal conditions (i.e., with no error code displayed), the status will loop the following message:

Table 32. Operational status codes

RPM Mode/RUNNING/ FAN STATUS CONTINUOUS LOOP Displayed when: 1) No error codes are present 2) Motor has completed ramping	$\text{rtr } 10000 \rightarrow 2000$	Indicates the current rpm of Motor 1 in the system. "0" rpm here indicate that no fan speed has been requested.
	$\text{rtr } 20000 \rightarrow 2000$	Indicates the current rpm of Motor 2 in the system. "0" rpm here indicate a fan off condition OR a fan "missing" (a).
	$\text{FSt } 1$ $\text{YES } r \text{ no}$	Indicates the status being calculated or Fan Motor 1. If "off," this indicates that either: 1) No fan speed is being requested or 2) The fan performance is failing to meet the request; refer to "ECM Motors," p. 140 for additional troubleshooting information. If "on," this indicates that the fan is performing correctly and will be used to report fan status correctly, depending on FPRU mode.
	$\text{FSt } 2$ $\text{YES } r \text{ no}$	Indicates the status being calculated or Fan Motor 2. If "off," this indicates that either: 1) No fan speed is being requested or 2) The fan performance is failing to meet the request; refer to "ECM Motors," p. 140 for additional troubleshooting information. 3) If the target speed for Motor 2 is "0," this is used to indicate a missing motor. If "on," this indicates that the fan is performing correctly and will be used to report fan status correctly, depending on FPRU mode.
	EhEn $\text{YES } r \text{ no}$	Indicates that the temperature sensing circuit has calculated a logical "on" based on the settings of the following parameters: $A_{127} \text{ } r \text{ } A_{126} \text{ } r \text{ } A_{1PU}$

(a) Motor 1 is the only motor in fan coil units.

User Interface

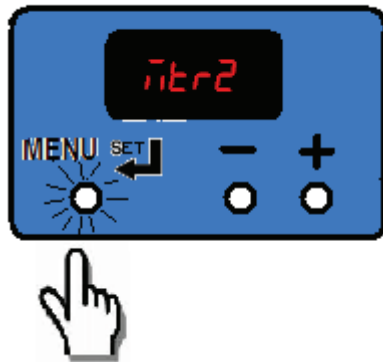
The VelociTach motor control board's on-board user interface is easy to use and supports:

- Verification/auditing of on-board parameter settings (read-only)
- Adjustment of the on-board settings (write)

The user interface has three input buttons (see Figure 90, p. 94), from left to right:

- Menu/Set
- Decrement
- Increment

Figure 90. User interface input buttons



Each button has several different actuation levels depending on length of press, and what the UI is currently displaying.

Table 33. Button actuation levels

Button	Menu/Set	
	Duration	Action
Short Press in Status Display	<1 sec	None
Short Press in Configuration Display		Toggles between parameter name and value without saving (abandons value if changed).
Long Press/Hold in Status Display	>3 sec	Enters the configuration menu
Long Press/Hold in Configuration Display	>3 sec	If on a parameter name, toggles to the value. If on a parameter value, saves the value settings and returns to the parameter name as confirmation.

Button	Decrement	
	Duration	Action
Short Press in Status Display	<1 sec	None
Short Press in Configuration Display	<1 sec	Scrolls through parameter names, or decreases value of parameter.
Long Press/Hold in Status Display	>3 sec	n/a
Long Press/Hold in Configuration Display	>3 sec	Faster scroll through parameter name, or faster decrease of values of parameters.

Button	Increment	
	Duration	Action
Short Press in Status Display	<1 sec	None
Short Press in Configuration Display	<1 sec	Scrolls through parameter names, or increases value of parameter.
Long Press/Hold in Status Display	>3 sec	n/a
Long Press/Hold in Configuration Display		Faster scroll through parameter name, or faster increase of values of parameters.

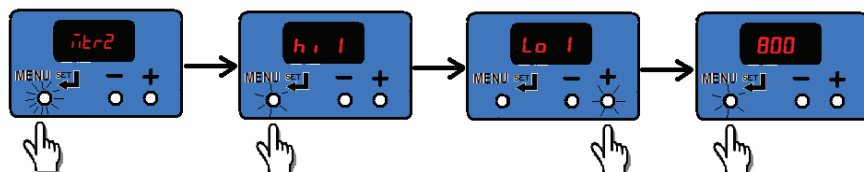
Configuration Examples

Example 1- View the value parameters without saving.

Verify the low speed value for motor 1 is set to 800 rpm.

Start with the motor control board scrolling status display and proceed as follows:

Figure 91. Verify low speed value

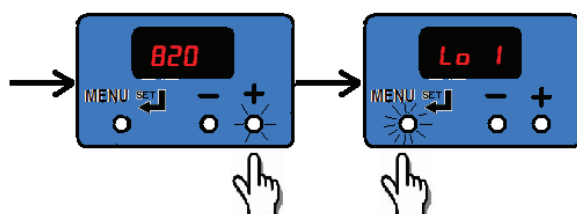


Example 2 - Change the value of low speed to 820 rpm.

Continue from the previous example as shown below, using a long press to "save" the new desired value.

If the display has timed out and returned to the status loop, repeat Example 1 to arrive back at this example's starting point.

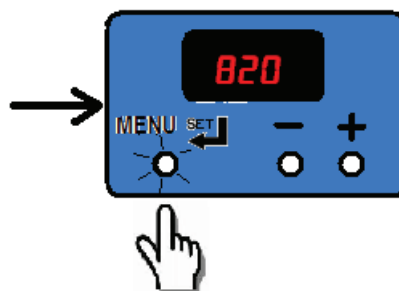
Figure 92. Change value of low speed value



Example 3 - Double-check the value of 820 rpm has been saved.

If the display has timed out and returned to the status loop, repeat Example 1 and Example 2 to arrive back at this example's starting point.

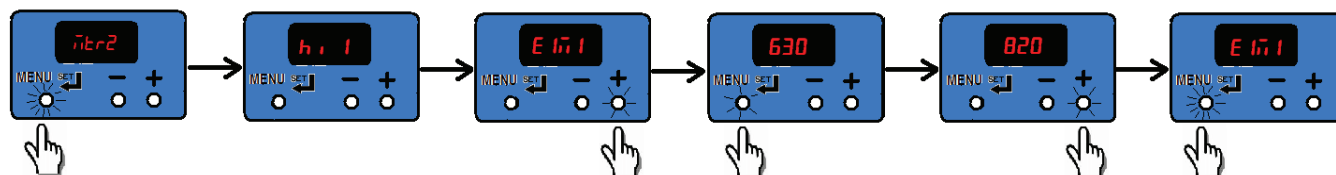
Figure 93. Verify value of 820 rpm



Example 4 - Change the value of a protected value on an electric heat unit.

It appears the value has been changed, but after checking the value, the original value has been retained.

Figure 94. Change value on electric heat unit



Priority/Error Display

Under special conditions, the status display will interrupt briefly to prioritize display of events:

Notes:

- During error displays, the user interface will be disabled, until the error is removed or resolved.
- If changes are made to parameters and saved, most settings take effect immediately. Any change to fan speeds will take effect and cause the configuration menu to exit immediately to begin tracking speeds via the on-board tachometer.
- If a error occurs while the configuration menu is in effect, all unsaved values will be discarded and the error codes will be displayed.

Table 34. Error codes

Displayed during abnormal operation.	Motor 1	Indicates a locked rotor condition of Motor 1. The motor will be locked out until the cause has been resolved, and the power cycled; refer to "ECM Motors," p. 140 for resolution details. Fan Status function, if being used, will report an inoperative motor. Electric heat and changeover heat will be shutdown.
	LOCK	
	Motor 2	Indicates a locked rotor condition of Motor 2. The motor will be locked out until the cause has been resolved, and the power cycled; refer to "ECM Motors," p. 140 for resolution details. Motor 1 will continue to operate, but will not be monitored. Fan Status function, if being used, will report an inoperative motor. Electric heat and changeover heat will be shutdown.
	LOCK	
	Motor 1	Indicates that Motor 1 has experienced a run-away or over speed condition, and has been shutdown. The unit will offer limited "limp-in" performance, and Motor 2 will continue to operate, but will not be monitored. Fan Status function, if being used, will report an inoperative motor. Refer to "ECM Motors," p. 140 to reset, the cause must be resolved and the power to the unit cycled. Electric heat and changeover heat will be shutdown.
	OSPd	
	Motor 2	Indicates that Motor 2 has experienced a run-away or over speed condition, and has been shutdown. The unit will offer limited "limp-in" performance, and Motor 1 will continue to operate, but will not be monitored. Fan Status function, if being used, will report an inoperative motor. Refer to "ECM Motors," p. 140 to reset, the cause must be resolved and the power to the unit cycled. Electric heat and changeover heat will be shutdown.
	OSPd	
	rAMP	Indicates the motor is transitioning between speeds, ramping up or down. The message "RAMP" is briefly displayed, followed by the target speed for "Motor 1" only. Once the target speed has been reached, the status display will resume operation.
	0000 → 2000	
	2000 → 0000	
	u 123	On power on, the version of software is briefly displayed, followed by the results of a POST (power on self test).

Note: Fan coil units have only Motor 1 installed.

Adjustments

After connections of power and hookup of customer installed controls/fan speed control and under normal operative conditions, the only adjustments needed to be made to the motor control board during commissioning of the unit are:

- Adjustment and calibration of the variable speed inputs (VSP/0–10V) on the system, where applicable.
- Adjustment, calibration or disabling of the optional auto-changeover function on CSTI units, where applicable.

In addition, the CSTI adapter board offers configurability that can be used in special cases to adjust the following operation of the unit:

- Courtesy cooling/main valve logic inversion relays for use with normally open valves
- Courtesy heating/auxiliary valve logic inversion relays for use with normally open valves
- Changeover function for use with changeover coils (in conjunction with the motor control board)

The switches are factory-set based on the model number configuration as ordered; however, the information is provided below to aid in the understanding of the operation of the system.

Adjusting Variable Speed Inputs

⚠ 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.

⚠ CAUTION

Burn Hazard!

Failure to follow this instruction could result in the unit overheating and becoming hot to the touch, which could result in minor or moderate injury, and/or equipment damage.

On electric heat units, certain parameter values are locked out to prevent overheating of the unit. These functions will appear to be saved; however, they will not be accepted if the Electric Heat Protection setting is "On". Do not change the Electric Heat Protection setting to "Off" and make changes to the protected settings unless you are programming an unconfigured service replacement board to match the unit settings on a ECM configuration label.

NOTICE

Equipment Damage!

Failure to follow instructions below could result in equipment damage.

- A single 24 Vac supply system must be used.
- Ensure proper polarity and grounding when connecting the 0 to 10 V system.
- The 0–10V (variable speed) inputs are available for use, but are not mandatory. The ECM system comes standard with three to five field-accessible thermostatic inputs (with adjustable speed), so the use of the 0–10V inputs is optional.
- All inputs are independently configurable and simultaneously accessible, and the motor control board will choose the highest user (configured and requested) speed. However, care should be taken with customer controls to avoid contention of signals.

The motor control board and adapter boards offer standard, normalizing 0–10V Variable speed fan inputs for use with field supplied controllers or thermostats. These inputs can be used as the only input to the system, used in addition to the thermostatic (H, M, L) inputs, or not used at all. The inputs are accessible via 1TB4 on the adapter boards.

The motor control board is factory configured to drive the unit to a minimum speed (catalogue "low speed" value), defined as $R_{L\tilde{1}}$ and $R_{L\tilde{2}}$ once the analog (0–10V) input is honored. As a default, the noise floor/threshold is set to 3 percent (0.3V). At 0.3V, the system will drive the motors to the speeds defined in defined as $R_{L\tilde{1}}$ and $R_{L\tilde{2}}$. If the analogue input goes to 10V, the motor control board will drive the motor to maximum speed (normally catalogue "high speed" value), defined as $R_{H\tilde{1}}$ and $R_{H\tilde{2}}$, and will change speed in response.

Although the VelociTach motor control board ships with settings that will work with most 0–10 VDC outputs, calibration should be performed to maximize response range and controller authority. Typically, the only settings

needed for the VSP inputs are calibration of the signal to ensure that the system obeys the following rules:

- The minimum output from the field supplied controller is met with a positive fan response. That is, we do not want the νF_{Lr} setting on the motor control board to be higher than the minimum output of the field supplied controller, as the motor control board will "ignore" a portion of the usable range of the customer fan variable speed output.
- The minimum output from the field supplied controller is not significantly greater than the floor setting νF_{Lr} floor. If the minimum output of the controller is significantly greater than the floor setting, the first point that the motor will turn on will be above the $R_{L\tilde{1}}$ and $R_{L\tilde{2}}$ value. The full range of motor control will not be fully utilized in this case, as the motor will never reach the low speed motor analogue input scaling value for Motor 1 and Motor 2 ($R_{L\tilde{1}}$ and $R_{L\tilde{2}}$).
- The maximum output of the controller needs to be 10V, or if lower, needs to be compensated using the analog input scaling value, $R_{\nu Sc}$ to normalize the operational range. As a default, the scaling value is set to 1.00 (so a voltage of 5V will be graded as 5V); however, to compensate for long runs or lower max voltages (i.e., lower than 10.00), the scaling value can be increased accordingly to maximize operational range.

For example, if the voltage is only reaching a value of 9.0V at the adapter boards, then the $R_{\nu Sc}$ parameter should be set to $(10/9) = 1.1111$. If left un-calibrated, the unit will never attain maximum speeds, defined as $R_{H\tilde{1}}$ and $R_{H\tilde{2}}$.

- The motor control board can accept slightly over-biased inputs up to 12 VDC, and the $R_{\nu Sc}$ parameter can be set to a value less than 1.0 to compensate.

VSP Setup Examples

Figure 95. Example 1: νF_{Lr} set too high and $R_{\nu Sc}$ set too high

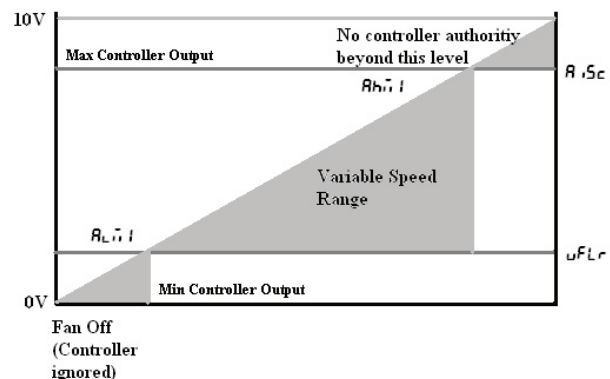


Figure 96. Example 2: $\omega F L r$ set too high but $R h i c$ set correctly

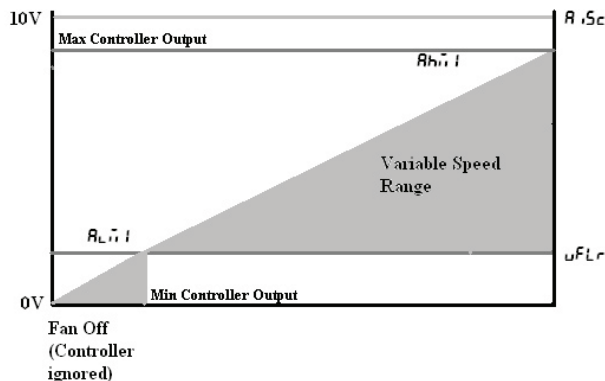
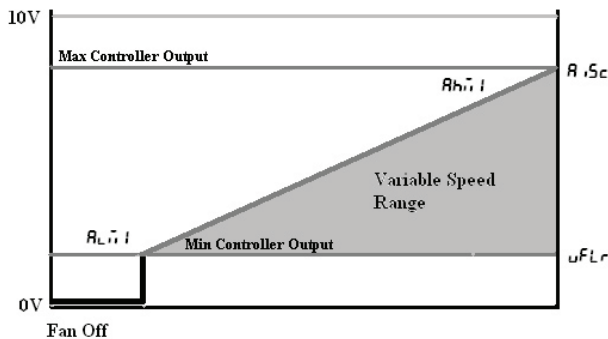


Figure 97. Example 3: $\omega F L r$ set correctly and $R h i c$ set correctly



Potentiometer/Rheostat For VSP

⚠ WARNING

Hazardous Voltage w/Capacitors!

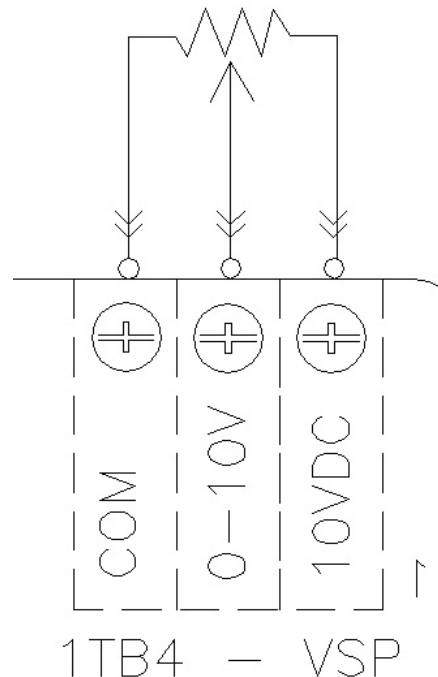
Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.

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.

A courtesy 10 VDC supply is provided that can support a 10mA draw. The use of a 1K or a 10K potentiometer is recommended, and only a stand-alone potentiometer (not shared with any other electrical system) should be employed. When a simple potentiometer is used as depicted in the following figure, the $\omega F L r$ setting will define a null-zone (off).

The typical connection is depicted in the following figure; however, please consult the unit schematic for the most updated instruction, as this is provided as reference only.

Figure 98. Typical connection



Adjusting Optional Auto-Changeover Function on CSTI Units

⚠ 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.

The motor control board provides additional temperature controlled logic to help coordinate certain electric-heat and valve logic functions:

- On units with electric heat and a changeover coil, the motor control board and adapter boards are pre-configured to cause hydronic heat and electric heat to be mutually exclusive:

On units with Customer Supplied Controllers (CSTI units), the motor control board and CSTI board will serve as the primary lockout.

- On CSTI units selected with a changeover coil configuration, the motor control board is factory configured to work in conjunction with the CSTI adapter board to provide a useful auto-changeover function. Traditionally, a fixed setpoint bi-metallic disc temperature switch is used to provide changeover with customer controls; however, the motor control board has defeatable and configurable bi-metallic disc temperature switch emulation when combined with the CSTI adapter board. The motor control board is preconfigured for typical values, so changeover settings do not necessarily need to be changed.
- An NTC thermistor is supplied and affixed to the supply pipes where applicable. The motor control board has several settings that affect the operation of the changeover function:
 - FPru** parameter should normally be set to **EHu** or **EHF5** to use the changeover functions.
 - EHu** parameter should be chosen if the unit has a changeover coil without electric heat.
 - EHF5** parameter should be chosen if the unit has a changeover coil with electric heat. Generally, this will perform the same as the **EHu** parameter but in addition, will disable heating function on electric heat and on the changeover coil if there are fan failures. The auxiliary heating coil function will continue to operate and respond to the customer heating request.
- AuPU** parameter should be set to **1** for **ESu** units and to **0** for ComfortLink or BACnet controller units.
- Au2u** parameter defines the temperature at which the motor control board will close the triac onboard the motor control board (if **FPru** parameter is set correctly).
- Au2b** parameter defines the temperature at which the motor control board will open the triac onboard the motor control board (if **FPru** parameter is set correctly). By leaving a "gap" between the make and break value, we will simulate hysteresis of a real bi-metallic disc temperature switch.
- When combined with the CSTI adapter board, the bi-metallic disc temperature switch emulation and the electric heat lockout function will work when the switches are set correctly.

The serial number of each unit and the custom configuration settings specific to that unit will be printed on the label for convenient matching of labels/settings to specific units. Programming a unit with the settings from another unit will result in abnormal operation. The label contains four important sections:

- How to enter the configuration menu
- The description and meaning of the error codes
- The description and meaning of the status display
- The parameter names and values specific to that unit

Figure 99. Motor control board label

O/N: H3N765A		
Serial Number: H21H84795		
Values for this unit are shown below Do not change values unless replacing module		
Description	Name	Value
Mtr1 High Spd	HI1	1089
Mtr1 Med Spd	MD1	945
Mtr1 Low Spd	LO1	800
EH Stg1 Mtr1 Spd	E1M1	0
EH Stg2 Mtr1 Spd	E2M1	0
Al High Spd Mtr1	AHM1	1089
Al Low Spd Mtr1	ALM1	800
Mtr1/2 PWM Freq	FREQ	100
Mtr1 High PWM	M1HI	90
Mtr1 Low PWM	M1LO	14.5
Mtr1 Qvspd RPM	RPM1	2500
Fan Proving Rcn	FPRV	FNST
Pulses Per Rev	FDBK	18
P Value Mtr1	PVL1	0.03
T Value Mtr1	IVL1	0.03
EH Sens Resistor	A1PU	IN
EH Ramp Accel	EHRP	2
Ramp Max Time	MHRP	15
EH Fan Off Delay	EHDL	15
EH Protect	EHPT	OFF

Configurations

Every Trane unit with ECM motors will have modules specifically configured at the factory for the operation of that unit. The motor control board configuration label is affixed to the low-voltage access lid on the outside of the control panel. The VelociTach™ motor control board label may be on the back-side of the low voltage access lid, depending on the unit configuration.



ECM Overview and Setup

Motor Control Board Settings

⚠ CAUTION

Burn Hazard!

Failure to follow this instruction could result in the unit overheating and becoming hot to the touch, which could result in minor or moderate injury, and/or equipment damage.

On electric heat units, certain parameter values are locked out to prevent overheating of the unit. These functions will appear to be saved; however, they will not be accepted if the Electric Heat Protection setting is "On". Do not change the Electric Heat Protection setting to "Off" and make changes to the protected settings unless you are programming an unconfigured service replacement board to match the unit settings on a ECM configuration label.

⚠ WARNING

Safety Alert!

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

All settings take effect immediately, including fan start and electric heat. Avoid hazardous voltage sources, moving parts, and electric heat elements when adjusting the motor control board. If avoiding these areas is not practical during motor control board adjustment, contact Trane Global Parts for configuration kit to power control board outside the unit with a 9-volt battery.

NOTICE

Motor Damage!

Failure to follow instructions below could result in motor damage.

Do not change PWM output voltage settings.

The following table lists the parameter names and typical settings of the motor control board, for reference only.

Do not change the electric heat protection settings if your unit has electric heat.

If the format setting for rpm values are not correct (i.e., not four-digit: XXXX), please check the operation mode of the motor control board *Mod 1* and *Mod 2* and motor signal output format *51 9 1* and *51 9 2*.

Note: The following notes are provided for reference only, and the motor control board label must be used as the ultimate guide for setting up an motor control board on specific units.

Table 35. Configuration settings of the motor control board (for reference only)

Description on Unit Label	User Interface Name	Typical User Interface Value	Description	
<i>Mtr 1 High Spd</i>	<i>H 1 1</i>	<i>1080</i>	Sets the high-speed rpm for Motor 1.	Do not exceed 2300 rpm.
<i>Mtr 1 Med Spd</i>	<i>Mod 1</i>	<i>777</i>	Sets the medium-speed rpm for Motor 1.	
<i>Mtr 1 Low Spd</i>	<i>Lo 1</i>	<i>632</i>	Sets the low-speed rpm for Motor 1.	Do not set under 600 rpm.
<i>EHStg1 Mtr1 Spd</i>	<i>E 1 1 1</i>	<i>0</i>	Assigns an rpm to be associated with a call for 1 st stage electric heat, for Motor 1 (only on units equipped with electric heat).	<i>E 1 1 1</i> , <i>E 1 1 2</i> , <i>E 2 1 1</i> , <i>E 2 1 2</i> settings are locked out on units with electric heat.
<i>EH Stg 2 Mtr 1 Spd</i>	<i>E 2 1 1</i>	<i>0</i>	Assigns an rpm to be associated with a call for 2 nd stage electric heat, for Motor 1 (only on electric heat equipped units).	
<i>AI High Spd Mtr 1</i>	<i>Ah 1 1</i>	<i>0</i>	Sets the maximum rpm for Motor 1 for the maximum input value of the analog input.	Analog inputs below the <i>uFLr</i> setting will be rejected.
<i>AI Low Spd Mtr 1</i>	<i>Al 1 1</i>	<i>0</i>	Sets the minimum turn-on rpm for Motor 1, when the analog input becomes active.	
<i>Mtr 2 Hgh Spd</i>	<i>H 1 2</i>	<i>0</i>	Sets the high-speed rpm for Motor 2.	Blower Coils have only one motor.
<i>Mtr 2 Med Spd</i>	<i>Mod 2</i>	<i>0</i>	Sets the medium-speed rpm for Motor 2.	

Table 35. Configuration settings of the motor control board (for reference only) (continued)

Description on Unit Label	User Interface Name	Typical User Interface Value	Description	
Mtr 2 Low Spd	L o 2	0	Sets the low-speed rpm for Motor 2.	
EHStg1 Mtr2 Spd	E 1st 2	0	Assigns an rpm to be associated with a call for 1 st stage electric heat, for Motor 2 (only on electric heat equipped units).	If the unit has only one motor, all seven speed settings for the second motor (H 1 2, 1st 2, L o 2, E 1st 2, E2nd 2, RL 1 2, RH 1 2) should be set to zero.
EH Stg 2 Mtr 2 Spd	E2nd 2	0	Assigns an rpm to be associated with a call for 2 nd stage electric heat, for Motor 2 (only on electric heat equipped units).	
AI High Spd Mtr 2	RH 1 2	0	Sets the maximum rpm for Motor 2 for the maximum input value of the analog input.	
AI Low Spd Mtr 2	RL 1 2	0	Sets the minimum turn-on rpm for Motor 2, when the analog input becomes active.	
Op Mode Mtr 1	1od 1	rP 1	Sets the operational mode for Motor 1.	Must be set to rP 1 for Blower Coil units.
Op Mode Mtr 2	1od 2	rP 1	Sets the operational mode for Motor 2.	Must be set to rP 1 for Blower Coil units.
Mtr 1 Out Format	5 1 1	P 1 1	Sets the interface type for Motor 1.	Must be set to P 1 1 for Blower Coil units.
Mtr 2 Out Format	5 1 2	P 1 1	Sets the interface type for Motor 2	Must be set to P 1 1 for Blower Coil units.
Mtr 1/2 PWM Freq.	F r E 9	100	Sets the PWM frequency, for cases when the PWM outputs are used.	On Blower Coil units, the P 1 1 must not be changed.
Mtr 1 PWM Volt	1 1 u L	5	Sets the PWM voltage, for cases when the PWM outputs are used.	This setting must NOT be changed, as damage to the motor may occur!
Mtr 2 PWM Volt	1 2 u L	5	Sets the PWM voltage, for cases when the PWM outputs are used.	This setting must NOT be changed, as damage to the motor may occur!
Mt1 Hgh PWM Lt	1 1 h 1	90	Sets the maximum output percentage that the controller will request from Motor 1.	This envelope protection value should not be altered.
Mt1 Low PWM Lt	1 1 L o	14.5	Sets the minimum maximum output percentage that the controller will request from Motor 1.	This envelope protection value should not be altered.
Mt2 Hgh PWM Lt	1 2 h 1	90	Sets the maximum output percentage that the controller will request from Motor 2.	This envelope protection value should not be altered.
Mt2 Low PWM Lt	1 2 L o	14.5	Sets the minimum maximum output percentage that the controller will request from Motor 2.	This envelope protection value should not be altered.
Mt1 Ovspd RPM	rP 1 1	2500	Selects the rpm above which the Motor 1 will be assumed to be in an overspeed condition and will need to be shutdown.	This envelope protection value should not be altered.
Mt2 Ovspd RPM	rP 1 2	2500	Selects the rpm above which the Motor 2 will be assumed to be in an overspeed condition and will need to be shutdown.	This envelope protection value should not be altered.
Fan Proving Fct	FPr u	F n 5 t	Selects which mode should be assigned to the Binary output circuit, depending on unit type.	This setting has to be correct for proper unit operation of electric heat and changeover units.
AI Boost Amp	R 1 5 c	1	Boosts or attenuates the analog input signal to compensate for long wire runs.	A value of 1 should be used if no voltage level compensation is needed (i.e., voltage peak is at 10 VDC).



ECM Overview and Setup

Table 35. Configuration settings of the motor control board (for reference only) (continued)

Description on Unit Label	User Interface Name	Typical User Interface Value	Description	
<i>AI Floor</i>	<i>uFLr</i>	<i>0.5</i>	Rejects noise on the analog input lines and sets up the motor control board to turn on if the thermostat or controller is commanding its analog outputs on.	
<i>PulsePerRev</i>	<i>FdbH</i>	<i>18</i>	Sets up the tachometer function to be compatible with the on-board motor and for correct speed calculation and calibration.	Do not change this setting as this is critical to proper unit operation.
<i>P Value Mtr 1</i>	<i>PuL1</i>	<i>0.03</i>	Sets up the on board closed loop control to control Motor 1 with proper stability.	Do not change this setting.
<i>I Value Mtr 1</i>	<i>IuL1</i>	<i>0.03</i>	Sets up the on board closed loop control to control Motor 1 with proper stability.	Do not change this setting.
<i>P Value Mtr 2</i>	<i>PuL2</i>	<i>0.03</i>	Sets up the on board closed loop control to control Motor 2 with proper stability.	Do not change this setting.
<i>I Value Mtr 2</i>	<i>IuL2</i>	<i>0.03</i>	Sets up the on board closed loop control to control Motor 2 with proper stability.	Do not change this setting.
<i>Ht Sens Mk Val F</i>	<i>R i2i</i>	<i>85</i>	Sets the make value for the motor control board triac output based on the thermistor input.	Operation also depends on <i>FPrU</i> , <i>R i2b</i> , and <i>R iPU</i> settings.
<i>Ht Sens Bk Val F</i>	<i>R i2b</i>	<i>90</i>	Sets the break value for the motor control board triac output based on the thermistor input.	Operation also depends on <i>FPrU</i> , <i>R i2i</i> , and <i>R iPU</i> settings.
<i>Ht Sens Resistor</i>	<i>R iPU</i>	<i>oUt</i>	Sets the input impedance of the thermistor input.	
<i>Mt 1 Ramp %/sec</i>	<i>i1IrP</i>	<i>3</i>	Sets the ramp rate for Motor 1, in % per second.	
<i>Mt 2 Ramp %/sec</i>	<i>i2IrP</i>	<i>3</i>	Sets the ramp rate for Motor 2, in % per second.	
<i>EH Ramp Accel</i>	<i>EhrP</i>	<i>2</i>	Sets the acceleration factor for the electric heat inputs.	Is used to force faster ramps when electric heat is requested.
<i>Ramp MAX Time</i>	<i>i1hrP</i>	<i>15</i>	Sets the maximum ramp time for both Motor 1 and Motor 2 (in seconds).	Overrides the ramp rates <i>i1IrP</i> and <i>i2IrP</i> if the calculated ramp time exceeds <i>i1hrP</i> .
<i>EH Fan off delay</i>	<i>EHdL</i>	<i>15</i>	Selects how long the fan needs to stay on after an electric heat request has been turned off.	Not used on fan-coil unit.
<i>Lck Rtr Protect</i>	<i>LrPt</i>	<i>on</i>	Selects whether to use the on-board locked rotor protection function.	This will shutdown the affected motor, if rotational response is not detected.

Table 35. Configuration settings of the motor control board (for reference only) (continued)

Description on Unit Label	User Interface Name	Typical User Interface Value	Description	
Protect Funct	EhPt	on	This function protects settings on the board that affect the safety of the electric heat system.	Do NOT change this setting. This setting locks out the following parameters from being changed, for safe operation of the unit.
				RiPU
				FPrU
				RiH
				RbH
				EiH1
				EiH2
				E2H1
				E2H2
				S19
				iOd1
				iOd2
				iIH1
				iILO
Protect Funct	EhPt	FLR	This function protects settings on the board that affect the safety of the electric heat system, and limit the maximum current the motor will draw under any operating condition.	Do NOT change this setting. This setting locks out the following parameters from being changed, for safe operation of the unit.
				EiH1
				E2H1
				EiH2
				E2H2
				iOd1
				iOd2
				S191
				S192
				iIH1
				iILO
				i2HI
				i2LO
				FPrU
				Ri2H
				Ri2b
				RiPU
Rmp dft (auto rst)	rPdF	oFF	This function shortens the ramps for faster unit commissioning and auto-resets to off after approximately 15 minutes of power-on operation.	To aid in commissioning of the unit, for approximately 10–15 minutes, the ramps will be shortened to quickly observe proper unit behavior and response to speeds.
Soft Rev	SoFt	uH_HH	Displays the software version.	Module should be received with most recent version.



ECM Overview and Setup

Fan Speed Response Verification

1. After performing controller specific commissioning, observe the display on the motor control board with the power on, to the unit. The motor control board display should display a looping status indicator as follows:

$\overline{H}t\overline{r}1 \rightarrow 0 \rightarrow \overline{H}t\overline{r}2 \rightarrow 0 \rightarrow F5t1 \rightarrow OFF \rightarrow F5t2 \rightarrow$
 $OFF \rightarrow EhEn \rightarrow 0n$

Notes:

- The *EhEn* indicator is unit-specific and may indicate "Off" at this point; refer to thermistor function for more information.
- A representative fan speed of "1080" rpm are shown in the example below. Each unit is factory-configured differently and will have different settings for different fan speeds.

2. While the unit remains on, exercise the fan controls on the unit, either directly or indirectly through request for unit heat/cool. Observe the fan spinning, and then observe the fan display on the motor control board. It should display a looping status indicator as follows:

For a size 200, 300, 400, 600, or 800 unit (using typical unit operating fan speeds):

$\overline{H}t\overline{r}1 \rightarrow 1080 \rightarrow \overline{H}t\overline{r}2 \rightarrow 0 \rightarrow F5t1 \rightarrow 0n \rightarrow F5t2 \rightarrow$
 $OFF \rightarrow EhEn \rightarrow 0n$

For a size 1000 or 1200 unit (using typical unit operating fan speeds):

$\overline{H}t\overline{r}1 \rightarrow 1080 \rightarrow \overline{H}t\overline{r}2 \rightarrow 1080 \rightarrow F5t1 \rightarrow 0n \rightarrow F5t2$
 \rightarrow
 $on \rightarrow EhEn \rightarrow 0n$

Note: The *EhEn* indicator is unit-specific and may indicate "Off" at this point; refer to thermistor function for more information.

3. **OPTIONAL:**

While the fan is running, if practical, change the fan speeds and observe the display temporarily indicate:
 $rR\overline{P}$

Exercise all fan speeds to ensure positive unit response and to validate any field wiring.



Start-Up

Pre-Startup Checklist

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

⚠ 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.

Note: Some circumstances may require the unit to run before building construction is complete. These operating conditions may be beyond the design parameters of the unit and may adversely affect the unit.

General Checklist

- Ensure supply-air and return-air ducts have been connected.
- Ensure the unit has been installed level.
- Ensure damper operator motors and connecting linkage have been installed.
- Verify damper operation and linkage alignment.
- Check that air filters are in place and positioned properly.
- Remove any debris from the unit interior.
- Remove all foreign material from the drain pan and check drain pan opening and condensate line for obstructions.
- Inspect electrical connections to the unit and unit controllers.
 - Connections should be clean and secure.
 - Compare the actual wiring with the unit diagrams.
 - Reference the appropriate controller manual for more details about starting units with factory-mounted controls.
- Check piping and valves for leaks. Open or close the valves to check for proper operation. Drain lines should be open.
- Leave this manual with the unit.

Fan-Related Checks

- Rotate fan wheel manually to confirm it turns freely in the proper direction.
- Verify the fan and motor are aligned.

Coil-Related Checks

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.

- Ensure coil and condensate drain piping connections are complete.
- Check the piping and valves for leaks.
 - Open or close the valves to check operation.
 - The drain lines should be open.
- Remove all foreign material from the drain pan and check the pan opening and condensate line for obstructions.

Electrical Checks

- Check all electrical connections for tightness.
- Verify motor voltage and amps on all phases with the unit nameplate ratings to ensure unit operates correctly.

Ductwork Checks

- If using return ductwork to the unit, secure it with three inches of flexible duct connector.
- Extend discharge duct upward without change in size or direction for at least one and one half fan diameters.
- Use a 3-inch flexible duct connection on discharge.
- Ensure trunk ductwork is complete and secure to prevent leaks.
- Verify that all ductwork conforms to NFPA 90A or 90B and all applicable local codes.

Unit Start-Up

Symbio 400-B Controller

The Symbio™ 400-B controller delivers single zone VAV control in a stand-alone operation or as part of a building automation system using BACnet® communications.

Analog Sensors

The zone sensor, entering water temperature sensor, and the discharge air sensor, and the outside air temperature sensor are 10 KΩ thermistors. See the following figure for the resistance-temperature curve for these thermistors.

Figure 100. Resistance temperature curve for the zone sensor, entering water temperature sensor, and discharge air sensor

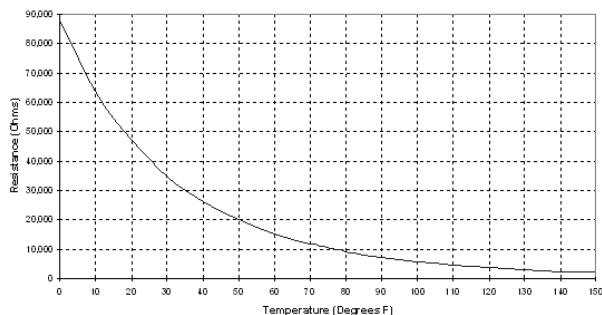


Table 36. Zone sensor thermistor curve (Resistance in Ohms)

°C	°F	R	°C	°F	R	°C	°F	R	°C	°F	R
0	32	32885	25	77	10004	50	122	3759	75	167	1484
1	33.8	31238	26	78.8	9557	51	123.8	3597	76	168.8	1436
2	35.6	29684	27	80.6	9135	52	125.6	3445	77	170.6	1389
3	37.4	28216	28	82.4	8737	53	127.4	3301	78	172.4	1345
4	39.2	26830	29	84.2	8362	54	129.2	3165	79	174.2	1302
5	41	25520	30	86	8007	55	131	3037	80	176	1260
6	42.8	24282	31	87.8	7672	56	132.8	2915	81	177.8	1220
7	44.6	23112	32	89.6	7355	57	134.6	2800	82	179.6	1182
8	46.4	22005	33	91.4	7056	58	136.4	2691	83	181.4	1145
9	48.2	20957	34	93.2	6772	59	138.2	2588	84	183.2	1109
10	50	19966	35	95	6503	60	140	2490	85	185	1074
11	51.8	19028	36	96.8	6248	61	141.8	2397	86	186.8	1041
12	53.6	18139	37	98.6	6006	62	143.6	2309	87	188.6	1009
13	55.4	17297	38	100.4	5777	63	145.4	2225	88	190.4	978
14	57.2	16499	39	102.2	5559	64	147.2	2145	89	192.2	948
15	59	15743	40	104	5352	65	149	2070	90	194	920
16	60.8	15025	41	105.8	5156	66	150.8	1998	91	195.8	892
17	62.6	14345	42	107.6	4969	67	152.6	1929	92	197.6	865
18	64.4	13700	43	109.4	4791	68	154.4	1864	93	199.4	839

Zone Sensor

The controller accepts the following zone sensor module inputs:

- Space temperature measurement (10kW thermistor)
- Local setpoint (either internal or external on the zone sensor module)
- Fan switch
- Timed override (On) and Cancel timed override
- Communication jack

Table 36. Zone sensor thermistor curve (Resistance in Ohms) (continued)

°C	°F	R	°C	°F	R	°C	°F	R	°C	°F	R
19	66.2	13087	44	111.2	4621	69	156.2	1802	94	201.2	814
20	68	12505	45	113	4460	70	158	1742	95	203	790
21	69.8	11953	46	114.8	4306	71	159.8	1686	96	204.8	767
22	71.6	11428	47	116.6	4160	72	161.6	1632	97	206.6	744
23	73.4	10929	48	118.4	4020	73	163.4	1580	98	208.4	722
24	75.2	10455	49	120.2	3886	74	165.2	1531	99	210.2	701

Space Temperature Measurement

Trane zone sensors use a 10kΩ thermistor to measure the space temperature. Typically, zone sensors are wall-mounted in the room and include a space temperature thermistor. As an option, the zone sensor can be unit-mounted with a separate space temperature thermistor located in the unit's return air stream. If both a hard-wired and communicated space temperature value exist, the controller ignores the hard-wired space temperature input and uses the communicated value.

External Setpoint Adjustment

Zone sensors with an external setpoint adjustment (1kΩ) provide the controller with a local setpoint (50°F to 85°F or 10°C to 29.4°C). The external setpoint is exposed on the zone sensor's front cover.

When the hard-wired setpoint adjustment is used to determine the setpoints, all unit setpoints are calculated based on the hard-wired setpoint value, the configured setpoints, and the active mode of the controller. The hard-wired setpoint is used with the controller's occupancy mode (occupied, occupied standby, or unoccupied), the heating or cooling mode, the temperature deadband values, and the heating and cooling setpoints (high and low limits) to determine the controller's active setpoint.

When a building automation system or other controller communicates a setpoint to the controller, the controller ignores the hard-wired setpoint input and uses the communicated value. The exception is the unoccupied mode, when the controller always uses the stored default unoccupied setpoints. After the controller completes all setpoint calculations, based on the requested setpoint, the occupancy mode, the heating and cooling mode, and other factors, the calculated setpoint is validated against the following setpoint limits:

- Heating setpoint high limit
- Heating setpoint low limit
- Cooling setpoint high limit
- Cooling setpoint low limit

These setpoint limits only apply to the occupied and occupied standby heating and cooling setpoints. These setpoint limits do not apply to the unoccupied heating and cooling setpoints stored in the controller's configuration.

When the controller is in unoccupied mode, it always uses the stored unoccupied heating and cooling setpoints. The unit can also be configured to enable or disable the local (hard-wired) setpoint. This parameter provides additional flexibility to allow you to apply communicated, hard-wired, or default setpoints without making physical changes to the unit.

Similar to hard-wired setpoints, the effective setpoint value for a communicated setpoint is determined based on the stored default setpoints (which determines the occupied and occupied standby temperature deadbands) and the controller's occupancy mode.

Fan Switch

The zone sensor fan switch provides the controller with an occupied (and occupied standby) fan request signal (Off, Low, Medium, High, Auto). If the fan control request is communicated to the controller, the controller ignores the hard-wired fan switch input and uses the communicated value. If the zone sensor switch is disabled, the controller resorts to its stored configuration default fan speeds for heating and cooling, unless the controller receives a communicated fan input.

When the fan switch is in the off position, the controller does not control any unit capacity. The unit remains powered and all outputs drive to the closed position. Upon a loss of signal on the fan speed input, the controller reports a diagnostic and reverts to using the default fan speed.

ON/Cancel Buttons

Momentarily pressing the on button during unoccupied mode places the controller in occupied bypass mode for 120 minutes. The controller remains in occupied bypass mode until the override time expires or until you press the Cancel button.

Communications

The controller communicates via LonTalk protocol. Typically, a communication link is applied between unit controllers and a building automation system. Peer-to-peer communication across controllers is possible even when a building automation system is not present. You do not need to observe polarity for LonTalk communication links.



Start-Up

The controller provides six 0.25-inch quick-connect terminals for the communication link connections, as follows:

- Two terminals for communication to the board.
- Two terminals for a connection from the zone sensor back to the controller.
- Two terminals for communication from the board to the next unit (daisy chain).

Table 37. Zone sensor wiring connections

TB1	Description
1	Space temperature / timed override detection
2	Common
3	Setpoint
4	Fan mode
5	Communications
6	Communications

Symbio 400-B Stand-Alone Operation

The factory pre-programs the Symbio 400-B with default values to control the temperature and unit airflow. Use Tracer SC building automation system or Tracer® TU software to change the default values. For more information, refer to *Symbio™ 400-B/500 Programmable Controllers For Blower Coil, Fan Coil, and Unit Ventilator Installation, Operation, and Maintenance* (BAS-SVX093*-EN).

Follow the procedure below to operate the controller in a stand-alone operation:

1. Turn power on at the disconnect switch option.
2. Position the fan mode switch to either high, medium, low, or the auto position.
3. Rotate the setpoint dial on the zone sensor module to 55°F for cooling or 85°F for heating.

The appropriate control valve will actuate assuming the following conditions:

- Room temperature should be greater than 55°F and less than 85°F.
- For a 2-pipe fan-coil unit with an automatic changeover sensor, the water temperature input is appropriate for the demand placed on the unit. For example, cooling operation is requested and cold water (5° lower than room temperature) flows into the unit.
- Select the correct temperature setpoint.

Note: Select and enable zone sensor temperature settings to prevent freeze damage to unit.

Symbio™ 400-B Operation

Controller

Off - Fan is off; control valves and fresh air damper option close. Low air temperature detection option is still active.

Auto - Fan speed control in the auto setting allows the modulating (3-wire floating point) or 2-position control valve option and 1-, 2-, 3- or variable-speed fan to work cooperatively to meet precise capacity requirement, while minimizing fan speed (motor/energy/acoustics) and valve position (pump energy, chilled water reset). As the capacity requirement increases, the water valve opens. When the fan speed capacity switch points are reached, the fan speed ramps up and the water valve repositions to maintain an equivalent capacity. The reverse sequence takes place with a decrease in required capacity.

Low/Med/High - The fan runs continuously at the selected speed and the valve option will cycle to meet setpoint.

Sequence of Operation

Power-Up Sequence

When 24 Vac power is initially applied to the controller, the following sequence occurs:

1. The Power Marquee LED turns on as red, then flashes green, and then turns a solid green.
2. All outputs are controlled **OFF** and all modulating valves and dampers close.
3. The controller reads all input local values to determine initial values.
4. The random start timer begins.
5. The random start timer expires.
6. Normal operation begins, assuming there are no generated diagnostics. If any points are in fault or alarm mode, the Power Marquee LED flashes red.

Important: Flashing red does not indicate that the controller will fail to operate. Instead, the point (s) that are in fault or alarm mode should be checked to determine if the status of the point (s) is acceptable to allow equipment operation.

Random Start

Random start is intended to prevent all units in a building from energizing at the same time. The random start timer delays the fan and any heating or cooling start-up from 5 to 30 seconds.

Occupancy Modes

Occupancy modes can be controlled in the following ways:

- The state of the local (hard wired) occupancy binary input BI1.
- A timed override request from a Trane zone sensor.
- A communicated signal from either a Tracer® SC or BAS.

A communicated request, from either a Tracer SC or BAS, takes precedence over local requests. If a communicated occupancy request has been established, and is no longer present, the controller reverts to the default (occupied) occupancy mode after 15 minutes (if no hard wired occupancy request exists). The controller has the following occupancy modes:

- Occupied
- Unoccupied
- Occupied standby
- Occupied bypass

Occupied Mode

In Occupied Mode, the controller maintains the space temperature based on the occupied space temperature setpoint \pm occupied offset. The controller uses the occupied mode as a default mode when other forms of occupancy request are not present and the fan runs continuously. The outdoor air damper, if present, will close when the fan is OFF. The temperature setpoints can be local (hard wired), communicated, or stored default values (configurable using the Tracer® TU service tool).

Unoccupied Mode

In unoccupied mode, the controller attempts to maintain the space temperature based on the unoccupied heating or cooling setpoint. The fan will cycle between high speed and **OFF**. In addition, the outdoor air damper remains closed, unless economizing. The controller always uses the stored default setpoint values (configurable using the Tracer® TU service tool), regardless of the presence of a hard wired or communicated setpoint value.

Occupied Standby Mode

The controller is placed in occupied standby mode *only* when a communicated occupied request is combined with an unoccupied request from occupancy binary input BI1. In occupied standby mode, the controller maintains the space temperature based on the occupied standby heating or cooling setpoints. Because the occupied standby setpoints have a typical temperature spread of 2°F (1.1°C) in either direction, and the outdoor air damper is closed, occupied standby mode reduces the demand for heating and cooling the space. The fan will run as configured (continuously) for occupied mode. The controller always uses the stored default setpoint values (configurable using the Tracer® TU service tool), regardless of hard wired or communicated setpoint values. In addition, the outdoor air damper uses the economizer occupied standby minimum position setpoint to reduce the ventilation rate.

Occupied Bypass Mode

The controller is placed in occupied bypass mode when the controller is operating in the unoccupied mode and when either the timed override **ON** button on the Trane zone sensor is pressed or the controller receives a communicated occupied bypass signal from a BAS. In occupied bypass mode, the controller maintains the space

temperature based on the occupied heating or cooling setpoints. The fan will run as configured (continuous or cycling). The outdoor air damper closes when the fan is **OFF**. The controller remains in occupied bypass mode until either the **CANCEL** button is pressed on the Trane zone sensor or the occupied bypass time (configurable using the Tracer® TU service tool) expires. The temperature setpoints can be configured as local (hard wired), communicated, or stored default values using the Tracer TU service tool.

Timed Override Control

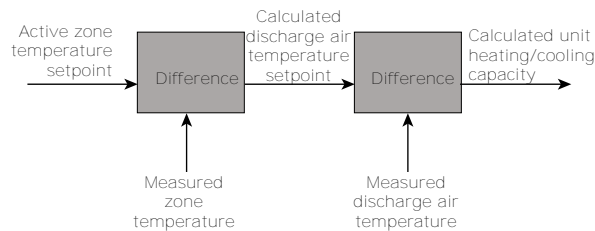
If the controller has a timed override option (ON/CANCEL buttons), pushing the ON button initiates a timed override on request. A timed override on request changes the occupancy mode from unoccupied mode to occupied bypass mode. In occupied bypass mode, the controller controls the space temperature based on the occupied heating or cooling setpoints. The occupied bypass time, which resides in the controller and defines the duration of the override, is configurable from 0 to 240 minutes (default value of 120 minutes). When the occupied bypass time expires, the unit transitions from occupied bypass mode to unoccupied mode. Pushing the CANCEL button cancels the timed override request. In addition, it will end the timed override before the occupied bypass time has expired and transition the unit from occupied bypass mode to unoccupied mode.

If the controller is in any mode other than unoccupied mode when the **ON** button is pressed, the controller still starts the occupied bypass timer without changing to occupied bypass mode. If the controller is placed in unoccupied mode before the occupied bypass timer expires, the controller is placed into occupied bypass mode and remains in this mode until either the **CANCEL** button is pressed on the Trane zone sensor or the occupied bypass time expires.

Zone Temperature Control

The controller has three methods of zone temperature control:

- **Cascade zone control**—used in the occupied, occupied bypass, and occupied standby modes. It maintains zone temperature by controlling the discharge air temperature to control the zone temperature. The controller uses the difference between the measured zone temperature and the active zone temperature setpoint to produce a discharge air temperature setpoint. The controller compares the discharge air temperature setpoint with the discharge air temperature and calculates a unit heating/cooling capacity accordingly (refer to the illustration below). The end devices (outdoor air damper, valves, and so on) operate in sequence based on the unit heating/cooling capacity (0–100 percent)..

Figure 101. Cascade zone control


If the discharge air temperature falls below the discharge air temperature low limit setpoint, (configurable using the Tracer® TU service tool), and the cooling capacity is at a minimum, the available heating capacity is used to raise the discharge air temperature to the low limit.

- **Simplified zone control**— if discharge air temperature failure occurs, then simplified zone controls runs. In the unoccupied mode, the controller maintains the zone temperature by calculating the required heating or cooling capacity (0–100%) according to the measured zone temperature and the active zone temperature setpoint. The active zone temperature setpoint is determined by the current operating modes, which include occupancy and heat/cool modes.
- **Discharge air temperature control**— is the backup mode that runs *only* if there is not valid zone temperature. In this mode, the active space temperature setpoint is used as the discharge air temperature setpoint.

Important: *This is not a normal operating mode. The source of the invalid zone temperature needs to be corrected to restore normal operation.*

Discharge Air Tempering

If the controller is in cooling mode, cascade zone control initiates a discharge air tempering function when:

- The discharge air temperature falls below the discharge air temperature low limit setpoint (configurable using the Tracer® TU service tool)
- All cooling capacity is at a minimum. The discharge air tempering function allows the controller to provide heating capacity (if available) to raise the discharge air temperature to the discharge air temperature low limit setpoint.
- The cold outdoor air is brought in through the outdoor air damper and when the damper is at (high) minimum position. This causes the discharge air temperature to fall below the discharge air temperature low limit setpoint.

Heating or Cooling Mode

The heating or cooling mode can be determined in one of two ways:

- By a communicated signal from a BAS or a peer controller
- Automatically, as determined by the controller

A communicated heating signal permits the controller to *only* heat and a communicated cooling signal permits the controller to *only* cool. A communicated auto signal allows the controller to automatically change from heating to cooling and vice versa.

In heating or cooling mode, the controller maintains the zone temperature based on the active heating setpoint and the active cooling setpoint, respectively. The active heating and cooling setpoints are determined by the occupancy mode of the controller.

For 2-pipe and 4-pipe changeover units, normal heat/cool operation *will not* begin until the ability to conduct the desired heating or cooling operation is verified. This is done using the entering water temperature sampling function, for which a valid entering water temperature is required. When neither a hard wired nor a communicated entering water temperature value is present on changeover units, the controller operates in *only* heating mode and assumes the coil water is hot. The sampling function is not used.

The entering water temperature sampling function is used *only* for changeover applications and for information and troubleshooting. It *does not* affect the operation of the controller.

Water Temperature Sampling Function

The entering water temperature sampling function is used with 2-pipe and 4-pipe changeover units and requires a valid entering water temperature value. If the entering water temperature value is less than 5°F (2.8°C) above a valid zone temperature value for hydronic heating, and greater than 5°F (2.8°C) below a valid zone temperature value for hydronic cooling, the sampling function is enabled. When the sampling function is enabled, the controller opens the main hydronic valve to allow the water temperature to stabilize. After 3 minutes, the controller again compares the entering water temperature value to the zone temperature value to determine if the desired heating or cooling function can be accomplished. If the entering water temperature value remains out of range to accomplish the desired heating/cooling function, the controller closes the main hydronic valve and waits 60 minutes to attempt another sampling. If the entering water temperature value falls within the required range, it resumes normal heating/cooling operation and disables the sampling function.

Fan Operation

The controller supports 1-, 2-, 3-speed fans and variable-speed fans. The fan always operates continuously while either heating or cooling during occupied, occupied standby, and occupied bypass operation. During unoccupied operation, the fan cycles between **OFF** and **HIGH**, regardless of the fan configuration. When running in

AUTO mode, the fan operates differently based on the mode and the type of fan.

For 1-, 2-, and 3-speed fans, each time the fan is enabled, the fan begins operation and runs on high speed for a period of time (0.5 seconds for fan coils and 3 seconds for fan coils) before changing to another speed. Initially running on high speed provides adequate torque to start the fan motor from the **OFF** position.

Note: *In occupied mode, the controller requires continuous fan operation because of cascade zone control. In unoccupied mode, the fan cycles.*

Manual Fan Speed Control

Regardless of the fan type, the fan runs continuously at the desired fan speed during occupied, occupied standby, and occupied bypass operation as follows:

- When the controller receives a communicated fan speed signal (**HIGH, MEDIUM, LOW**).
- The associated fan speed switch is set to a specific fan speed
- The Supply Fan Speed Request point is overridden

During unoccupied operation, the fan cycles between **OFF** and **HIGH**, regardless of the communicated fan speed signal or fan speed switch setting (unless either of these is **OFF**, which in turn, will control the fan **OFF**).

The fan turns OFF when:

- The controller receives a communicated **OFF** signal
- The fan speed switch is set to **OFF**
- Specific diagnostics are generated
- The default fan speed is set to **OFF** and the fan is operating in the **AUTO** mode

Note: *The supply fan speed source can be configured for BAS, local, or default value control using the Tracer® TU service tool.*

AUTO Fan Operation; 1-, 2-, 3-speed Fans

When the controller receives a communicated auto signal (or the associated fan speed switch is set to **AUTO** with no communicated value present), the fan operates in the **AUTO** mode. In **AUTO** mode, the fan operates according to the fan default (configurable using the Tracer® TU service tool). The fan speed has multiple speed configurations (default is **AUTO**) or set to **OFF** for both heating and cooling operation. When configured as **AUTO** (and with multiple speeds available), the fan changes based on the required capacity calculated by the control algorithm.

AUTO Fan Operation; ECM Energy Efficient Mode

When the controller is configured for *Energy Efficient Mode*, by means of the *Fan Operating Mode Request MV* point, the controller and daughter board will minimize

energy use by running the fan at the lowest possible speed while maintaining space temperature. The controller will fully utilize valves, economizer, or electric heat which increases fan speed to meet space temperature (unless the fan has been manually controlled. Refer to the preceding section "[Manual Fan Speed Control](#)," p. 111.

AUTO Fan Operation; ECM Acoustical Mode

When the controller is configured for *Acoustical Mode*, by means of the *Fan Operating Mode Request MV* point, the controller and daughter board will minimize acoustical nuisance by balancing changes in fan speed and total fan noise. The controller will fully **OPEN** cooling and heating valves before increasing fan speed to meet space temperature (unless the fan has been manually controlled. Refer to "[Manual Fan Speed Control](#)," p. 111. If multiple stages of electric heat exist the controller will use a single minimum air flow for each stage.

AUTO Fan Operation; ECM Acoustical Mode

When the controller is configured for *Acoustical Mode*, by means of the *Fan Operating Mode Request MV* point, the controller and daughter board will minimize acoustical nuisance by balancing changes in fan speed and total fan noise. The controller will fully **OPEN** cooling and heating valves before increasing fan speed to meet space temperature (unless the fan has been manually controlled. Refer to "[Manual Fan Speed Control](#)," p. 111. If multiple stages of electric heat exist the controller will use a single minimum air flow for each stage.

Exhaust Control

Exhaust control is achieved by a single-speed exhaust fan and controlled by binary output 2 (BO2). Exhaust control, if not present, can be enabled by selecting **Yes** under the *Exhaust Fan Selection* on the Tracer® TU Configuration page under the *Equipment Options* group.

Note: *Exhaust fan configuration cannot be selected with 3-speed fan operation.*

Important: *If exhaust control is added to an existing configuration, all other configuration options should be verified to match the correct equipment options. Temperature and flow setpoints will revert to default values.*

The exhaust function is coordinated with the supply fan and outdoor/return air dampers as follows:

- The exhaust fan energizes when the fan is running and when the outdoor air damper position is greater than or equal to the exhaust fan enable position (or the outside air damper position at which the exhaust fan turns **ON**).
- The exhaust fan turns **OFF** when the fan either turns **OFF** or the outdoor air damper closes to 10 percent below the exhaust fan enable position.

- If the exhaust fan/damper enable setpoint is less than 10 percent, the exhaust output is energized if the outdoor air damper position is at the setpoint and de-energized at 0.

Valve Operation

The controller supports one or two 3 wire modulating, two-position or field supplied 0-10V valves, depending on the application (refer [Table 38, p. 112](#)). The controller opens and closes the appropriate valve(s) to maintain the active zone temperature setpoint at the heating setpoint in heating mode or the cooling setpoint in cooling mode (refer to *Cascade Zone Control* in “[Zone Temperature Control](#),” p. 109).

Controllers used for 2-pipe applications support heating, cooling, or heat/cool changeover with a single valve/coil. A controller used for 4-pipe applications supports cooling or heat/cool changeover with a main valve/coil and heating *only* with an auxiliary valve/coil.

Three-Wire Modulating Valve Operation

Two binary outputs control each valve: one to drive the valve open and one to drive the valve closed. The stroke time for each valve is configurable using the Tracer® TU service tool. The controller moves the modulating valve to the desired positions based on heating or cooling requirements.

Three-Wire Modulating Valve Calibration

Modulating valve calibration is automatic. During normal controller operation, the controller overdrives the actuator (135 percent of the stroke time) whenever there is a request for a position of 0 percent or 100 percent. At either power-up, after a power outage, or when the occupancy status changes to unoccupied, the controller first drives all modulating valves (and dampers) to the closed position. The controller calibrates to the fully **CLOSED** position by over driving the actuator (135 percent of the stroke time). Thereafter, the controller resumes normal operation.

Two-position Valve Operation

For two position valves, one binary output drives the valve open for N.C. actuators or drives the valve closed for N.O. actuators. When power is removed the valve moves back to its original position. (Closed for N.C. and open for N.O.) 1.0 to 4.6 Cv and PIC valves are capacitor discharge return. 7.4 and 10.0 Cv valves are spring return. The controller will cycle the valve fully open or closed based on heating or cooling requirements.

Modulating Outdoor/Return Air Damper

The controller operates the modulating outdoor/return air dampers based on the following:

- Occupancy mode
- Outdoor air temperature (communicated or hard wired sensor)
- Setpoint
- Zone temperature
- Discharge air temperature
- Discharge air temperature setpoint

The minimum position for an outdoor air damper is configurable using the Tracer® TU service tool for both occupied mode and occupied standby mode and for low-speed fan operation. A controller can receive a BAS-communicated outdoor air damper minimum position.

A BAS-communicated minimum position setpoint has priority over all locally configured setpoints. When a communicated minimum position setpoint is not present, the controller uses the configured minimum position for low fan speed whenever the fan is running at low speed, regardless of the occupancy state. Refer to [Table 38, p. 112](#) and [Table 39, p. 113](#) for more information about how the controller determines the position of the modulating outdoor air damper.

Table 38. Modulating outdoor air damper position setpoint determination

Occupancy	BAS-communicated Setpoint	Fan speed	Active Minimum Setpoint
Unoccupied	Any value	Any value	0 percent (closed)
Occupied Occupied bypass Occupied standby	Valid	Any value	BAS-communicated
Occupied Occupied bypass Occupied standby	Invalid	Low	Occupied low fan minimum
Occupied Occupied bypass	Invalid	Medium/high	Occupied minimum
Occupied standby	Invalid	Medium/high	Occupied standby minimum

Table 39. Relationship between outdoor temperature sensors and damper position

Outdoor Air Temperature	Modulating outdoor air damper position		
	Occupied or Occupied Bypass	Occupied Standby	Unoccupied
No or invalid outdoor air temperature	Open to occupied minimum position	Open to occupied standby minimum position	Closed
Failed outdoor air sensor	Open to occupied minimum position	Open to occupied standby minimum position	Closed
Outdoor air temperature present and economizing possible (Refer to “Economizing (Free Cooling),” p. 113)	Economizing; damper controlled between occupied minimum position and 100 percent	Economizing; damper controlled between occupied standby minimum position and 100 percent	Open and economizing during unit operation; otherwise closed
Outdoor air temperature present and economizing not possible (Refer to “Economizing (Free Cooling),” p. 113)	Open to occupied minimum position	Open to occupied standby minimum position	Closed

Economizing (Free Cooling)

Cooling with outdoor air (during the times when the temperature is low enough to allow) is referred to as economizing (free cooling). The controller and applications with modulating outside air damper, support economizing. The modulating outdoor air damper provides the first source of cooling for the controller.

The controller initiates economizing if the outdoor air temperature is below the economizer enable point (configurable using the Tracer® TU service tool). If economizing is initiated, the controller modulates the outdoor air damper (between the active minimum damper position and 100 percent) to control the amount of outdoor air cooling capacity. When the outdoor air temperature rises 5°F (2.8°C) above the economizer enable point, the controller disables economizing and moves the outdoor air damper back to its predetermined minimum position, based on the current occupancy mode or communicated minimum outdoor air damper position. If an outdoor air temperature value is not present, economizing is disabled.

Electric Heat Operation

In a unit configured with staged electric heat, the electric heating circuit(s) are cycled **ON** and **OFF** appropriately to maintain the desired space temperature at the active heating setpoint. In a unit configured with SCR (modulating) electric heat, a 0 to 10 Volt DC signal is used to adjust SCR capacity in order to maintain the desired space temperature. This signal is provided by the factory installed Symbio™ 400B or from the field controller.

Note: For CSTI, a heat enable relay is provided for field wiring.

In both staged and modulating electric heat applications, the simultaneous use of electric and hydronic heat is not supported and the controller will operate electric heat *only* when hot water is *not* available (for example, in a changeover unit). In addition, the controller will run the

supply fan for 30 seconds after electric heat is turned **OFF** in order to dissipate heat from the unit.

Note: This delay does not apply to hydronic heating.

Factory-configured electric heat units have built-in mechanical protections to prevent dangerously high discharge air temperatures.

Dehumidification Operation

The controller supports space dehumidification when:

- Mechanical (DX or hydronic) cooling is available
- The heating capacity is located in the reheat position
- The space relative humidity is valid

The space relative humidity can be a BAS-communicated value or come directly from a wired relative humidity sensor. The controller begins to dehumidify the space when the space humidity exceeds the humidity setpoint. The controller continues to dehumidify until the sensed humidity falls below the setpoint minus the relative humidity offset.

Peer-to-Peer Communication

Peer-to-peer communication is accomplished by means of custom TGP2 programming in the Tracer® SC system controller or via hard wiring *only* between controllers.

Unit Protection Strategies

The following unit protection strategies are initiated when specific conditions exist in order to protect the unit or building from damage:

- Smart reset
- Low coil temperature protection
- Condensate overflow
- Fan status
- Fan off delay



Start-Up

- Filter maintenance timer
- Freeze avoidance
- Freeze protection (discharge air temperature low limit)

Smart Reset

The controller will automatically restart a unit that is locked out as a result of a **Low Coil Temp Detection** (BI3) diagnostic. Referred to as *smart reset*, this automatic restart will occur 30 minutes after the diagnostic occurs. If the unit is successfully restarted, the diagnostic is cleared. If the unit undergoes another **Low Coil Temp Detection** diagnostic within a 24-hour period, the unit will be locked out until it is manually reset.

Note: Freeze protection will also perform a smart reset.

Low Coil Temperature Protection

For more information, refer to *Tracer® UC400-B Programmable Controller for Blower Coil, Fan Coil, and Unit Ventilator Installation, Operation, and Programming Guide* (BAS-SVX48*-EN) or *Symbio™ 400-B/500 Programmable Controllers For Blower Coil, Fan Coil, and Unit Ventilator Installation, Operation, and Maintenance* (BAS-SVX093*-EN) and the preceding section “[Smart Reset](#),” p. 114.

Condensate Overflow

For more information, refer to *Symbio™ 400-B/500 Programmable Controllers For Blower Coil, Fan Coil, and Unit Ventilator Installation, Operation, and Maintenance* (BAS-SVX093*-EN).

Fan Status

In 1-, 2- and 3-speed fans, the status is based on the statuses of the supply fan output multistate and analog points dedicated to fan control. The fan status is reported as **HIGH**, **MEDIUM**, **LOW**, and as a percentage, whenever the fan is running. The fan status is reported as **OFF** whenever the fan is not running. The fan status switch provides feedback to the controller as follows:

- If the fan is not operating when the controller has the fan controlled to **ON**, the controller generates a *Low Airflow-Supply Fan Failure* diagnostic.
- If the controller energizes the fan output for 1 minute, and the fan status switch indicates no fan operation, the controller performs a unit shutdown and generates a *Low Airflow-Supply Fan Failure* diagnostic.
- If the fan has been operating normally for one minute, but the fan status switch indicates no fan operation, the same diagnostic is generated.

This manual diagnostic discontinues unit operation until the diagnostic has been cleared from the controller. If a diagnostic reset is sent to the controller, and the fan condition still exists, the controller attempts to run the fan for 1 minute before generating another diagnostic and performing a unit shutdown. A diagnostic reset can be sent to the controller from the Tracer® TU *Alarms* page or by

temporarily overriding the *Reset Diagnostic Request* on the Tracer® TU *Binary Status* page.

Note: In the ECM fan application, the *VelociTach* board will monitor the status of the fan. In case of a failure, the engine board will disable the motor immediately, and the low airflow diagnostic is sent.

Fan Off Delay

After heating has been controlled OFF, the controller keeps the fan energized for an additional 30 seconds in order to remove residual heat from the heating source.

Filter Maintenance Timer

The filter maintenance timer tracks the amount of time (in hours) that the fan is enabled. The Filter Runtime Hours Setpoint (configurable using the Tracer® TU service tool) is used to set the amount of time until maintenance (typically, a filter change) is required. The timer can be enabled/disabled from the **Supply Fan** group on the **Setup Parameters** page in Tracer® TU.

The controller compares the fan run time to filter runtime hours setpoint. Once the setpoint is reached, the controller generates a **Filter Change Required** diagnostic. When the diagnostic is cleared, the controller resets the filter maintenance timer to zero, and the timer begins accumulating fan run time again. The diagnostics can be cleared and the filter timer reset by temporarily overriding the **Filter Timer Reset Request** on the **Binary Status** page or by using the reset button on the **Alarms** page in Tracer TU.

Freeze Avoidance

Freeze avoidance is used for low ambient temperature protection. It is initiated *only* when the fan is **OFF**. The controller enters the freeze avoidance mode when the outdoor air temperature is below the freeze avoidance setpoint (configurable using the Tracer® TU service tool). The controller disables freeze avoidance when the outdoor air temperature rises 3°F (1.7°C) above the freeze avoidance setpoint.

The following occurs when the controller is in freeze avoidance mode:

- Valves are driven open to allow water to flow through the coil
- Fan is **OFF**
- Economizing is disabled
- The outdoor/return air damper is closed
- DX cooling is **OFF**
- Electric heat stages are **OFF**

Freeze Protection (Discharge Air Temperature Low Limit)

The controller monitors the discharge air temperature with a 10 kΩ thermistor wired to AI4. The freeze protection operation is initiated whenever the discharge air

temperature falls below the discharge air temperature low limit. The discharge air temperature low limit is configurable using the Tracer® TU service tool. During freeze protection, the controller increases the heating capacity or decreases the cooling capacity in order to raise the discharge air temperature above the low limit. If the discharge air temperature remains below the low limit for 3 minutes, the controller generates a **Discharge Air Temp Limit** diagnostic.

Freeze protection will also perform a smart reset. Refer to [“Smart Reset,” p. 114.](#)

Routine Maintenance

⚠ 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.

⚠ 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.

Maintenance Checklist

Table 40. Maintenance checklist

Frequency	Maintenance
Every week	Observe unit weekly for any change in running condition and unusual noise.
Every month	Clean or replace air filters if clogged or dirty.
Every three to six months	<ul style="list-style-type: none"> Manually rotate the fan wheel to check for obstructions in the housing or interference with fan blades. Remove any obstructions and debris. Check motor bracket torque. Inspect and clean drain pans. Inspect coils for dirt build-up. Clean fins if airflow is clogged.
Every year	<ul style="list-style-type: none"> Inspect the unit casing for chips corrosion. If damage is found, clean and repaint. Clean the fan wheels. Remove any rust from the shaft with an emery cloth and recoat with L.P.S. 3 or equivalent. Inspect and clean drain pans. Check damper linkages, fan set screws, and blade adjustment. Clean, but do not lubricate, the nylon damper rod bushings. Clean damper operators. Inspect, clean, and tighten all electrical connections and wiring. Rotate the fan wheel and check for obstructions. The wheel should not rub. Adjust the center if necessary. Examine flex connections for cracks or leaks. Repair or replace damaged material.

Air Filters

⚠ 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.

Always install filters with directional arrows pointing toward the fan. For units with high efficiency filters (MERV 8 or MERV 13), the filters need to be replaced with equivalent MERV-rated filters to maintain unit performance.

Fans

⚠ 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.

Inspecting and Cleaning Fans

Fan sections of air handlers should be inspected every six months at a minimum or more frequently if operating experience dictates. If evidence of microbial growth (mold) is found, identify and remedy the cause immediately. Refer to ["Diagnostics and Troubleshooting," p. 125](#) for possible causes and solutions. To clean the fan section:

1. Disconnect all electrical power to the unit.
2. Wearing the appropriate personal protective equipment, remove any contamination.
3. Vacuum the section with a vacuum device that uses high-efficiency particulate arrestance (HEPA) filters with a minimum efficiency of 99.97 percent at 0.3 micron particle size.
4. Thoroughly clean any contaminated area(s) with a mild bleach and water solution or an EPA-approved sanitizer specifically designed for HVAC use.
5. Immediately rinse the affected surfaces thoroughly with fresh water and a fresh sponge to prevent potential corrosion of metal surfaces.

6. Allow the unit to dry completely before putting it back into service.
7. Be careful any contaminated material does not contact other areas of the unit or building. Properly dispose of all contaminated materials and cleaning solution

⚠ 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.

Fan Motors

Inspect fan motors periodically for excessive vibration or temperature. Operating conditions will vary the frequency of inspection.

Torque Rating

Check and adjust fan wheel set screws whenever a component is removed or an adjustment is made. Refer to for recommendations.

Table 41. Recommended torques

Fan wheel screw	Torque (in·lb)	Ft·lb	N·m
	120-130	10.0-10.8	13.6-14.7

Table 42. BCHE/BCVE fan, filter, and mixing box general data

Unit Size	12	18	24	36	48	54	60	72	90	120
Nominal CFM	400	600	800	1200	1600	1800	2000	2400	3000	4000
Airflow										
Minimum cfm	250	375	500	750	1000	1125	1250	1500	1875	2500
Maximum cfm	500	675	1000	1600	2000	2400	2500	3000	4000	5000
Fan Data										
Fan wheel, in. (dia X width)	9 x 4	9 x 4	9 x 4	9 x 6	12 x 8	9 x 9	12 x 8	9 x 9	12 x 9	12 x 12
RPM range	800-2500	800-2500	800-2500	800-2500	600-1700	800-2500	600-1700	800-2500	600-1800	600-1800
Motor hp	0.5-1.0	0.5-1.0	0.5-1.0	0.5-2.3	0.5-3.5	1.0-3.5	1.0-3.5	1.0-3.5	1.0-5.0	1.5-5.0
Flat Filter (BCHE)										
(Qty) Size	(1) 12 x 20	(1) 12 x 24	(1) 12 x 24	(1) 12 x 12 (1) 12 x 24	—	(1) 16 x 16 (1) 16 x 25	—	(2) 16 x 25	(1) 20 x 24 (1) 24 x 24	(3) 18 x 24
Flat Filter (BCVE)										
(Qty) Size	—	—	(1) 12 x 24	(1) 18 x 24	(1) 18 x 20 (1) 12 x 20	—	(1) 18 x 24 (1) 12 x 24	(2) 16 x 25	(1) 20 x 24 (1) 24 x 24	(3) 18 x 24
Combination Flat Filter (BCHE/BCVE)										



Routine Maintenance

Table 42. BCHE/BCVE fan, filter, and mixing box general data (continued)

Unit Size	12	18	24	36	48	54	60	72	90	120
Nominal CFM	400	600	800	1200	1600	1800	2000	2400	3000	4000
Airflow										
Merv 8 (Qty) Size	(1) 12 x 20	(1) 12 x 24	(1) 12 x 24	(1) 12 x 12 (1) 12 x 24	–	(1) 16 x 16 (1) 16 x 25	–	(2) 16 x 25	(1) 24 x 20 (1) 24 x 24	(3) 24 x 18
Merv 13 (Qty) Size	(1) 12 x 20	(1) 12 x 24	(1) 12 x 24	(1) 12 x 12 (1) 12 x 24	–	(1) 16 x 16 (1) 16 x 25	–	(2) 16 x 25	(1) 24 x 20 (1) 24 x 24	(3) 24 x 18
Bottom (or Top) Access Filter										
(Qty) Size	(1) 12 x 20	(1) 12 x 24	(1) 12 x 24	(1) 12 x 12 (1) 12 x 24	–	(1) 16 x 16 (1) 16 x 25	–	(2) 16 x 25	(1) 20 x 24 (1) 24 x 24	(3) 18 x 24
Angle Filter										
(Qty) Size	(2) 12 x 20	(2) 12 x 24	(2) 12 x 24	(2) 12 x 12 (2) 12 x 24	–	(2) 12 x 20 (2) 12 x 24	–	(2) 12 x 12 (4) 12 x 20	(2) 20 x 20 (2) 20 x 25	(6) 18 x 20
Mixing Box										
Damper opening width, in.	14	14	20	20	–	36	–	36	38	38
Damper opening height, in.	8.3	8.3	8.3	8.3	–	10.5	–	10.5	15.5	15.5
Return/Discharge Attenuator (BCHE)										
Opening width, in.	9	9	9	14	–	20	–	26	20	26
Opening height, in.	13	13	13	13	–	14	–	14	22	22
Return Attenuator (BCVE)										
Opening width, in.	–	–	13	13	18	–	18	26	20	26
Opening height, in.	–	–	13	13	16	–	16	14	22	22
Discharge Attenuator (BCVE)										
Opening width, in.	–	–	10	13	15	–	18	26	20	26
Opening height, in.	–	–	13	13	16	–	16	14	22	22

Notes:

1. Minimum air flow limits apply to units with hot water or electric heat only. There is no minimum airflow limit on cooling only units. Maximum airflow limits are to help prevent moisture carryover.
2. 2.3 and 3.5 are only available at 575V.

Table 43. BCHE coil general data

Unit Size	12	18	24	36	54	72	90	120
Nominal cfm	400	600	800	1200	1800	2400	3000	4000
Hydronic and DX coil data								
Area - ft ^{2(a)}	0.9	1.1	1.7	2.7	3.7	4.9	6.1	7.6
Width - in. ^(b)	8	8	12	12	14	14	22	22
Length - in. ^(c)	16	20	20	32	38	50	40	50
Velocity - ft/min.	450	540	480	450	487	494	491	524
1-row coil								
Minimum gpm ^(d)	1	1	1	1	3.5	3.5	5.5	5.5
Maximum gpm ^(e)	5.2	5.2	5.2	5.2	18.6	18.6	29.3	29.3
Dry coil weight - lb ^(f)	7	8	10	13	17	22	24	28
Wet coil weight - lb ^(f)	8	9	11	15	20	25	28	34
Internal volume - in ³ ^(f)	16	19	29	45	60	78	99	123
2-row coil								
Minimum gpm ^(d)	1	1	2	2	3.5	4.7	7.4	7.4
Maximum gpm ^(e)	5.2	5.2	10.4	10.4	18.6	37.3	58.6	58.6
Dry coil weight - lb ^(f)	9	11	14	19	25	33	37	45
Wet coil weight - lb (kg) ^(f)	10	12	16	22	30	39	45	54
Internal volume - in ^{3(f)}	32	39	59	89	122	156	199	246
3-row coil - DX coil								
Internal volume - in ³	48	58	87	133	181	234	299	368
4-row coil								
Minimum gpm	2	2	3	3	4.7	4.7	7.4	7.4
Maximum gpm	10.6	10.6	16.0	16.0	37.3	37.3	58.6	58.6
Dry coil weight - lb ^(f)	14	17	22	31	41	52	61	75
Wet coil weight - lb ^(f)	17	19	26	37	51	65	76	94
Internal volume - in ³ ^(f)	65	78	118	179	244	316	402	496
4-row coil - DX coil								
Internal volume - in ³ ^(f)	64	78	117	177	242	313	399	492
6-row coil								
Minimum gpm ^(d)	2	2	3	4	4.7	4.7	7.4	7.4
Maximum gpm ^(e)	10.6	10.6	16	32	37.3	37.3	58.6	58.6
Dry coil weight - lb ^(f)	19	22	29	43	56	72	84	104
Wet coil weight - lb ^(f)	22	26	35	54	70	90	106	131
Internal volume - in ³ ^(f)	98	118	177	268	367	475	605	746
6-row coil - DX coil								
Internal volume - in ³ ^(f)	96	117	175	266	364	469	597	736
8-row coil								
Minimum gpm ^(d)	2	2.7	3	4	4.7	4.7	7.4	7.4
Maximum gpm ^(d)	10.6	21.3	16.0	32.0	37.3	37.3	58.6	58.6
Dry coil weight - lb ^(f)	24	29	37	55	71	92	107	133
Wet coil weight - lb ^(f)	28	34	45	69	89	115	136	169
Internal volume - in ³ ^(f)	130	157	237	359	490	634	808	996



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Table 43. BCHE coil general data (continued)

- (a) Area is rounded, use length and width to calculate the precise area.
- (b) Coil width = Length in the direction of a coil header, typically vertical.
- (c) Coil length = Length of coil in direction of the coil tubes, typically horizontal and perpendicular to airflow.
- (d) The minimum waterflow at 1-1.5 fps tubeside velocity is to ensure the coil self-vents properly. There is no minimum waterflow limit for coils that do not require self venting. See "Water Coil Piping" section for minimum self venting velocities.
- (e) Maximum gpm limits are to prevent erosion and noise problems.
- (f) DX coil height and width dimensions are same as comparable hydronic coils. Four- and six-row DX coil dry weight dimensions are same as comparable 4-row and 6-row hydronic coils. A 3-row DX coil dry weight is 25% less than a comparable 4-row hydronic coil. Internal volumes exclude headers. Weights are rounded up to the nearest pound.

Table 44. BCVE coil general data

Unit Size	24	36	48	60	72	90	120
Nominal cfm	800	1200	1600	2000	2400	3000	4000
Hydronic and DX coil data							
Area - ft ² (a)	1.7	2.5	3.5	4.2	4.9	6.1	7.7
Width - in. (b)	12	18	20	24	14	22	22
Length - in. (c)	20	20	25	25	50	40	50
Velocity - ft/min.	480	480	461	480	494	491	524
1-row coil							
Minimum gpm (d)	1.4	1.4	2.3	2.7	3.5	5.5	5.5
Maximum gpm (e)	7.1	7.1	11.8	14.1	18.6	29.3	29.3
Dry coil weight - lb (f)	5	7	9	10	22	24	29
Wet coil weight - lb (f)	7	9	11	13	25	28	34
Internal volume - in ³ (f)	29	44	59	71	78	99	123
2-row coil							
Minimum gpm (d)	2.7	4.1	4.5	5.4	4.7	7.4	7.4
Maximum gpm (e)	14.1	21.2	23.6	28.3	37.3	58.6	58.6
Dry coil weight - lb (f)	8	11	14	17	33	37	45
Wet coil weight - lb (kg) (f)	10	15	19	22	39	45	54
Internal volume - in ³ (f)	58	87	118	142	156	199	246
3-row coil - DX coil							
Internal volume - in ³	87	130	176	212	234	299	368
4-row coil							
Minimum gpm (d)	2.7	4.1	4.5	5.4	4.7	7.4	7.4
Maximum gpm (e)	14.1	21.2	23.6	28.3	37.3	58.6	58.6
Dry coil weight - lb (f)	15	20	27	32	52	61	75
Wet coil weight - lb (f)	20	28	37	44	65	76	94
Internal volume - in ³ (f)	118	177	239	287	316	402	496
4-row coil - DX coil							
Internal volume - in ³	116	174	236	283	313	399	492
6-row coil							
Minimum gpm (d)	2.7	4.1	4.5	5.4	4.7	7.4	7.4
Maximum gpm (d)	14.1	21.2	23.6	28.3	37.3	58.6	58.6
Dry coil weight - lb (f)	20	28	38	45	72	84	104
Wet coil weight - lb (f)	27	39	52	62	90	106	131
Internal volume - in ³ (f)	177	266	360	431	475	605	746

Table 44. BCVE coil general data (continued)

Unit Size	24	36	48	60	72	90	120
Nominal cfm	800	1200	1600	2000	2400	3000	4000
6-row coil - DX coil							
Internal volume - in ³ (f)	175	262	355	426	469	597	736
8-row coil							
Minimum gpm (d)	N/A	N/A	N/A	N/A	4.7	7.4	7.4
Maximum gpm (e)	N/A	N/A	N/A	N/A	37.3	58.6	58.6
Dry coil weight - lb (f)	N/A	N/A	N/A	N/A	92	107	133
Wet coil weight - lb (f)	N/A	N/A	N/A	N/A	115	136	170
Internal volume - in ³ (f)	N/A	N/A	N/A	N/A	634	808	996

(a) Area is rounded, use length and width to calculate the precise area.

(b) Coil width = Length in the direction of a coil header, typically vertical.

(c) Coil length = Length of coil in direction of the coil tubes, typically horizontal and perpendicular to airflow.

(d) The minimum waterflow at 1-1.5 fps tubeside velocity is to ensure the coil self-vents properly. There is no minimum waterflow limit for coils that do not require self venting. See "Water Coil Piping" section for minimum self venting velocities.

(e) Maximum gpm limits are to prevent erosion and noise problems.

(f) DX coil height and width dimensions are same as comparable hydronic coils. Four- and six-row DX coil dry weight dimensions are same as comparable 4-row and 6-row hydronic coils. A 3-row DX coil dry weight is 25% less than a comparable 4-row hydronic coil. Internal volumes exclude headers. Weights are rounded up to the nearest pound.

Coils

All coils should be kept clean to maintain maximum performance.

Water Coils

⚠ 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.

⚠ 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.

To clean water coils:

1. Disconnect all electrical power to the unit.
2. Wearing the appropriate personal protective

equipment, use a soft brush to remove loose debris from both sides of the coil.

3. Install a block-off to prevent spray from going through the coil and into a dry section of the unit and/or system ductwork.
4. Mix a high-quality coil cleaning detergent with water according to the manufacturer's instructions.

Note: If the detergent is strongly alkaline after mixing (PH 8.5 or higher), it must contain an inhibitor. Follow the cleaning solution manufacturer's instructions regarding the use of the product.

5. Place the mixed solution in a garden pump-up sprayer or high-pressure sprayer. If a high pressure sprayer is to be used:
 - Maintain minimum nozzle spray angle of 15 degrees.
 - Spray perpendicular to the coil face.
 - Keep the nozzle at least 6 inches from the coil.
 - Do not exceed 600 psi.
6. Spray the leaving air side of the coil first, then the entering air side.
7. Thoroughly rinse both sides of the coil and the drain pan with cool, clean water.
8. Repeat [Step 6](#) and [Step 7](#) as necessary.
9. Straighten any coil fins that may have been damaged during the cleaning process.
10. Confirm the drain line is open following the cleaning process.
11. Allow the unit to dry thoroughly before putting it back into service.
12. Replace all panels and parts and restore electrical



Routine Maintenance

power to the unit.

13. Be careful any contaminated material does not contact other areas of the unit or building. Properly dispose of all contaminated materials.

Refrigerant Coils

⚠ WARNING

Hazardous Pressures!

Failure to follow instructions below could result in a violent explosion, which could result in death or serious injury.

If a heat source is required to raise the tank pressure during removal of refrigerant from cylinders, use only warm water or heat blankets to raise the tank temperature. Do not exceed a temperature of 150°F. Do not under any circumstances apply direct flame to any portion of the cylinder.

⚠ WARNING

Hazardous Pressures!

Failure to follow instructions could result in coil bursting, which could result in death or serious injury. Coils contain refrigerant under pressure. To avoid excessive pressure in the coil, do not exceed 150°F coil cleaning solution temperature.

To clean refrigerant coils:

1. Disconnect all electrical power to the unit.
2. Wearing the appropriate personal protective equipment, use a soft brush to remove loose debris from both sides of the coil.
3. Install a block-off to prevent spray from going through the coil and into a dry section of the unit and/or system ductwork.
4. Mix a high-quality coil cleaning detergent with water according to the manufacturer's instructions.

Note: If the detergent is strongly alkaline after mixing (PH 8.5 or higher), it must contain an inhibitor. Follow the cleaning solution manufacturer's instructions regarding the use of the product.

5. Place the mixed solution in a garden pump-up sprayer or high-pressure sprayer. If a high pressure sprayer is to be used:
 - Maintain minimum nozzle spray angle of 15 degrees.
 - Spray perpendicular to the coil face.
 - Keep the nozzle at least 6 inches from the coil.
 - Do not exceed 600 psi.
6. Spray the leaving air side of the coil first, then the entering air side.
7. Thoroughly rinse both sides of the coil and the drain pan with cool, clean water.

8. Repeat [Step 6](#) and [Step 7](#) as necessary.
9. Straighten any coil fins damaged during the cleaning process.
10. Confirm the drain line is open following the cleaning process.
11. Allow the unit to dry thoroughly before putting it back into service.
12. Replace all panels and parts and restore electrical power to the unit.
13. Be careful any contaminated material does not contact other areas of the unit or building. Properly dispose of all contaminated materials and cleaning solution.

Coil Winterization

Water coil winterization procedures consist primarily of draining water from the coil before the heating season. Trane recommends flushing the coil with glycol if coils will be exposed to temperatures below 35 degrees

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.

Install field-fitted drains and vents to permit winterization of coils not in use and to assist in evacuating air from the water system during start-up. If draining is questionable because of dirt or scale deposits inside the coil, fill the coil with glycol before the heating season begins.

1. Remove the vent and drain plugs.
2. Blow the coil out as completely as possible with compressed air.
3. Fill and drain the coil several times with full strength glycol so that it mixes thoroughly with the water retained in the coil.
4. Drain the coil out as completely as possible.
5. To ensure no water remains in the coil, do not replace the vent and drain plugs until the coils are put back into service.

Moisture Purge Cycle

By its very nature, any HVAC unit with a cooling coil serves as a dehumidifier, reducing the surrounding air's ability to hold water vapor as its temperature falls. This normally doesn't present a problem when the unit is running. However, when the fan stops, water vapor condenses on the cold metal surfaces inside the air handler and remains there until the air warms sufficiently to re-evaporate it. This damp, dark environment—though temporary—can

encourage the growth of mold, mildew, and other microbial contaminants.

Providing a moisture purge cycle 15 to 30 minutes after shutdown disperses the cold, humid air inside the air-handling system more evenly throughout the building. This four-step cycle:

- Closes the outdoor air dampers.
- Turns off the cooling coil.
- Opens any variable-air-volume terminals connected to the air handler.
- Operates the supply fan for 10 to 15 minutes.

Air movement discourages water condensation and hastens re-evaporation of any condensate that does happen to form. This simple preventative measure effectively combats microbial growth and curbs moisture-related deterioration of air-handling components.

Cleaning Non-Porous Surfaces

⚠ 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.

If microbial growth on a non-porous insulating surface (closed cell insulation or sheet metal surface) is observed:

1. Disconnect all electrical power to the unit.
2. Wearing the appropriate personal protective equipment, use a brush for sheet metal surfaces or a soft sponge on a foil face or closed cell foam surface to mechanically remove the microbial growth.

Note: *Be careful not to damage the non-porous surface of the insulation.*

3. Install a block-off to prevent spray from going into a dry section of the unit and/or system ductwork.
4. Thoroughly clean the contaminated area(s) with an EPA-approved sanitizer specifically designed for HVAC use.
5. Rinse the affected surfaces thoroughly with fresh water and a fresh sponge to prevent potential corrosion of the drain pan and drain line.
6. Repeat [Step 4](#) and [Step 5](#) as necessary.
7. Confirm the drain line is open following the cleaning process.
8. Allow the unit to dry thoroughly before putting it back into service.
9. Replace all panels and parts and restore electrical power to the unit.

10. Be careful any contaminated material does not contact other areas of the unit or building. Properly dispose of all contaminated materials and cleaning solution.

Cleaning Porous Surfaces

⚠ 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.

To clean a porous insulating surface matte face (fiberglass insulation):

1. Disconnect all electrical power to the unit.
2. Wearing the appropriate personal protective equipment, use a vacuum device with a HEPA filter (99.97 percent efficient at 0.3 micron particles) to remove the accumulated dirt and organic matter.
Note: *Be careful not to tear the insulation surface or edges.*
3. Confirm the drain line is open following the cleaning process.
4. Allow the unit to dry thoroughly before putting it back into service.
5. Replace all panels and parts and restore electrical power to the unit.
6. Be careful any contaminated material does not contact other areas of the unit or building. Properly dispose of all contaminated materials and cleaning solution.

Drain Pans

⚠ 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.

The condensate drain pan and drain line must be checked to assure the condensate drains as designed. This inspection should occur a minimum of every six months or more often as dictated by operating experience.

Routine Maintenance

If evidence of standing water or condensate overflow exists, identify and remedy the cause immediately. Refer to ["Diagnostics and Troubleshooting," p. 125](#) for possible causes and solutions. Refer to Installation — Mechanical section for drain pan removal steps if necessary.

To clean drain pans:

1. Disconnect all electrical power to the unit.
2. Wearing the appropriate personal protective equipment, remove any standing water.
3. Scrape solid matter off of the drain pan.
4. Vacuum the drain pan with a vacuum device that uses high-efficiency particulate arrestance (HEPA) filters with a minimum efficiency of 99.97 percent at 0.3 micron particle size.
5. Thoroughly clean any contaminated area(s) with a mild bleach and water solution or an EPA-approved sanitizer specifically designed for HVAC use.
6. Immediately rinse the affected surfaces thoroughly with fresh water and a fresh sponge to prevent potential corrosion of metal surfaces.
7. Allow the unit to dry completely before putting it back into service.
8. Be careful any contaminated material does not contact other areas of the unit or building. Properly dispose of all contaminated materials and cleaning solution.

Coil Removal

1. For Refrigerant coils, see ["Refrigerant Removal and Evacuation," p. 40](#) for disconnection procedure. For Hydronic Coils, shut off water supply to coil.
2. Disconnect all electrical power to the unit.
3. Disconnect piping from coil headers.
4. Remove coil and motor side panels.
5. If any sensors or screws listed in the following steps are inaccessible through the coil header side of unit, remove opposite side panel.
6. Disconnect the following switches and sensors: Float, Freeze/Frost Stat, Refrigerant. See [Figure 102, p. 124](#), [Figure 103, p. 124](#), and [Figure 104, p. 124](#).
7. Remove screws that attach coil gusset to Z-bracket. See [Figure 46, p. 55](#) and [Figure 47, p. 55](#).
8. Slide Coil(s) assembly out. See [Figure 105, p. 124](#).

Figure 102. Float switch



Figure 103. Freeze/Frost stat

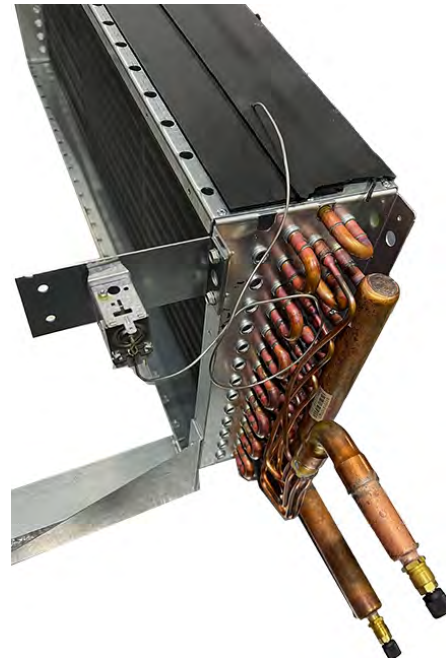


Figure 104. Refrigerant sensor



Figure 105. Coil assembly





Diagnostics and Troubleshooting

This section is intended to be used as a diagnostic aid only. For detailed repair procedures, contact your local Trane service representative.

⚠ 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.

Table 45. Troubleshooting recommendations

Symptom	Probable Cause	Recommended Action
Motor fails to start	Blown line fuse or open circuit breaker	Replace fuse or reset circuit breaker.
	Improper wiring or connections	Check wiring with diagram supplied on unit.
	Improper current supply	Compare actual supply power with motor nameplate recommendations. Contact power company for adjustments.
	Mechanical failure	Check that fan rotates freely.
Motor stalls	Low line voltage	Check across AC line. Correct voltage if possible.
Excessive vibration	Poor fan alignment	Check motor bracket screws. Check fan position on shaft.
Motor runs and then dies down	Partial loss of line voltage	Check for loose connections. Determine adequacy of main power supply.
Motor does not come up to speed	Low voltage at motor terminals	Check across AC line and correct voltage loss if possible.
	Line wiring to motor too small	Replace with larger sized wiring.
Motor overheats	Overloaded motor	Reduce load or replace with a larger motor.
	Motor fan is clogged with dirt preventing proper ventilation	Remove fan cover, clean fan and replace cover.
Excessive motor noise	Motor mounting bolts loose	Tighten motor mounting bolts.
	Fan rubbing on fan cover	Remove interference in motor fan housing.
Low water coil capacity	Incorrect airflow	Check fan operating condition.
	Incorrect water flow	Inspect the water pumps and valves for proper operation and check the lines for obstructions.
	Incorrect water temperature	Adjust the chiller or boiler to provide the proper water temperature.
	Coil is piped incorrectly	Verify coil piping (see "Piping and Connections," p. 56.)
	Dirty fin surface	Clean the fin surface.
	Incorrect glycol mixture	Verify glycol mixture and adjust if necessary.



Diagnostics and Troubleshooting

Table 45. Troubleshooting recommendations (continued)

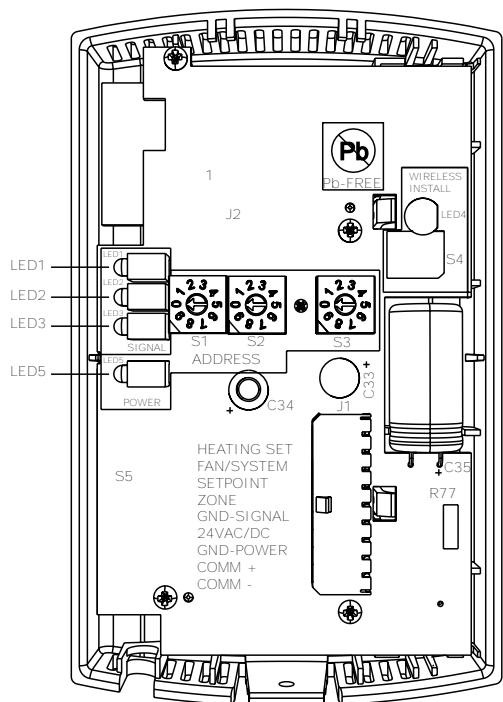
Symptom	Probable Cause	Recommended Action
Low refrigerant coil capacity	Incorrect airflow	Check fan operating condition.
	Expansion valve is not operating properly or is sized incorrectly	Check sensing bulb temperature. Verify valve operation. Verify proper valve size.
	Incorrect refrigerant charge	Verify refrigerant charge and adjust if necessary.
	Condensing unit failure	Verify condensing unit operation.
	Coil is piped incorrectly	Verify coil piping (see "Piping and Connections," p. 56.)
	Clogged refrigerant line filter	Change filter core.
	Failure of suction/liquid line components	Verify component operation
	Dirty fin surface	Clean the fin surface. Do not use steam to clean refrigerant coils.
	Fin frosting	Verify defrost cycle operation. Verify frostat operation. Verify refrigerant charge.
Drain pan is overflowing	Plugged drain line	Clean drain line
	Unit not level	Level unit
	Improper trap design	Design trap per unit installation instructions
Standing water in drain pan	Improper trap design	Design trap per unit installation instructions
	Unit not level	Level unit
	Plugged drain line	Clean drain line
Wet interior	Coil face velocity too high	Reduce fan speed
	Improper trap design	Design trap per unit installation instructions
	Drain pan leaks/overflows	Repair leaks
	Condensation on surfaces	Insulate surfaces
Excess dirt in unit	Missing filters	Replace filters
	Filter bypass	Reduce filter bypass by ensuring all blockoffs are in place.
Microbial growth (mold) inside air handler	Standing water in drain pan	See "Standing water in drain pan" above

Wireless Zone Sensors (WZS)

The receiver for all models has four LEDs: LED1, LED2, LED3, and LED5. The following figure shows their locations.

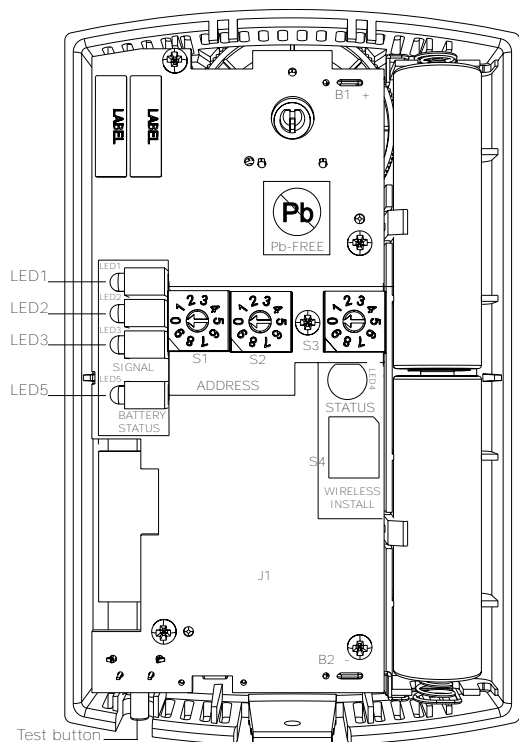
Note: To view LEDs on a flush mount receiver on a fan coil unit, the front panel of the unit must be removed.

Figure 106. Receiver for all fan coil models showing LED locations



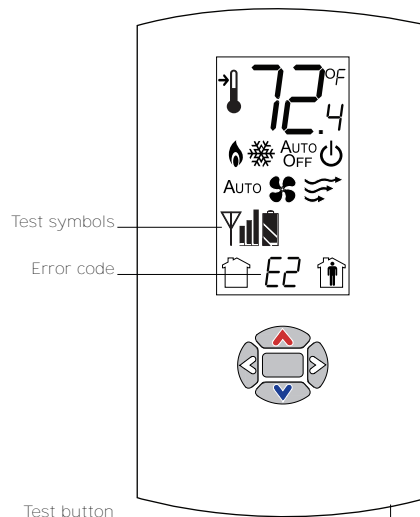
The sensor for a wireless zone sensor (WZS) has four LEDs: LED1, LED2, LED3, and LED5 and a test button. The following figure shows their locations.

Figure 107. WZS showing LED locations and test button



The sensor for a wireless display sensor (WDS) has test symbols and error codes that appear on the display, and a test button. See the following figure.

Figure 108. Wireless display sensor (WDS) shows test symbols and error codes



Receiver Diagnostics

LED1, LED2, and LED3, located on the receiver of all models respond to diagnostics by exhibiting specific blinking patterns. They respond independently of any user action (see the following table).

Diagnostics and Troubleshooting

Table 46. Diagnostics on the receiver

LED state	Indicates...
LED1: Off LED2: Off LED3: 1-blink pattern repeated continuously ^(a)	Disassociated Receiver is not associated, waiting for a sensor. Receiver lost communication with sensor. Receiver has no devices on its wireless personal area network. Association with a device has been manually removed.
LED1: Off LED2: Off LED3: 2-blink pattern repeated continuously ^(a)	Address set to 000 Address not set to between 001–999.
LED1: Off LED2: Off LED3: 3-blink pattern repeated continuously ^(a)	Not configured Receiver configuration properties not properly set (defective receiver).

^(a) Blink pattern is On for 1/4 s, Off for 1/4 s, with 2 s Off between repetitions.

Sensor Diagnostics

LED1, LED2, and LED3, located on the WZS respond to diagnostics by exhibiting specific blinking patterns. View their response by pressing the Test button.

Error codes appear on the WDS when diagnostics occur (see the following table).

Table 47. Diagnostics for wireless zone sensors and error code shown on wireless display sensor

LED state when Test button is pressed on WZS	Error code shown on WDS	Indicates...
n/a	E0, E5, E7	Sensor failure Replace sensor
LED1: Off LED2: Off LED3 ^(a) : 1-blink pattern repeated 3 times	E1	Disassociated Sensor is not associated with a receiver.
LED1: Off LED2: Off LED3 ^(a) : 2-blink pattern repeated 3 times	E2	Address set to 000 Address not set to between 001–999.
LED1: Off LED2: Off LED3 ^(a) : 3-blink pattern repeated 3 times	E3	Software error Replace sensor
LED1: Off LED2: Off LED3 ^(a) : 4-blink pattern repeated 3 times	E4	Input voltage too high No RF transmission is permitted with an input battery voltage greater than 3.9 V.

^(a) Blink pattern is On for 1/4 s, Off for 1/4 s, with 2 s Off between repetitions.

Testing Signal Strength

To initiate a signal strength test, push the Test button on the sensor (see location of Test button in [Figure 107, p. 127](#) and [Figure 108, p. 127](#)).

Models WZS: LED1, LED2, and LED3 respond by indicating signal strength. You can view them on the sensor ([Table 48, p. 129](#)) and the receiver ([Table 49, p. 129](#)).

Model WDS: Test symbols on the sensor display indicate signal strength ([Table 48, p. 129](#)). LED1, LED2, and LED3, on the receiver, respond by indicating signal strength ([Table 49, p. 129](#)).

Table 48. Observing signal strength on the wireless zone sensor





User action	LED state	Symbol displayed on WDS	Indicates...
None	LED1: Off LED2: Off LED3: Off	No Test symbols appear	Normal state No Test button press.
Press Test button on the sensor	LED1: Off LED2: Off LED3: Off		Associated; no communication with receiver Associated, but no signal from the receiver after pressing Test button.
	LED1: On LED2: On LED3: On Displays for 5 seconds, then constantly Off		Excellent signal strength Good signal margin for reliable communication.
	LED1: Off LED2: On LED3: On Displays for 5 seconds, then constantly Off		Satisfactory signal strength Adequate signal strength for reliable communication. Moving sensor or receiver may improve signal strength. Increased channel switching may reduce battery life.
	LED1: Off LED2: Off LED3: On Displays for 5 seconds, then constantly Off		Poor signal strength Unreliable communication. Strongly recommend moving the sensor or receiver to a better location.

Table 49. Observing signal strength on the receiver

User action	LED state on receiver	Indicates...
None	LED1: Off LED2: Off LED3: Off	Normal state No Test button press.
Press Test button on the sensor	LED1: On LED2: On LED3: On Displays for 5 seconds, then constantly Off	Excellent signal strength Good signal margin for reliable communication.
	LED1: Off LED2: On LED3: On Displays for 5 seconds, then constantly Off	Satisfactory signal strength Adequate signal strength for reliable communication. Moving sensor or receiver may improve signal strength. Increased channel switching may reduce battery life.
	LED1: Off LED2: Off LED3: On Displays for 5 seconds, then constantly Off	Poor signal strength Unreliable communication Strongly recommend moving the sensor or receiver to a better location

Testing Battery Status

Initiate a battery status test as follows:

- On the WZS, push the Test button on the sensor (see location on [Figure 107, p. 127](#)). LED5 on the sensor responds by indicating the level of battery strength, as shown in [Table 50, p. 130](#).
- On the WDS, push the Test button on the sensor (see location on [Figure 108, p. 127](#)). In response, a battery test symbol appears on the display. The symbol shown indicates battery life expectancy (see [Table 51, p. 130](#)).




Diagnostics and Troubleshooting

Table 50. Battery status indicated by LED5 on the wireless zone sensors

User action	LED state	Indicates...
Press Test button	Solid green for 5 seconds	Battery is adequate for proper operation.
	Solid red for 5 seconds	25% battery life left. Batteries should be replaced.
	No light	Batteries life expired or not installed properly, or sensor is defective.
None	Blinking red: 1-blink pattern ^(a) repeated 5 times. Cycle repeats every 15 minutes.	Approximately 14 days of operation remain before the battery is too weak to power the sensor.

^(a) Blink pattern is On for 1/4 s, Off for 3/4 s, with 2 s Off between repetitions.

Table 51. Battery status shown on the wireless display sensor

User action	Battery test symbol	Indicates...	Battery test symbol	Indicates...	Battery test symbol	Indicates...
Press Test button		Full battery power.		50 percent battery life left.		25 percent battery life left. Replace batteries. Flashing symbol indicates that approximately 14 days of operation remain before the battery is too weak to power the sensor.

24 V Power Status Indicator

LED5 on the receiver of all models (see [Figure 106, p. 127](#)) lights and stays constantly On when 24 V power is normal.

Check Signal Strength on a Site

Use the wireless sensor system to check the signal strength on a site.

1. Power up a receiver with a 24 V transformer (user supplied).
2. Associate the sensor to a receiver of the same model intended for the job.
3. Place the receiver at the desired location.
4. Place or hold the sensor at the desired location.
5. Press the Test button (S5) on the sensor and observe the signal strength as indicated by LED1, LED2, and LED3 on model WZS (see [Figure 107, p. 127](#)), and on the display on model WDS (see [Figure 108, p. 127](#)).

For more information on interpreting the LEDs and the display symbols that indicate signal strength, see [“Testing Signal Strength,” p. 128](#).

Replacing Sensor Batteries

Sensor battery type, length of life, and installation are addressed in this section.

Battery Type

NOTICE

Battery Damage!

Failure to follow instructions below could result in battery leakage and, in some cases, cause the safety release vent to open.

Do NOT attempt to recharge the batteries. The batteries are manufactured in a ready-to-use state and are NOT designed for recharging.

NOTICE

Sensor Damage!

Do not hook up the sensor to a power supply as it could result in sensor damage.

Use two non-rechargeable 1.5 V lithium AA batteries in the sensor. To maintain UL rating, use only UL-listed lithium batteries. The sensor ships with Energizer® L91 batteries already installed. Replacement batteries are available at Trane Service Parts Centers or other local suppliers.

Battery Life

Battery life is five years under normal conditions. If the sensor is not used for an extended period of time, do one of the following:

- Set the sensor address to 000 to place the sensor into a low-power hibernation mode.
- Remove the batteries

Notes:

- If lithium batteries are temporarily unavailable, alkaline batteries can be used. However, alkaline battery life is very short by comparison.
- The battery life for model WDS may decrease with extended LCD display activity.

Battery Installation
⚠ WARNING
Risk of Injury with Batteries!

Failure to follow handling instructions below could result in severe injury.

- **Do NOT install batteries backwards.**
- **Do NOT disassemble, charge, or expose batteries to water, fire, or high temperature.**
- **Keep batteries away from children. If swallowed, contact your local poison control center immediately.**

1. Observe the polarity indicators that are molded into the cover.
2. Install two batteries (of the type specified in “[Battery Type](#),” p. 130) in the battery-holding slot that is molded into the sensor cover.

The sensor has been designed to prevent damage if the batteries are installed backwards, to reduce the potential for injury.

Manual Association

Before attempting manual or automatic association, the receiver must indicate readiness to associate (one blink pattern of LED3 on receiver). Refer to “[Observing Receiver for Readiness](#),” p. 76.

At any time, the manual association method can be used to associate the receiver with the sensor. If an association was previously established between a receiver and a sensor and needs to be re-established, the manual association process may be used. If an association has not yet been established, the automatic association process is recommended (see “[Associating Sensor to Receiver](#),” p. 77).

1. Using a small screwdriver, set the three rotary address switches (locations S1, S2, S3) on the receiver to an address between 001 and 999.

Note: An address can be changed at any time after initial association has been established. It is not necessary to power down the receiver or sensor.

2. Set the three rotary address switches (locations S1, S2, S3) on the sensor to the same address as the receiver.
3. Record the address and location of the receiver and sensor pair.

4. After verifying that the receiver and sensor are powered up, press the Test button on the sensor to establish that the signal strength (“[Testing Signal Strength](#),” p. 128) and the battery life (“[Testing Battery Status](#),” p. 129) are adequate for proper functioning.

Disassociation

The receiver disassociates from the sensor (by removing all stored association information), conducts a channel scan, and restarts itself, if any of the following are true:

- The receiver address is changed from its current setting (001–999)
- The receiver receives a disassociation notification from its associated sensor
- The receiver does not receive a communication from its associated sensor within 50 minutes.
- The sensor and receiver are associated and communicating at the time the sensor is set to 000 and the Test button is pressed.

Note: A disassociated sensor will transit an association request every 10 minutes.

Sensor/Receiver Compatibility

Version 1.5 and higher receivers are compatible with all sensors models and support all functions. Receivers released prior to version 1.5 are compatible with only model WZS.

Replacing a Failed Sensor or Receiver

Note: Receivers ship installed on the unit. To remove the receiver, press in the retention tabs on the underside of the receiver enclosure and push upward.

To replace a failed sensor or receiver:

1. Confirm that the device is disassociated (see [Table 46](#), p. 128 and [Table 47](#), p. 128).
2. Set the rotary address switch of the new device to match the address of the remaining sensor or receiver.

Note: There is no need to remove power from the remaining device.

3. Apply power to the new device. Association between the new and the remaining devices will automatically occur.

Note: When replacing a WDS sensor, the receiver (version 1.5 or higher) will automatically configure the sensor to match the last stored configuration, if the sensor has not been placed into configuration mode and the factory default configuration is still valid. If the sensor configuration does not match the desired system features, it can be manually configured.

Servicing and Testing WZS

If the wireless sensor system is not working as expected, use the tools and procedure described in this section.

Servicing and Testing Tools

No special tools or software are necessary to service and test the wireless sensor system. Test the system by using:

- The LEDs on the receiver, LEDs on the model WZS sensor, and the display on the model WDS sensor
- The Test button on the sensor
- The address test mode on the receiver
- A common volt-ohm meter

Procedure for Testing Zone Sensor

If the wireless zone sensor is not working as expected:

1. Observe LED5 on the receiver. LED5 is On solid green whenever the receiver is powered.
2. Verify that the receiver is properly grounded. Both the GND-SIGNAL (black) wire and the GND-POWER (yellow) wire must be grounded.
3. Press the Test button on the sensor.
 - Model WZS: LED5 should turn On solid green, indicating proper battery strength. LED1, LED2, and LED3 will indicate signal strength.
Note: *When checking signal strength, both LED1 and LED3 on the receiver and sensor illuminate in unison if the sensor and receiver are associated. Use this feature to confirm association.*
 - Model WDS: Battery life ([“Testing Battery Status,”](#) p. 129) and signal strength ([“Testing Signal Strength,”](#) p. 128) are indicated on the display.

Procedure for Testing Receiver

If the receiver is not working as expected:

1. Verify that the receiver is powered.
2. Set the receiver address to 000 to force the zone temperature output and zone temperature setpoint output to their default mode values (see [“Failure and Default Modes,”](#) p. 132).
3. Measure the receiver output resistance.
4. When the test is complete, reset the receiver address to its previous setting.
5. Press the Test button on the sensor to force re-association.
6. Confirm association and communication by noting LED1, LED2, and LED3 as described in [“Testing Signal Strength,”](#) p. 128.

Forcing a Sensor to Transmit

To force a wireless sensor to transmit during servicing, press the Test button on the sensor.

Output Power Level

The maximum output power level of a wireless sensor set is controlled by software and restricted by channel of operation and agency requirements per country or region. The sensor has a default maximum power level of 10 mW, but the receiver determines the ultimate output power level of the sensor.

Failure and Default Modes

The following table provides output values for failure and default modes of operation, which can be used for troubleshooting.

Table 52. Output values - failure and default modes of operation

Situation	Zone temperature output	Zone setpoint output	Heating setpoint output	Fan/System output
Receiver address = 000	11.17 kΩ, 72.5°F (22.5°C), indefinitely	451 Ω, 72.5°F (22.5°C), indefinitely	501 Ω, 70.5°F (21.4°C), indefinitely	2320 Ω Fan = Auto System = Off
Receiver address = 001 to 999 and: Receiver is powered up, but not is associated, or Receiver has received a disassociation request from the associated sensor.	11.17 kΩ, 72.5°F (22.5°C) Hold for 15 minutes, then open	451 Ω, 72.5°F (22.5°C), Hold for 15 minutes, then open	501 Ω, 70.5°F (21.4°C), indefinitely	2320 Ω Fan = Auto System = Off
Receiver address = 001 to 999 and receiver has not received a communication within 35 minutes from the associated sensor.	Open	Open	Open	Open
Receiver has no power.	Open	Open	Open	Open
Thermistor in sensor has failed to either open or close.	Open	Normal value	Normal value	n/a
Setpoint potentiometer has failed to either open or close.	Normal value	Open	Open	n/a

Measuring Output Resistance

To measure the resistance of receiver outputs for zone temperature and setpoints for all models, and heating setpoint and fan/system for the WDS:

1. Ensure that the GND-SIGNAL (black) wire and the GND-POWER (yellow) wire are grounded to the transformer.
2. Disconnect the ZONE (white) and SETPOINT (RED) wires from the controller. Disconnect the HEAT SETPOINT (brown) and FAN/SYSTEM (green) wires from the controller, if applicable.
3. Measure resistance as follows:
 - a. All models: Measure between the grounded GND-SIGNAL (black) wire and either the SETPOINT (red) or ZONE (white) wire. Compare resistance measurements to those in [Table 53, p. 133](#).

Table 53. Receiver resistance table for all models

Zone or setpoint temperature	Nominal zone temperature output resistance	Nominal setpoint/heating setpoint output resistance
55°F (12.8°C)	17.47 KΩ	792 Ω
60°F (15.6°C)	15.3 KΩ	695 Ω
65°F (18.3°C)	13.49 KΩ	597 Ω
70°F (21.1°C)	11.9 KΩ	500 Ω
75°F (23.9°C)	10.5 KΩ	403 Ω
80°F (26.7°C)	9.3 KΩ	305 Ω
85°F (29.4°C)	8.25 KΩ	208 Ω

- b. WDS only: Measure between the grounded GND-SIGNAL (black) wire and the FAN/SYSTEM (green) wire. Compare resistance measurements to those given in [Table 54, p. 133](#).

Note: The output circuits are not electrically powered; consequently, resistance can be measured without risk of damage to the volt-ohm meter.

Table 54. Receiver resistance table for model WDS

Fan command	Nominal output resistance
High	16,130 Ω
Med	13,320 Ω
Low	10,770 Ω
Auto	2320 Ω
Off	4870 Ω

Cleaning the Sensor

NOTICE

Sensor Damage!

Do not spray glass cleaner or any other solution directly on the sensor as it could damage it.

You can clean the sensor by applying glass cleaner to a soft, non-abrasive cloth, and gently wiping the face, including the buttons and LCD display. Use of a premoistened towelette designed for lens or screen cleaning is also acceptable.

Avoid inadvertent pressing of the Occupied/Unoccupied buttons on the keypad on the WDS sensor as this may result in an unwanted timed override or settings change.

Symbio 400-B Controller

LED Activity

LED activity, an indication or troubleshooting tip for each, and any related notes.

There are 15 LEDs on the front of the Symbio™ 400-B controller. The following table provides a description of LED activity.

Diagnostics and Troubleshooting

LED Name	Activities	Indication and Troubleshooting Tips	Notes
Marquee LED	Shows solid green when the unit is powered and no alarm exists	Indicates normal operation	When powering the Symbio 400-B and expansion module, the Marquee LED will blink RED , blink GREEN (indicating activated and controller/expansion module are communicating), and then stay GREEN CONTINUOUSLY (indicating normal power operation).
	Shows blinking green during a device reset or firmware download	Indicates normal operation	
	Shows solid red when the unit is powered , but represents low power or a malfunction	If low power ; could be under voltage or the microprocessor has malfunction. Measure for the expected value range. For more information, refer to <i>Symbio™ 400-B/500 Programmable Controllers For Blower Coil, Fan Coil, and Unit Ventilator Installation, Operation, and Maintenance</i> (BAS-SVX093*-EN). If malfunction ; un-power and then re-power unit to bring the unit back up to normal operation.	
	Shows blinking red when an alarm or fault exists	An alarm or fault condition will occur if the value for a given point is invalid or outside the configured limits for the point. Alarm and fault conditions vary, and they can be configured by the programmer.	
	LED not lit	Indicates power is OFF or there is a malfunction OFF or malfunction ; cycle the power. For more information, refer to <i>Symbio™ 400-B/500 Programmable Controllers For Blower Coil, Fan Coil, and Unit Ventilator Installation, Operation, and Maintenance</i> (BAS-SVX093*-EN).	
Link and IMC	TX blinks green	Blinks at the data transfer rate when the unit transfers data to other devices on the link	TX LED: Regardless of connectivity or not, this LED will constantly blink as it continually looks for devices to communicate to. LED not lit: Determine if, for example, a Tracer® SC or BACnet device is trying to talk to the controller or if it is capable of talking to the controller. Also determine if the communication status shows down all of the time. In addition, check polarity and baud rate. For more information, refer to <i>Symbio™ 400-B/500 Programmable Controllers For Blower Coil, Fan Coil, and Unit Ventilator Installation, Operation, and Maintenance</i> (BAS-SVX093*-EN).
	RX blinks yellow	Blinks at the data transfer rate when the unit receives data from other devices on the link ON solid yellow ; indicates there is reverse polarity	
	LED is not lit	Indicates that the controller is not detecting communication Not lit ; cycle the power to reestablish communication	
Service	Shows solid green when the LED has been pressed		When the Symbio 400-B is placed into boot mode, the system will not run any applications such as trending, scheduling, and TGP2 runtime. The controller will be placed into boot mode if the service pin is held in when power is applied. In boot mode, the controller is non-operational and is waiting for a new main application to be downloaded.
	LED not lit	Indicates controller is operating normally	
Binary B01 through B09	Shows solid yellow	Indicates a corresponding binary output has been commanded ON Relay coil ; indicates that a command has been made to energize TRIAC ; indicates that a command has been made to turn ON	If the user is currently powering the Symbio 400-B from a USB port, the Led lights will turn ON . However, the binary outputs <i>will not</i> be activated. Commanded ON ; As an example of commanded ON, a command could be a manual command such as an override or a command could be from TGP2 based on a list of conditions that are met telling these outputs to turn ON. LED not lit: Did the user command it to be ON? If yes, see the Marquee LED at the top of this table. For more information, refer to <i>Symbio™ 400-B/500 Programmable Controllers For Blower Coil, Fan Coil, and Unit Ventilator Installation, Operation, and Maintenance</i> (BAS-SVX093*-EN).
	LED not lit	Indicates that a relay output is de-energized or no power to the board Not lit ; cycle power to reestablish communication	

Overriding Outputs

Analog and multistate value request points are included in order to safely override outputs without disrupting TGP2 program operation. To override valves and dampers for commissioning or testing purposes, access the following points on the Tracer® TU analog or multistate status pages:

- Cool valve request
- DX cool request
- Heat valve request
- Electric heat request
- Economizer request
- Supply fan speed active

For more information, refer to *Symbio™ 400–B/500 Programmable Controllers For Blower Coil, Fan Coil, and Unit Ventilator Installation, Operation, and Maintenance* (BAS-SVX093*-EN).

Diagnostics

Diagnostics are informational messages that indicate the operational status of the controller. In response to most diagnostics, the controller attempts to protect the equipment by enabling/disabling, or by opening/closing specific outputs. Other diagnostics provide information about the status of the controller, but have no effect on outputs. Diagnostics are reported in the order in which they occur. Multiple diagnostics can be present simultaneously. Diagnostic messages are viewed using the Tracer® TU service tool or through a BAS.

Note: *Tracer TU will report only active diagnostics.*

Diagnostics Types

Diagnostics are categorized according to the type of clearing method each uses and the type of information each provides.

The diagnostic types are:

- Manual (latching) diagnostics
- Automatic (non-latching) diagnostics
- Smart reset diagnostics
- Informational diagnostics

Note: *Clearing diagnostics refers to deleting diagnostics from the software; it does not affect the problem that generated the message.*

Manual (Latching) Diagnostics

Manual diagnostics (also referred to as latching) cause the unit to shutdown. Manual diagnostics can be cleared from the Symbio™ 400-B controller in one of the following ways:

- By using the Tracer® TU service tool to reset latching diagnostics on the **Alarms Status** tab or by temporarily overriding the **Reset Diagnostic Request** (bv/2) on the **Binary Status** tab.
- Through a building automation system.
- By cycling power to the controller. When the 24 Vac power to the controller is cycled **OFF** and then **ON** again, a power-up sequence occurs.

Automatic (Non-latching) Diagnostics

Automatic diagnostics clear automatically when the problem that generated the diagnostic is solved.

Smart Reset Diagnostics

Smart Reset Diagnostics are latching diagnostics that will auto-recover if the condition is corrected. After the controller detects the first smart reset diagnostic, the unit waits 30 minutes before initiating the smart reset function. If another diagnostic of this type occurs again within 24 hours after an automatic clearing, clear the diagnostic manually.

Informational Diagnostics

Informational diagnostics provide information about the status of the controller. They *do not* affect machine operation, but can be cleared from the controller using the BAS or Tracer® SC.

Building Automation System

Some building automation systems can reset diagnostics in the controller. For more complete information, refer to the product literature for the building automation system.

Trane Service Tools

Tracer® TU can be used to reset diagnostics present in a Symbio™ 400-B controller.

Controller Diagnostics

The following table lists each diagnostic that can be generated by the Symbio 400-B controller, the diagnostic effect on outputs (*consequences*), and diagnostic type.

Note: *The generic binary output is unaffected by diagnostics.*

Diagnostics and Troubleshooting

Table 55. Diagnostics generated by Symbio™ 400- controller

Diagnostic	Probable Cause	Consequences	Diagnostic Type
Filter change required	Fan run hours exceed the time set to indicate filter change.	<ul style="list-style-type: none"> Fan Unaffected Valves Unaffected Electric heat Unaffected 	Informational
Condensate overflow	The drain pan is full of water.	<ul style="list-style-type: none"> Fan OFF Valves Closed Outdoor air damper Closed DX/electric heat OFF 	Manual
Low coil temp detection	The leaving fluid temperature may be close to freezing.	<ul style="list-style-type: none"> Fan OFF Valves Open Outdoor air damper Closed DX/electric heat OFF 	Smart reset/Manual
Low airflow supply fan failure	The fan drive belt, contactor, or motor has failed.	<ul style="list-style-type: none"> Fan OFF Valves Closed Outdoor air damper Closed DX/electric heat OFF 	Manual
Space temperature failure ^(a)	Invalid or missing value for zone temperature.	<ul style="list-style-type: none"> Discharge air temperature control runs Unit shuts OFF if both space temperature and discharge air temperature fail 	Automatic
Entering water temp failure	Invalid or missing value for zone temperature.	<ul style="list-style-type: none"> Fan Unaffected (enabled) Valves Unaffected Outdoor air damper Unaffected DX/electric heat Unaffected 	Automatic
Discharge air temp low limit	Discharge air temperature has fallen below the Discharge Air Temperature Low Limit.	<ul style="list-style-type: none"> Fan OFF Valves Open Outdoor air damper Closed DX/electric heat OFF 	Smart reset/manual
Discharge air temp failure	Invalid or missing value for discharge air temperature.	<ul style="list-style-type: none"> Simplified zone control algorithm runs Unit shuts OFF if zone temperature fails 	Automatic
Outdoor air temp failure	Invalid or missing value for outdoor air temperature.	<ul style="list-style-type: none"> Fan Unaffected Valve Unaffected Outdoor air damper Minimum Position DX cooling/electric heat unaffected 	Automatic
Humidity input failure	Invalid or missing value for relative humidity.	<ul style="list-style-type: none"> Fan Unaffected Valves Unaffected Outdoor air damper Unaffected DX cooling/electric heat Unaffected 	Automatic
CO ₂ sensor failure	Invalid or missing value for CO ₂ .	<ul style="list-style-type: none"> Fan Unaffected Valves Unaffected Outdoor air damper Unaffected DX cooling/electric heat Unaffected 	Informational

Table 55. Diagnostics generated by Symbio™ 400- controller (continued)

Diagnostic	Probable Cause	Consequences	Diagnostic Type
Generic AIP failure	Invalid or missing value for generic analog input.	<ul style="list-style-type: none"> Fan Unaffected Valves Unaffected Outdoor air damper Unaffected DX cooling/electric heat Unaffected 	Informational
Local fan mode failure	Invalid or missing fan-speed switch (<i>reverts to default fan speed</i>).	<ul style="list-style-type: none"> Fan Unaffected Valves Unaffected Outdoor air damper Unaffected DX cooling/electric heat Unaffected 	Automatic
Local setpoint failure	Invalid or missing value for zone temperature setpoint (<i>reverts to default setpoint</i>).	<ul style="list-style-type: none"> Fan Unaffected Valves Unaffected Outdoor air damper Unaffected DX cooling/electric heat Unaffected 	Automatic

^(a) For detailed information about zone temperature control methods, refer to [Zone Temperature Control](#), p. 109.

Fans with Symbio™ 400- Controller

Table 56. Fan does not energize

Probable Cause	Explanation
Unit wiring	The wiring between the controller outputs and the fan relays and contacts must be present and correct for normal fan operation. Refer to applicable wiring diagram.
Failed end device	The fan motor and relay must be checked to ensure proper operation.
Normal operation	<p>The fan will turn OFF when:</p> <ul style="list-style-type: none"> The controller receives a communicated off signal. The fan-speed switch is set to OFF if no communicated value is present. Specific diagnostics are generated. The default fan speed is set to OFF and the fan is operating in the Auto mode. <p>If the controller is in unoccupied mode, the fan cycles between OFF and the highest fan speed.</p>
No power to the controller	If the controller does not have power, the unit fan does not operate. For the controller to operate normally, it must have an input voltage of 24 Vac. If the Marquee/Power LED is OFF continuously, the controller does not have sufficient power or has failed.
Diagnostic present	Several diagnostics affect fan operation. For detailed information about these diagnostics, refer to Table 55 , p. 136.
Unit configuration	The controller must be properly configured based on the actual installed end devices and application. If the unit configuration does not match the actual end device, the fans may not work correctly.
Random start observed	After power-up, the controller always observes a random start from 5 to 30 seconds. The controller remains OFF until the random start time expires.
Cycling fan operation/continuous	The controller continuously operates the fan when in the occupied, occupied standby, or occupied bypass mode. When the controller is in the unoccupied mode, the fan is cycled between high speed and OFF with capacity.
Unoccupied operation	Even if the controller is configured for continuous fan operation, the fan normally cycles with capacity during unoccupied mode. While unoccupied, the fan cycles ON or OFF with heating/cooling to provide varying amounts of heating or cooling to the space.
Fan mode off	If a local fan mode switch determines the fan operation, the OFF position controls the fan to off.
Requested mode off	The user can communicate a desired operating mode (<i>such as OFF, heat, and cool</i>) to the controller. If OFF is communicated to the controller, the unit controls the fan to off. There is no heating or cooling.



Diagnostics and Troubleshooting

Valves with Symbio™ 400-B Controller

Table 57. Valves remain closed

Probable Cause	Explanation
Unit wiring	The wiring between the controller outputs and the valve(s) must be present and correct for normal valve operation. Refer to applicable wiring diagram.
Failed end device	The valves must be checked to ensure proper operation.
No power to the controller	If the controller does not have power, the unit valve(s) will not operate. For the controller to operate normally, apply an input voltage of 24 Vac. If the Marquee/Power LED is OFF continuously, the controller does not have sufficient power or has failed.
Diagnostic present	Several diagnostics affect valve operation. For detailed information about these diagnostics, refer to Table 55, p. 136 .
Normal operation	The controller opens and closes the valves to meet the unit capacity requirements.
Unit configuration	The controller must be properly configured based on the actual installed end devices and application. If the unit configuration does not match the actual end device, the valves may not work correctly.
Random start observed	After power-up, the controller always observes a random start from 5 to 30 seconds. The controller remains OFF until the random start time expires.
Requested mode off	The user can communicate a desired operating mode (such as OFF , heat, and cool) to the controller. If OFF is communicated to the controller, the unit controls the fan to off. There is no heating or cooling.
Entering water temperature sampling logic	The controller includes entering water temperature sampling logic, which is automatically initiated during 2-pipe and 4-pipe changeover, if the entering water temperature is either too cool or too hot for the desired heating or cooling.
Valve configuration	Ensure the valves are correctly configured, using the Tracer® TU service tool, as normally open or normally closed as dictated by the application. For modulating valves, ensure the stroke time is set correctly. Refer to Table 19, p. 38 .

Table 58. Valves remain open

Probable Cause	Explanation
Unit wiring	The wiring between the controller outputs and the valve(s) must be present and correct for normal valve operation. Refer to applicable wiring diagram.
Failed end device	The valves must be checked to ensure proper operations.
Normal operation	The controller opens and closes the valves to meet the unit capacity requirements.
Diagnostic present	Several diagnostics affect valve operation. For detailed information about these diagnostics, refer to Table 55, p. 136 .
Unit configuration	The controller must be properly configured based on the actual installed end devices and application. If the unit configuration does not match the actual end device, the valves may not work correctly.
Entering water temperature sampling logic	The controller includes entering water temperature sampling logic, which is automatically initiated during 2-pipe and 4-pipe changeover, if the entering water temperature is either too cool or too hot for the desired heating or cooling.
Valve configuration	Ensure the valves are correctly configured, using the Tracer® TU service tool, as normally open (NO) or normally closed (NC) as dictated by the application. For modulating valves, ensure the stroke time is set correctly. Refer to Table 19, p. 38 .
Freeze avoidance	When the fan is OFF with no demand for capacity (0%), and the outdoor air temperature is below the freeze avoidance setpoint, the controller opens the water valves (100%) to prevent coil freezing. This includes unoccupied mode when there is no call for capacity or any other time the fan is OFF .

DX Coils or Electric Heat with Symbio™ 400-B Controller

Table 59. DX or electric heat does not energize

Probable Cause	Explanation
Unit wiring	The wiring between the controller outputs and the end devices must be present and correct for normal operation. Refer to applicable wiring diagram.
Failed end device	Check the control contactors or the electric heat element, including any auxiliary safety interlocks, to ensure proper operation.
No power to the controller	If the controller does not have power, heat outputs do not operate. For the controller to operate normally, apply an input voltage of 24 Vac. If the Marquee/Power LED is OFF continuously, the controller does not have sufficient power or has failed.
Diagnostic present	Several diagnostics affect DX and electric heat operation. For detailed information about these diagnostics, refer to Table 55, p. 136 .
Normal operation	The controller controls compressor or electric heat outputs as needed to meet the unit capacity requirements.
Unit configuration	The controller must be properly configured based on the actual installed end devices and application. If the unit configuration does not match the actual end device, DX or electric heat may not operate correctly.
Requested mode off	The user can communicate a desired operating mode (such as OFF , heat, and cool) to the controller. If OFF is communicated to the controller, the unit shuts off the compressor or electric heat.
Freeze avoidance	When the fan is OFF with no demand for capacity (0%), and the outdoor air temperature is below the freeze avoidance setpoint, the controller disables compressors and electric heat outputs (100%) to prevent coil freezing. This includes unoccupied mode when there is no call for capacity or any other time the fan is OFF .

Outdoor Air Dampers with Symbio™ 400-B Controller

Table 60. Outdoor air damper remains closed

Probable Cause	Explanation
Unit wiring	The wiring between the controller outputs and the outdoor air damper must be present and correct for normal outdoor air damper operation. Refer to applicable wiring diagram.
Failed end device	Check damper actuator to ensure proper operation.
No power to the controller	If the controller does not have power, the outdoor air damper does not operate. For the controller to operate normally, apply an input voltage of 24 Vac. If the Marquee/Power LED is OFF continuously, the controller does not have sufficient power or has failed.
Diagnostic present	Several diagnostics affect outdoor air damper operation. For detailed information about these diagnostics, refer to Table 55, p. 136 .
Normal operation	The controller opens and closes the outdoor air damper based on the controller's occupancy mode and fan status. Normally, the outdoor air damper is open during occupied mode when the fan is running and closed during unoccupied mode.
Unit configuration	The controller must be properly configured based on the actual installed end devices and application. If the unit configuration does not match the actual end device, the outdoor air damper may not work correctly.
Warm-up and cool-down sequence	The controller includes both a morning warm-up and cool-down sequence to keep the outdoor air damper closed during the transition from unoccupied to occupied. This is an attempt to bring the space under control as quickly as possible.
Requested mode off	The user can communicate a desired operating mode (such as OFF , heat, or cool) to the controller. If OFF is communicated to the controller, the unit closes the outdoor air damper.

Table 61. Outdoor air damper remains open

Probable Cause	Explanation
Unit wiring	The wiring between the controller outputs and the outdoor air damper must be present and correct for normal outdoor air damper operation. Refer to applicable wiring diagram.
Failed end device	Check damper actuator to ensure proper operation.
Normal operation	The controller opens and closes the outdoor air damper based on the controller occupancy mode and fan status. Normally, the outdoor air damper is open during occupied mode when the fan is running and closed during unoccupied mode. (Refer to the section, "Modulating Outdoor/Return Air Damper," p. 112.)
Unit configuration	The controller must be properly configured based on the actual installed end devices and application. If the unit configuration does not match the actual end device, the outdoor air damper may not work correctly.

ECM Motors

⚠ 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.

An electronically commutated motors (ECM) is a closed loop system that has equipment protections and envelope enforcements. Do not assume that the motor has failed without first consulting the VelociTach engine status/diagnostics screen. In many cases, the engine shuts down the motor operation and locks it out to prevent equipment damage.

Electric heat operation and changeover coil control on CSTI units are coordinated by the VelociTach motor control board.

The mini-access lid on the front of the main control panel lid has the VelociTach troubleshooting/setup guide affixed to the back of the lid. This guide is unit-specific and should be consulted before determining the disposition of a unit.

⚠ 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.

General Information

The VelociTach motor control board oversees and monitors all motor operations and changes to speed resulting from:

- Direct fan speed requests
 - Customer fan speed switches
 - Thermostat fan speed, On or 0–10V requests
 - Automatic fan request from DDC controllers
- Indirect fan speed requests
 - Electric heat requests will bring the fan to the proper speed.
- Conflicting fan speed requests
 - If two or more commands are received (direct or indirect), the fan will honor the higher speed requested.

Note: In some cases, indirect requests will result in fan behavior change regardless of whether the end-device fails to actuate (due to device failure, or safety/down-stream lockouts).

The VelociTach motor control board also coordinates the operation of electric heat, electric/hydronic heat lockouts, and CSTI changeover coil operation.

Troubleshooting Tips

- VelociTach motor control board configuration must perfectly match the factory-supplied ECM. Refer to for configuration of the motor control board "Adjustments," p. 96.
- The VelociTach motor control board will display troubleshooting information, and contains dual tachometers to aid in performance verification.
- Under normal circumstances, the VelociTach display will display the operational status of the motors and electric heat circuit/sensors, however, a malfunction will drive a priority display mode that will present the error code instantly to the screen. The error must be cleared by solving by powering down, removing the cause of the problem and restarting the engine board.
- VelociTach label (see ECM Setup chapter) setup document (affixed to the back of the low voltage access

lid) should be used to verify engine configuration settings.

- For proper operation of the system, all plugs must be firmly seated in all boards and motors. Insecure connections will cause malfunction and the system will shutdown.
- Do not unplug or plug-in motors or connectors while the system is receiving a speed request of any kind. The system must be powered down before plugging or unplugging connections to the adapter boards, engine boards or motors. Failure do so will register diagnostics or cause unsafe operation and reduction in the contact life of the connectors.

- The motor will not spin if plugged in while the ECM engine is requesting power.

Motor

The motor connections and motor plug connections to the adapter boards should be secure. Unit should be powered off to check the fit of the connectors.

When configured correctly, the system will always respond positively to direct, indirect, and conflicting speed requests with very few exceptions.

Table 62. Motor does not spin, spins too slowly

Situation	Probable Cause	Solution
Motor has been locked out due to engine locked rotor protection	Motor 1 has an obstruction. "Status Display" will be interrupted to display: $LOC H \rightarrow \overline{N} E r I \rightarrow L r P t$	<ul style="list-style-type: none"> • Remove obstruction from the fan wheel. • Ensure that motor plugs and all plugs to adapter boards and the ECM engine board are secure • Verify that the configuration does not specify a motor that is physically missing. Most units require only one motor. The controller is made aware of the missing motor by specifying all speeds related to Motor 2 to 0 rpm. • Verify that $\overline{N} L a$ and $\overline{N} 2 L a$, the low motor signal output limits, are set correctly.
Motor has been locked out due to overspeed or runaway condition	Motor 1 has an overspeed condition. The "Status Display" will be interrupted to display: $OSP d \rightarrow \overline{N} E r I \rightarrow OSP d$	<ul style="list-style-type: none"> • Ensure that set-screw is attached firmly to the motor shaft. • Ensure that motor plugs and all plugs to adapter boards and the ECM engine board are secure. • Verify that the configuration does not specify a speed lower than 450 rpm for the affected motor. Speeds below 450 rpm are not supported on fan-coil units.
VSP Inputs (0–10V inputs) are of the wrong polarity	Variable speed (VSP) inputs may not be properly wired to 1TB4	<ul style="list-style-type: none"> • Do not short the courtesy 10 VDC supply to chassis or loads that require greater than 10 mA of DC current. • Observe proper polarity of 0–10 VDC inputs. Failure to observe proper polarity can cause failure of the VelociTach motor control board or the customer-supplied controller.
Customer Controller output signal to VSP Inputs are too low ^(a) .	Noise floor is set too high.	<ul style="list-style-type: none"> • The VelociTach motor control board contains an adjustable noise floor parameter, $NFL r$ that can be configured to reject signals below the noise floor. • The noise floor parameter is set too high, it can be lowered as long as there are acceptable noise levels on the inputs lines.

^(a) If the customer supplied controller outputs signals that are below the noise threshold, they will be ignored by the ECM Engine.

Typical equipment and controls design practice will ensure that the fans will come on if there is a call for heat, cool, or ventilation. In most cases, we will depend on the controller/thermostat to call for the fan to come on when appropriate, but during calls for electric heat, or calls for heat on CSTI units equipped with electric heat, as a call for the appropriate fan speed. This behavior, as described previously, is an indirect request.

When a call for electric heat is made, the system will positively drive the fan on to the correct speed, regardless of whether the controller has asked for fan operation or not. The unit design incorporates an interlock instead of a lock-out. (It does not lock out electric heat if the fan is set to off; it brings the fan on.)

Notes:

- *In many cases, indirect requests will result in fan behavior change regardless of whether the end-device fails to actuate (due to device failure, or safety/down-stream lockouts). If there is hot water available on CSTI units with changeover coils and electric heat, we will still drive the fan to the appropriate electric heat speed.*
- *The new fan coil designs incorporate sophisticated fan interlocks that will lockout heat if there is a fan failure.*



Diagnostics and Troubleshooting

If the preceding conditions do not describe the behavior of the unit, the following checks should be performed:

Table 63. Motor spins too fast or spins without any apparent speed request

Situation	Probable Cause
Motor not controllable	Verify that the voltage jumper on the motor plug harness is absent for 208-230V units and 277V units. If the jumper is present for these units, the motor electronics will be damaged, and the motor will not be controllable.
Fan speed request too low	Verify that the fan speed request is not below 450 rpm. Speeds below 450 rpm are not supported on the fan coil product.
Inputs not of consistent polarity	<p>Verify that the all binary inputs to the customer terminal blocks are of proper and consistent polarity.</p> <ul style="list-style-type: none"> For CSTI units, the fan inputs and end device inputs on TB3 must receive signals that are 24 Vac with respect to the unit chassis. For Fan Speed Switch (FSS) units, that incorporate the Tracer® CSTI adapter board, all inputs to TB3 must be 24 Vac with respect to unit chassis. <p>Note: Do not short 24 Vac (pos 1 or pos 2) to chassis; refer to the unit schematic.</p>
Failure of motor control board	<p>Verify that variable speed (VSP) inputs are properly wired to 1TB4.</p> <ul style="list-style-type: none"> Do not short the courtesy 10 VDC supply to chassis or loads that require greater than 10 mA of DC current. Observe proper polarity of 0–10 VDC inputs. Failure to observe proper polarity can cause failure of the VelociTach motor control board or the customer-supplied controller.
Output signals being ignored	Verify that the signal on the VSP inputs is noise free. The VelociTach motor control board contains an adjustable noise floor parameter, μF_{Lr} , that can be configured to reject signals below the noise floor. If the customer supplied controller outputs signals that are below the noise threshold, they will be ignored by the ECM engine.
Motor spinning too fast	Verify that VSP input settings are correct. The motor control board contains an adjustable digital amplifier, R_{5C} , to compensate for long 10 VDC cable runs. For normalized (0–10 VDC) signals, this setting should be set to 1.000. If it is set too high, the motors will run faster than the requested ratio, and will hit the limit R_{h7} before the input voltage has reached its upper limit.
Motor not controllable	Verify that \tilde{r}_{IL0} and \tilde{r}_{2L0} , the low motor signal output limits, are set correctly.

Replacing ECM Components

⚠ 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.

Replacement Guidelines

- ECM motors contain capacitors which store residual energy. Please keep clear of the fan wheels for five minutes after the power has been removed from the system, as a power request with the motor powered off, could result in a very short period of actuation.

Unplugging the motor is adequate to ensure that there will be no power request.

- Configuration adjustments to the VelociTach motor in accordance with the parameters that are printed on the label adjacent to the VelociTach board. These parameters reflect the factory settings for the unit. Subsequent changes to parameters made during commissioning will not be reflected in the printed parameters.
- Initial hookups to the CSTI and standard adapter board, including low voltage interconnections, must be made with the power off.
- Do not make connections to the motors or the adapter boards while power is ON. Do not remove connections to the motor or the adapter boards while the power is ON.
- Caution should be taken to stay clear of hazardous voltages, moving parts and electric heat elements while making adjustments to the VelociTach motor control board. If it is not practical to stay clear of these areas during adjustment, please contact Trane Global Parts for configuration kit that allows easy powering of the engine board outside of the unit with a 9V battery.

- For safe operation, it is necessary to configure replacement boards to match the setup/switch configuration of the previously installed boards.
 - Ensure that new circuit modules are firmly seated on the nylon standoffs, and that the nylon standoffs are firmly seated on the metal panel
 - Ensure that drip-loops are maintained on wiring on pipe end of unit to avoid wicking of water into the unit.
 - Before assuming that any of the boards or components in the new system have failed, please ensure that the VelociTach motor control board has been configured correctly and that the switches on the CSTI board (where applicable) are set correctly.
 - It is necessary to configure the service replacement VelociTach motor control board before commissioning the unit. The board is pre-configured with safe values, but will NOT work correctly unless properly configured. The factory shipped parameter settings are on the label adjacent to the VelociTach.
 - Only genuine Trane replacement components with identical Trane part numbers should be used.
 - Unit fan assemblies contain concealed wires that should be removed before the fan-board is removed, to avoid nicking the wire.
 - Care should be maintained to retain the order of the motors with respect to the motor plugs. On a unit with two motors, the double-shafted motor will always be to the left side, and will be designated as Motor 2 by the controller.
- ☐ Ensure that blunt-tip screws are used when in the proximity of wire harnesses.

Replacement Checklist

NOTICE

Equipment Damage!

Failure to follow these instructions could result in equipment damage.

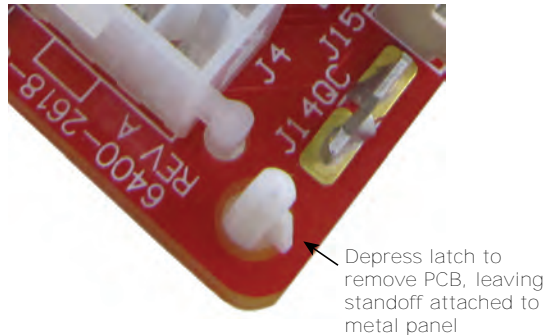
The motor harness attached to the single plug to which the motor mates contains the 115V motor voltage jumper. The motor harness should always be present for 115V units and should not be modified or substituted.

- ☐ Ensure that motor harness is correct (harness will have jumper installed for 115V units only).
- ☐ Ensure that configuration on the VelociTach motor control board matches the affixed label.
- ☐ Maintain correct plug/motor association. The plugs will have the motor number and shaft configuration printed on an affixed label.
- ☐ Ensure that configuration of switches on CSTI adapter board matches depiction of switches on the unit schematic.
- ☐ Ensure that all wires are plugged in securely.
- ☐ Ensure that edge protection on sharp edges, grommets, and wire management devices are maintained when replacing components.

Circuit Module Replacement

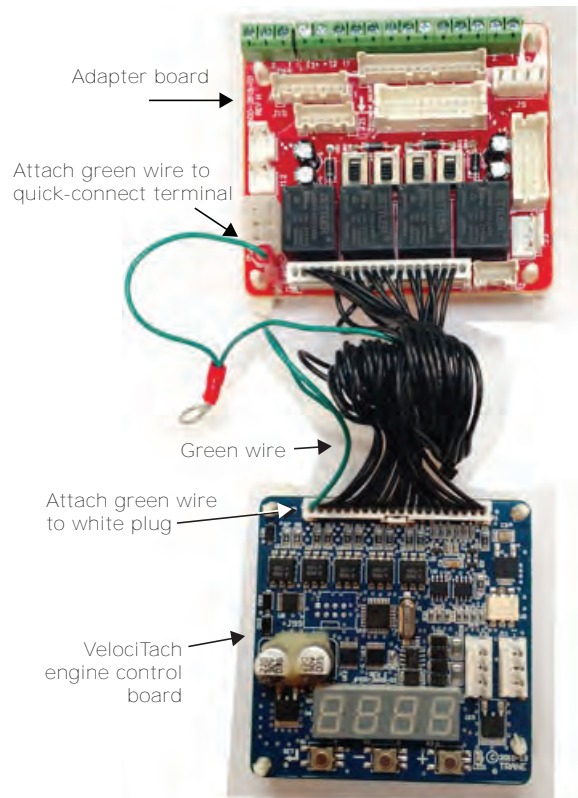
1. Circuit modules are equipped with nylon standoffs which can either be removed by squeezing the barbs at the rear of the control panel, or squeezing the latch above the circuit module. If the latter method is chosen, the standoffs will be retained on the metal panel. The new standoffs (affixed to the replacement modules) can be removed if necessary, so the new module circuit board can be attached to the retained standoffs.

Figure 109. Remove PCB



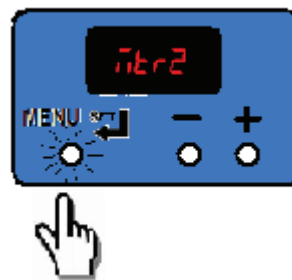
2. If replacing the VelociTach motor control board, special care should be taken to avoid electro-static discharge damage. Please use an ESD protection wrist-strap and frequently touch a grounded surface (with unit power off) to discharge any static buildup.
3. Replace connectors carefully onto the appropriate board. For units with a green wire attached to the CSTI or standard adapter boards, please **ensure that the green wire is attached to the engine board white connector** as shown in the following figure.

Figure 110. CSTI wiring



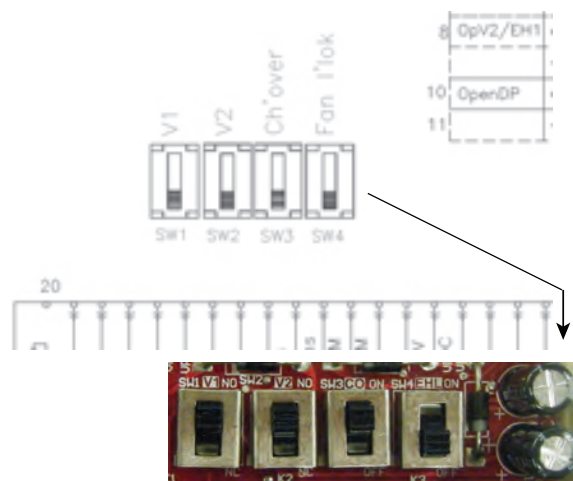
4. Ensure that the new VelociTach motor board controller is configured to match the configuration label that is present on the unit. It is necessary to configure the VelociTach board to avoid improper operation of the unit, discomfort to the end user, and loud fan operation.

Figure 111. Configure VelociTach board



5. Ensure that the CSTI adapter board switches are set correctly, as indicated in the unit schematic (where applicable) shown in the following figure.

Figure 112. Ensure CSTI adapter board switches are set correctly



6. After replacing modules, commission the unit by performing at a minimum, “Fan Speed Response Verification,” p. 104.

Application Notes

The ECM motor has some notable differences to traditional designs.

RPM Mode

The motors are programmed from the factory to run in rpm mode and will not change rpm based on external static pressure, except at the performance limits of the motor/controller. The units are shipped with the rpm set to the selected value for High. The speeds can be changed for high, medium, and low operation, but should not be changed for the electric heat actuation speeds.

Generally, the fans deliver less cfm for the same rpm, if the static is increased and the power will decrease. The fan will deliver more cfm for the same rpm, if the static is decreased and the fan power will increase. A unit with high static configuration should not be used to free-deliver air (i.e., with no ducting attached).

Field Power Wiring

This motor uses an electronic variable speed motor control, which includes a line reactor to minimize power line harmonic currents. It is recommended that good wiring practices be followed to manage building electrical power system harmonic voltages and currents to avoid electrical system problems or other equipment interaction.

Performance Boundaries

While the speeds of the fan motors can be adjusted, never program a fan speed outside the operating limits for the given unit size. In many cases, units configured for high-static operation will not achieve the desired rpm if the ESP of the unit is too low, or the unit is allowed to “free-discharge.” The VelociTach motor control board contains settings that will limit the output power of the motor under

these overload conditions. If the motors cannot achieve rpm close to the target for a specific period of time, the unit will disable electric heat and fan-status indicators.

MCA/MOP and Power Draw

ECM motors have variable output but are shipped at specific settings to deliver proper performance and reliability. The power draw indicated in the catalog indicates the power consumed when applied properly (as shipped and with the nominal ESP applied). However, the nameplate of the unit indicates the maximum input draw of the motor, as the motor settings can be changed to draw more power.

Electric Heat Relays

For quiet operation, the units employ power relays instead of definite purpose contactors for electric heat actuation. The coils of multiple relays are hooked in parallel to simulate a multi-pole contactor, as shown in the following figure. Two sets of three relays are used to perform the function of a two 3 pole contactors.

Troubleshooting Other Unit Functions

In some cases, the normal or abnormal operation of the ECM may interact with other components in the system. Generally, verification of the engine and adapter boards' wiring and configuration should be checked if there are unexplained abnormalities in other areas of the unit:

- Valve operation
- Electric heat operation
- Changeover sensor operation
- Damper operation
- Condensate overflow switch

A high degree of protection is provided on electric heat units. If electric heat fails to actuate, it may be because of one of the following events:

- Fans are failing to meet target speed. If a second motor is not present, all settings for speeds for Motor 2 should be set to 0000.
- Hot water may be available in the changeover coil.
- Target speeds for motors may be set too high:
 - The *FPRU* parameter may be set incorrectly.
 - The *RPV* parameter may be set incorrectly.

Wiring Diagrams

Table 64. Wiring diagram matrix

Number	Description
Power	
502629290001	Schematics, Power Schematic, CSTI/Thermostat
502629350001	Schematics, Power Schematic, UC400B Or UC400B W/WCI/SYMBIO 400-B Or SYMBIO 400-B W/WCI
Controls	
502629300001	Schematics, Control Schematic, CSTI, Standard Coil
502629320001	Schematics, Control Schematic, CSTI, DX Coil W/ 1 Stage EH Or W/ Heat Valve
502629330001	Schematics, Control Schematic, CSTI, DX Coil W/ 2 Stage EH
502629340001	Schematics, Control Schematic, Thermostat+NOT (DX W/DAMPER/ W/EH OR DAMPER W/EH W/O DX OR DX W/EH W/O DAMPER)
502629360001	Schematics, Control Schematic, UC400B Or UC400B W/WCI/SYMBIO 400-B Or SYMBIO 400-B W/WCI, Standard Coil
502629370001	Schematics, Control Schematic, UC400B Or UC400B W/WCI/SYMBIO 400-B Or SYMBIO 400-B W/WCI, DX Coil
502631400001	Schematics, Control Schematic, Thermostat+ DX W/DAMPER/ W/EH OR DAMPER W/EH W/O DX OR DX W/EH W/O DAMPER
502635860001	SCHEMATICS; BCXE, CSTI DX WITH A2L COIL W/ HEAT VALVE OR W/EH
502635870001	SCHEMATICS; BCXE, CSTI 2STG DX WITH A2L COIL W/EH
502635880001	SCHEMATICS; BCXE, UC400-B, SYMBIO 400-B DX WITH A2L COIL
Zone Sensors and Dampers	
502629380001	Schematics, Control Schematic, UC400B Or UC400B W/WCI/SYMBIO 400-B Or SYMBIO 400-B W/WCI, Zone Sensors and Dampers

Layout and Control Box Diagrams

Figure 113. Size 12 to 120 BCHE unit with left-hand control box with motor, electric heat, condensate overflow, low-limit switch, discharge air temperature, and angle filter/mixing box actuator

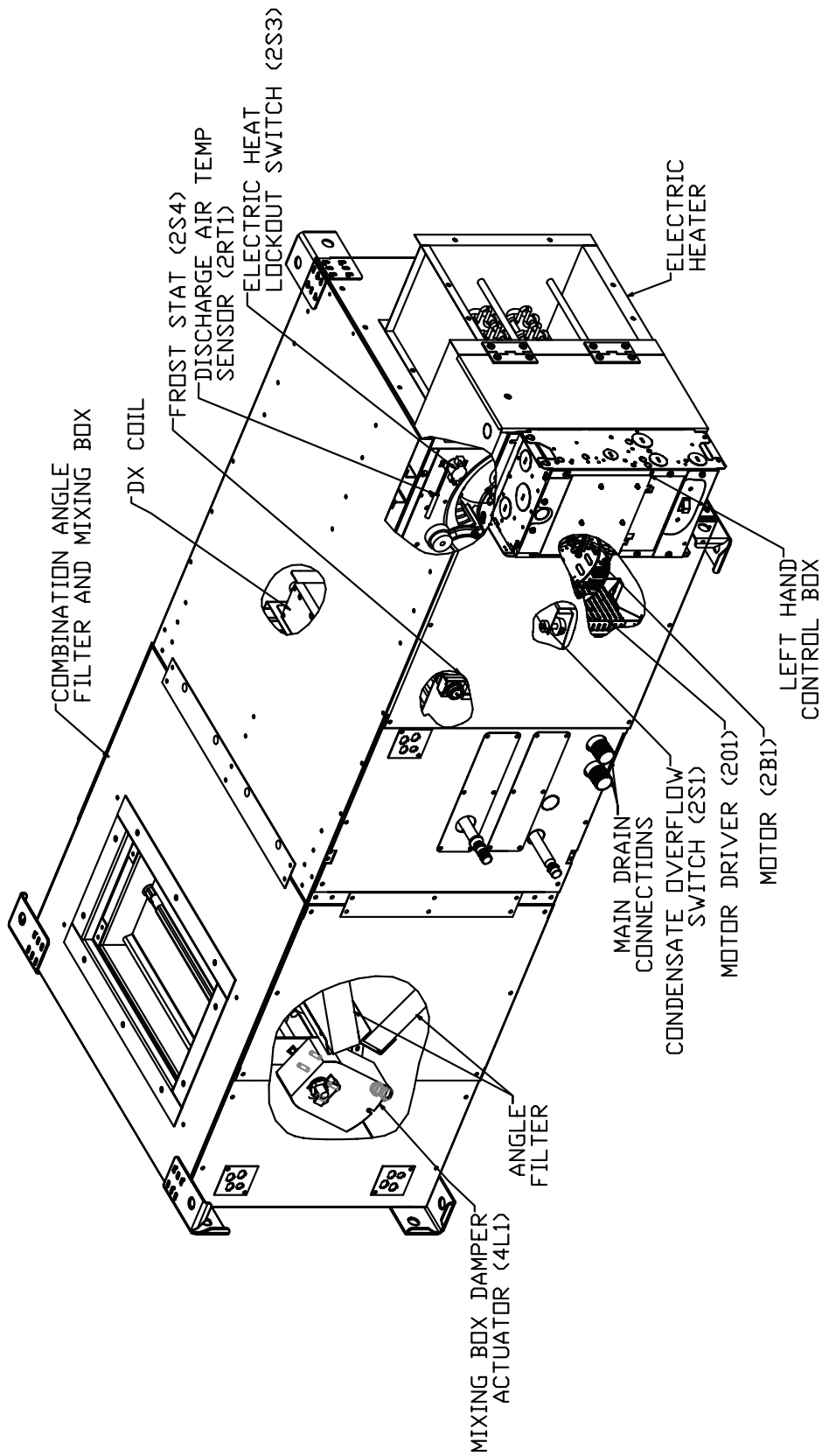


Figure 114. Size 24 to 60 BCVE unit with condensate overflow, low-limit switch, and discharge air temp

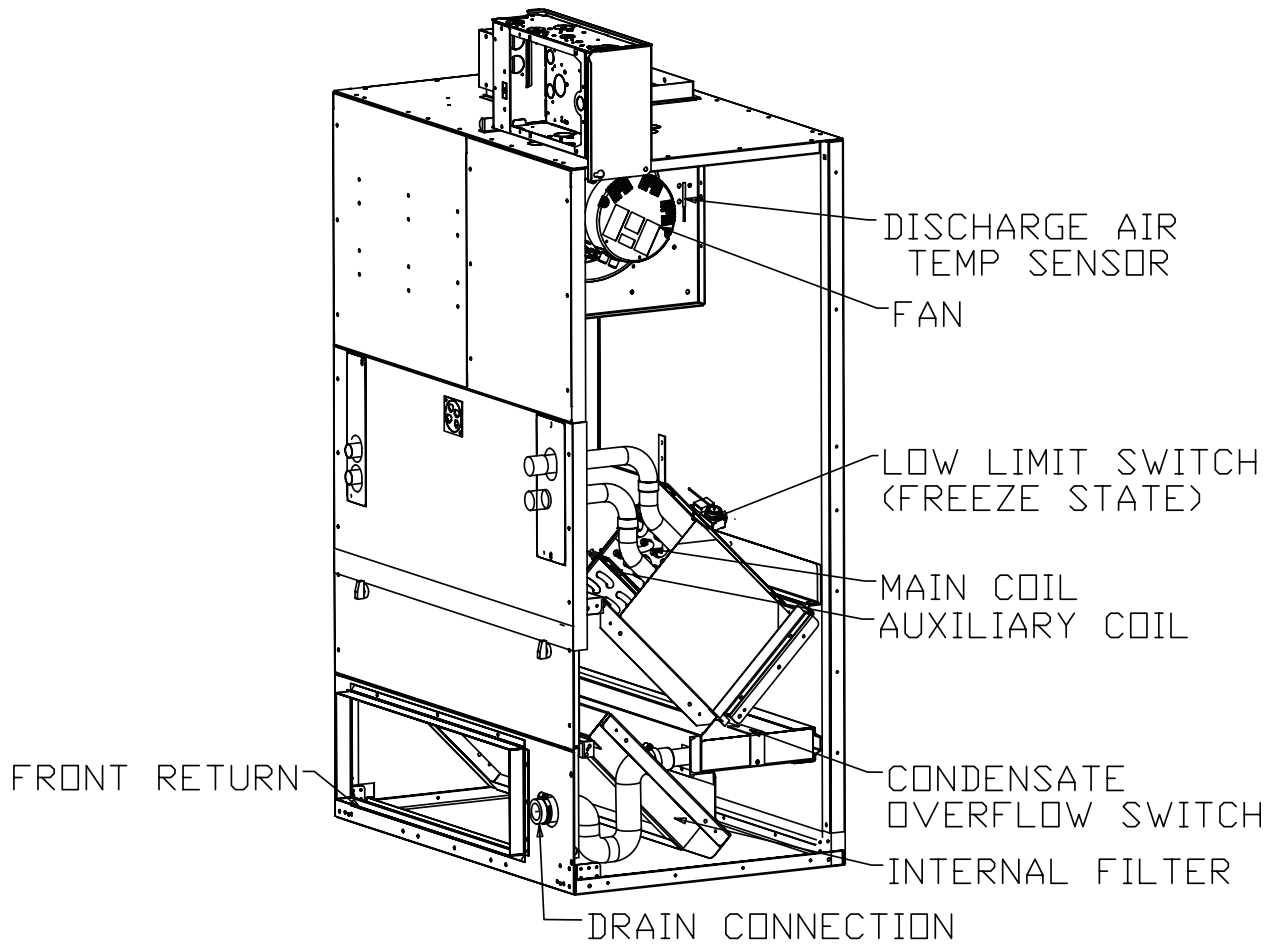
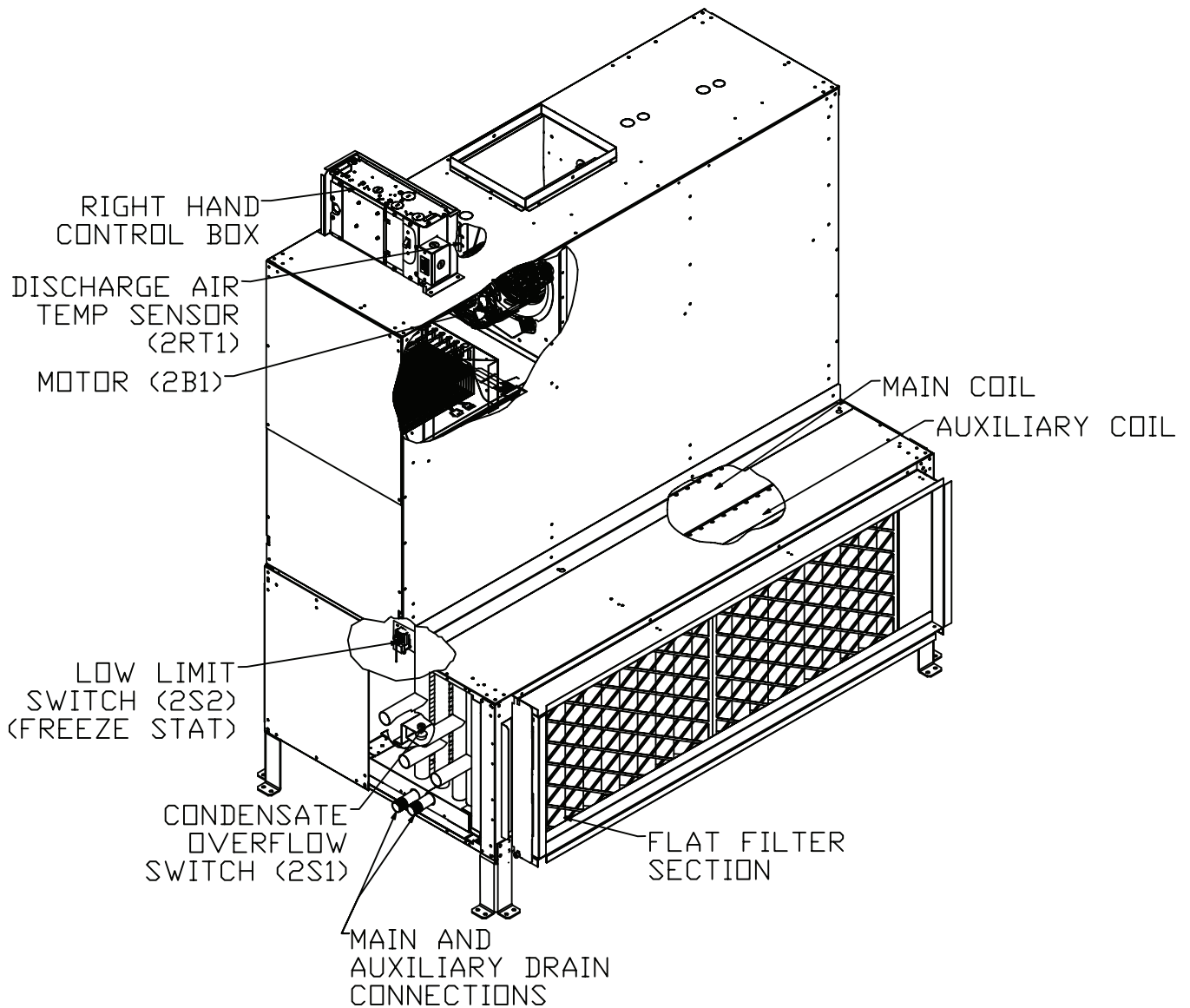


Figure 115. Size 72 to 120 BCVE unit with right-hand control box with motor, condensate overflow, low-limit switch, and discharge air temperature



Layout and Control Box Diagrams

Figure 116. Control box for Symbio 400-B controller

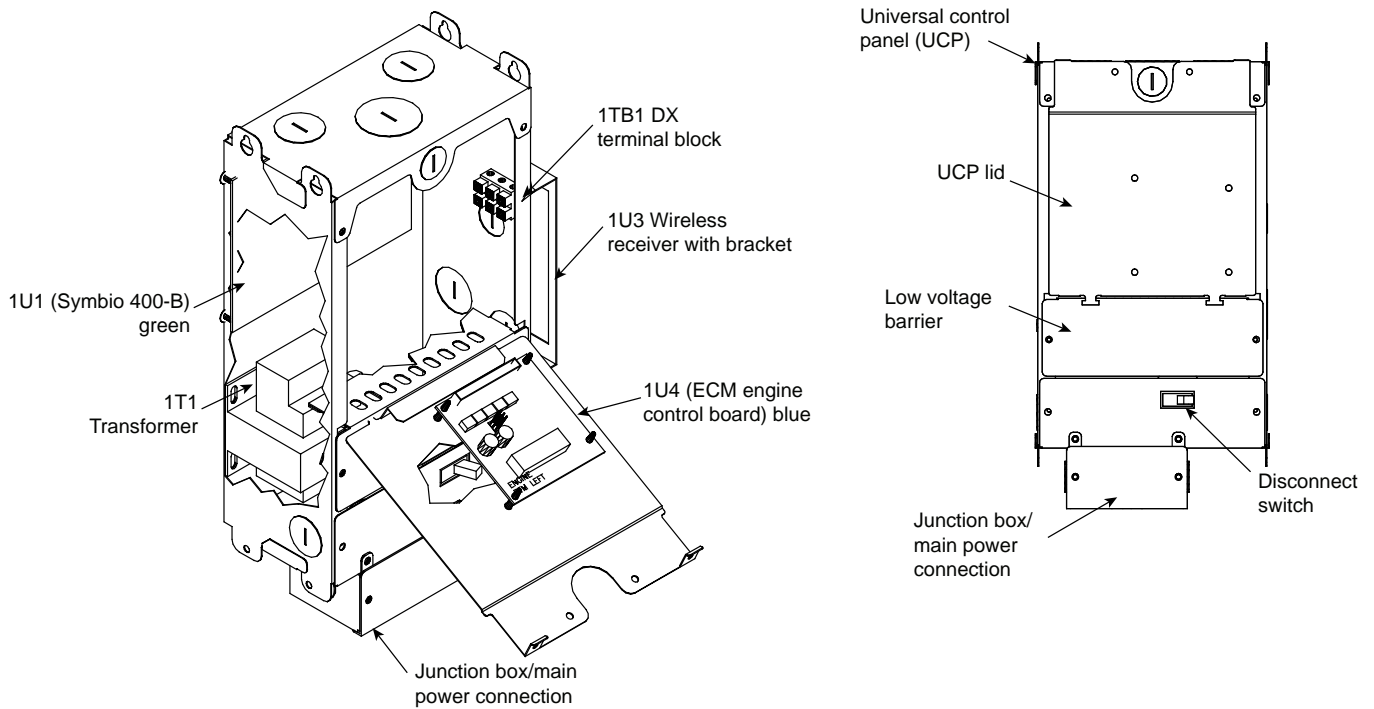
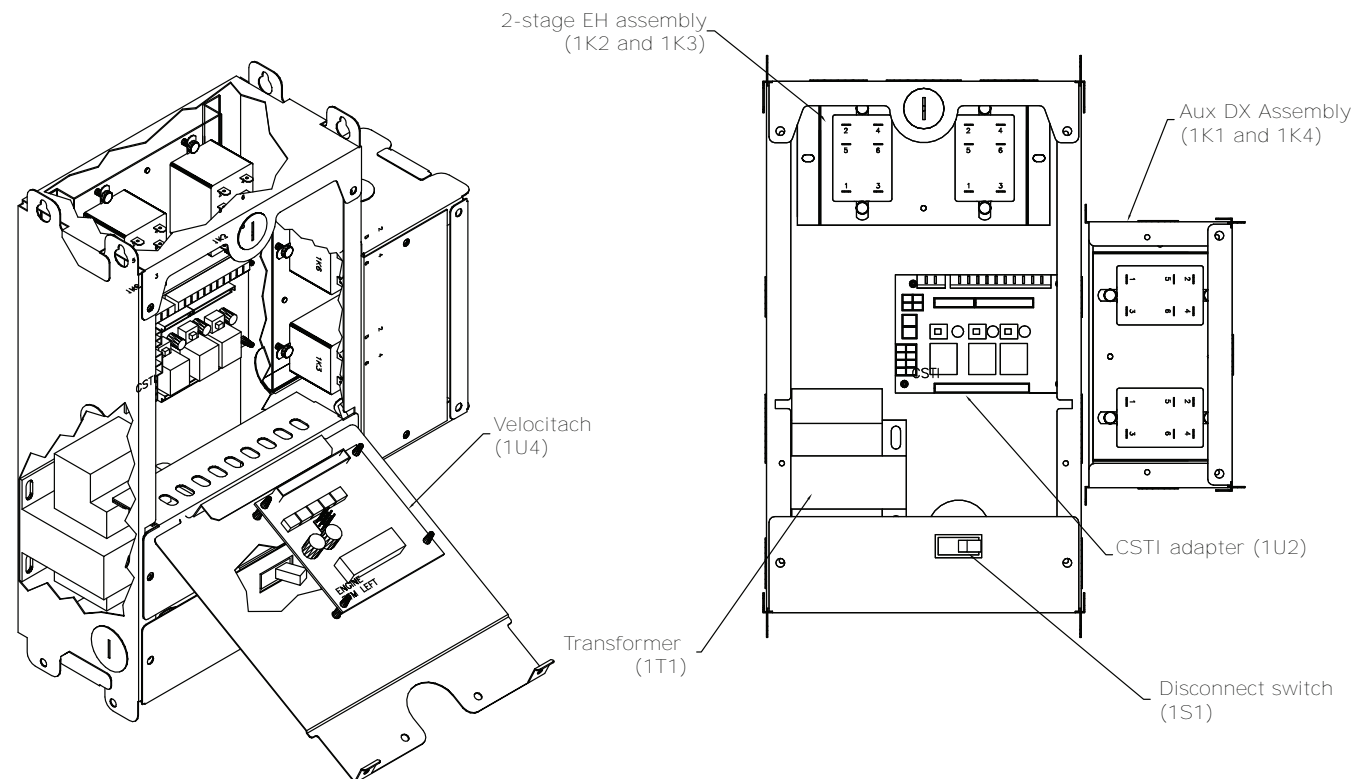


Figure 117. Control box for CSTI with 2-stage EH and DX coil



Note: Aux DX assembly can be mounted either left hand or right hand depending on unit arrangement.

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