Installation Manual: YORK® Sun Select KV27, KH27, KX27, KY27 to KV50, KH50, KX50, KY50

R-454B

BHC Residential & Light Commercial LLC, 5005 York Drive, Norman, OK 73069

6433024-YIM-D-0526

Supersedes: 6433024-YIM-C-0625

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Contents

General

GoTemp Pro App

BHC Residential & Light Commercial LLC believes in empowering our customers with up-to-date, unit-specific information. Download the GoTemp Pro app, a powerful-comprehensive app designed for contractors on the jobsite, available now in the App Store for iOS and Google Play for Android. Use the App to scan the unique QR code on the unit rating plate for easy access to product information and resources such as nomenclature, technical guide, installation manual, wiring diagrams, parts list, product registration, warranty and much more. Simplify your tasks, save time, and stay ahead with the most comprehensive app built for professionals.

GoTemp Pro integrates functionality previously provided by CWa and MAP, allowing you to utilize the on-board communication card or simply plug in the CWCVT to enable Bluetooth connectivity.

Certifications

Trademarks

YORK® is a registered trademark of Johnson Controls International plc and its affiliated companies. Used under license.

Third-Party Trademarks Notice: For information about third-party trademarks, refer to the relevant company websites.

Safety considerations

This is a safety alert symbol. When you see this symbol on labels or in manuals, be alert to the potential for personal injury.

Understand and pay particular attention the signal words DANGER, WARNING or CAUTION.

DANGER indicates an imminently hazardous situation, which, if not avoided, will result in death or serious injury.

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 may result in minor or moderate injury. It is also used to alert against unsafe practices and hazards involving only property damage.

WARNING

Improper installation may create a condition where the operation of the product could cause personal injury or property damage. Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. Refer to this manual for assistance or for additional information, consult a qualified contractor, installer or service agency.

CAUTION

This product must be installed in strict compliance with the installation instructions and any applicable local, state and national codes including, but not limited to building, electrical, and mechanical codes.

WARNING

This unit 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 they do not play with the unit. Cleaning and maintenance shall not be performed by children without supervision.

⚠ WARNING

Before you perform service or maintenance operations on the unit, turn off the main power switch to unit. Electrical shock could cause personal injury. Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. Refer to this manual. For assistance or additional information consult a qualified installer, service agency, or the gas supplier.

⚠ WARNING

ELECTRICAL SHOCK, FIRE, OR EXPLOSION HAZARD

Failure to follow safety warnings exactly could result in dangerous operation, serious injury, death or property damage.

Improper servicing could result in dangerous operation, serious injury, death, or property damage.

*Before servicing, disconnect all electrical power to the furnace.

*When servicing controls, label all wires prior to disconnecting. Reconnect wires correctly.

*Verify proper operation after servicing.

⚠ CAUTION

R454-B is a mildly flammable refrigerant. Unit installation must be in compliance with UL/CSA 60335-2-40 and installation and operations manual available on Solution Navigator, DS Solutions app, and shipped with the unit.

⚠ CAUTION

This system uses R-454B refrigerant which is mildly flammable refrigerant. No other refrigerant may be used in this system. Gage sets, hoses, refrigerant containers, and recovery systems must be designed to handle R-454B. If you are unsure, consult the equipment manufacturer. Failure to use R-454B compatible servicing equipment may result in property damage or injury.

⚠ WARNING

FIRE OR EXPLOSION HAZARD

If the information in this manual is not followed exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.

WHAT TO DO IF YOU SMELL GAS:

- Do not try to light any appliance.
- Do not touch any electrical switch
- Do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

Installation and service must be performed by a qualified installer, service agency or the gas supplier.

Due to system pressure, moving parts, and electrical components, the installation and servicing of air conditioning equipment can be hazardous. Only qualified, trained service personnel must install, repair, or service this equipment. Untrained personnel can perform basic maintenance functions of cleaning coils and filters, and replacing filters.

Observe all the precautions in the literature, labels, and tags that accompany the equipment whenever you work on air conditioning equipment. Be sure to follow all other applicable safety precautions and codes including ANSI Z223.1 or CSA-B149.1- latest edition.

Wear safety glasses and work gloves. Use a quenching cloth and have a fire extinguisher available during brazing operations.

This unit is classified as an **appliance not accessible to the general public**.

Inspecting the unit

When the unit is delivered, inspect it for any damage caused during transit. If damage is evident, note the extent of the damage on the carrier's freight bill. Make a separate request for inspection by the carrier's agent in writing.

CAUTION

This product must be installed in strict compliance with the enclosed installation instructions and any applicable local, state and national codes including, but not limited to, building, electrical, and mechanical codes.

The furnace and its individual shut-off valve must be disconnected from the gas supply piping system during any pressure testing at pressures in excess of 1/2 psig. Pressures greater than 1/2 psig will cause gas valve damage resulting in a hazardous condition. If it is subjected to a pressure greater than 1/2 psig, the gas valve must be replaced.

The furnace must be isolated from the gas supply piping system by closing its individual manual shut-off valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 psig.

Reference

Additional information is available in the following reference forms:

- Technical Guide - 6433028
- Installation Manual - 6433024
- Smart Equipment Control Quick Start Guide - 1136326
- A2L Refrigerant Installation Manual - 6651753

Renewal parts

Contact your local ducted systems parts distribution center for authorized replacement parts.

Approvals

The design is certified by CSA as follows:

- For use as a cooling only unit, cooling unit with supplemental electric heat, or a forced air furnace.
- For outdoor installation only.
- For installation on combustible material and may be installed directly on combustible flooring or, in the U.S., on wood flooring or Class A, Class B or Class C roof covering materials.
- For use with natural gas. The unit can be converted to LP with a kit.

CAUTION

This product must be installed in strict compliance with the enclosed installation instructions and any applicable local, state, and national codes including, but not limited to, building, electrical, and mechanical codes.

WARNING

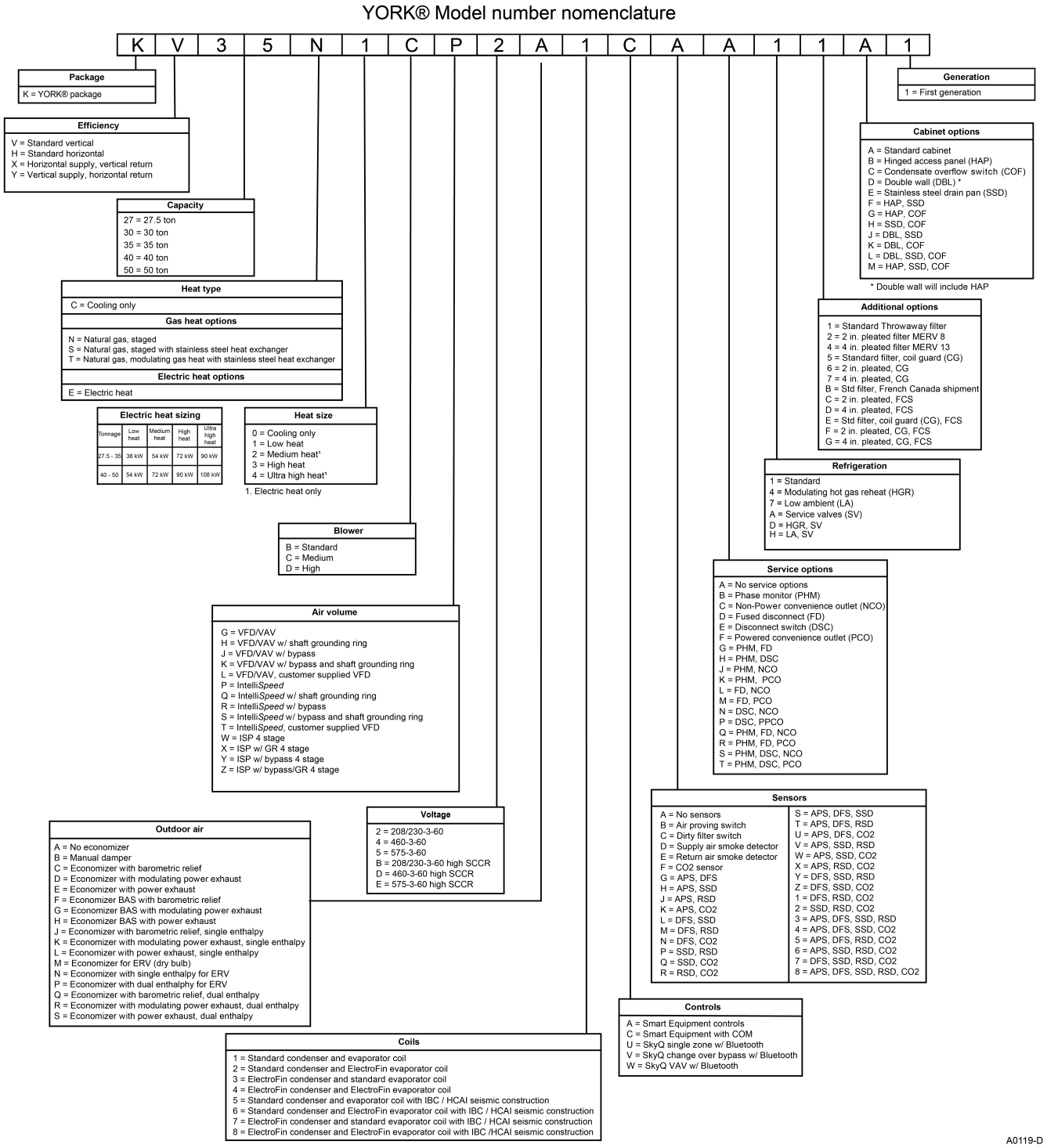
Improper installation may create a condition where the operation of the product could cause personal injury or property damage.

CAUTION

This system uses R-454B refrigerant which operates at lower pressures than R-410A. No other refrigerant may be used in this system.

Nomenclature

Figure 1: Product nomenclature



Installation

Installation safety information

Read the following instructions before you install this appliance. This is an outdoor combination heating and cooling unit. The installer must ensure that these instructions are made available to the consumer. The installer must instruct the consumer to retain the instructions for future reference.

- Refer to the unit rating plate for the approved type of gas for this product.
- Install this unit only in a location and position as specified in the location section.
- Never test for gas leaks with an open flame. Use commercially available soap solution made specifically for the detection of leaks when you check all connections.
- Always install the furnace to operate within the furnace's intended temperature-rise range with the duct system and within the allowable external static pressure range. This information is specified on the unit name/rating plate. Refer to the online instructions for further information.
- Do not use this equipment for the temporary heating of buildings or structures under construction.
- Provide adequate combustion and ventilation air to the furnace space as specified in the clearances section.

⚠ WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow the safety warning exactly could result in serious injury, death, or property damage. Never test for gas leaks with an open flame. Use a commercially available soap solution made specifically for the detection of leaks to check all connections. This may result in a fire or explosion, causing property damage, personal injury, or loss of life.

Limitations

These units must be installed in accordance with national wiring regulations and the following standards.

Requirements in the U.S.A.

- National Electrical Code, ANSI/NFPA No. 70 - latest edition
- National Fuel Gas Code, ANSI Z223.1 - latest edition
- Gas-Fired Central Furnace Standard, ANSI Z21.47a. - latest edition
- Local building codes
- Local gas utility requirements

Requirements in Canada

- Canadian Electrical Code, CSA C22.1
- Installation Codes, CSA - B149.1
- Local plumbing and waste water codes
- Other applicable local codes

Refer to unit application data found in this document and to the A2L Refrigerant Installation Manual.

After the installation is complete, adjust gas fired units to obtain a temperature rise within the range specified on the unit rating plate.

If components are added to a unit to meet local codes, they are installed at the dealer's or customer's expense.

The size of the unit for the proposed installation must be based on a heat loss/heat gain calculation made according to the methods of the Air Conditioning Contractors of America (ACCA).

Do not use this furnace for temporary heating of buildings or structures under construction.

NOTICE

The Smart Equipment control board used in this product can effectively operate the cooling system down to 0°F when this product is applied in a comfort cooling application for people. An economizer is typically included in this type of application. When you apply this product for process cooling applications,such as computer rooms or switchgear, call the applications department for Ducted Systems at 1-877-874-SERV for guidance. Additional accessories may be needed for stable operation at temperatures below 30°F.

Unit components

Figure 2: Component location

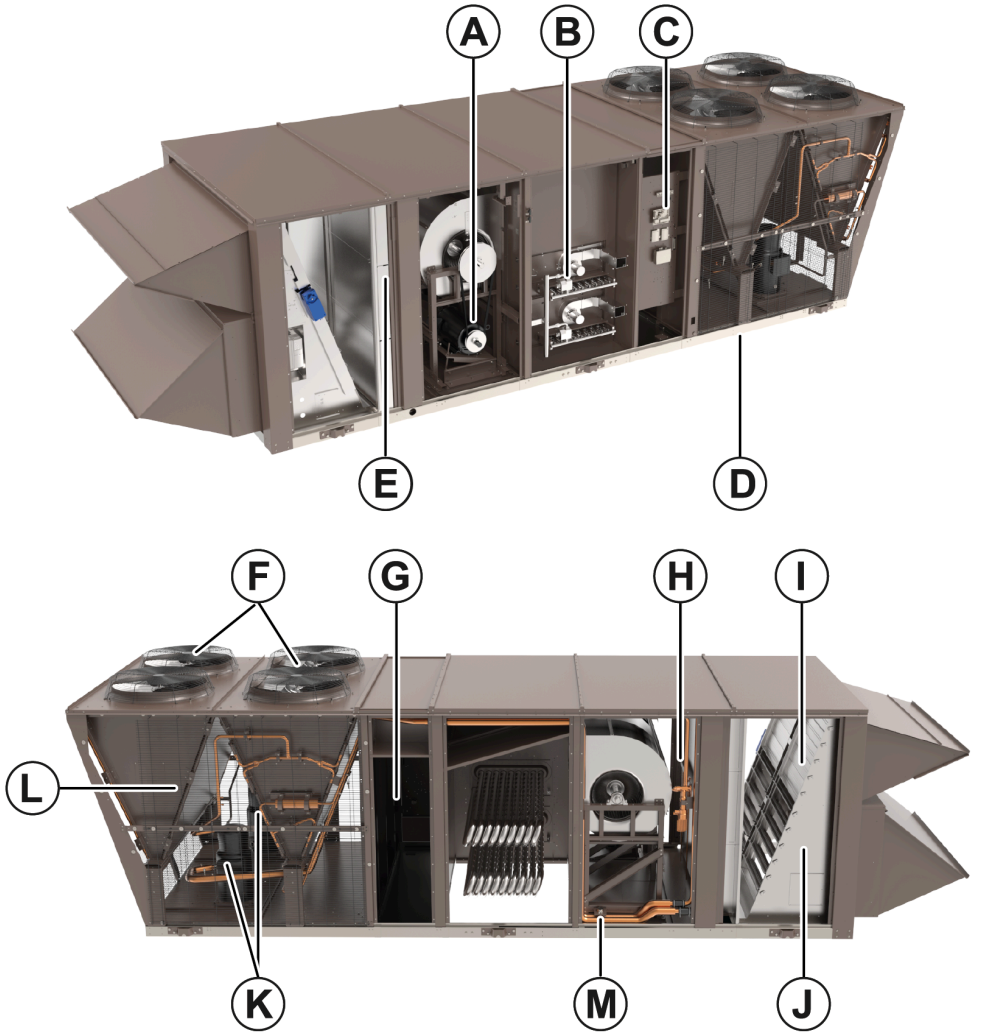


Table 1: Component location table

Item	Description	Item	Description
A	Belt drive blower motor with dual centrifugal fan design	H	Copper tube/aluminum fin evaporator coil
B	Optional staged or modulating gas heat with aluminized or stainless steel heat exchanger. Optional electric heat not shown.*	I	Optional economizer. Optional manual outside air dampers not shown.
C	Smart Equipment controls	J	Optional powered exhaust or barometric relief location (not visible)
D	Full perimeter base rails with attached lifting lugs	K	Scroll compressors in various arrangements to produce two stages or four stages of cooling, depending on the selected model
E	Filter access, 2 in. or 4 in. filter options	L	MicroChannel condenser coils
F	Condenser fans	M	Refrigerant Detection System (RDS) sensor
G	Optional variable frequency drive location (VFD not shown)		
ⓘ	**Note:** *Electric heat is only available for standard horizontal and standard vertical airflow		

Unit limitations

Table 2: Unit limitations

Unit voltage	Applied voltage (V)		Outdoor DB temperature
	Minimum	Maximum	Maximum (°F)
208/230-3-60	180	254	125
460-3-60	416	508	125
575-3-60	520	635	125

Location

Guidelines to select a suitable location for these units:

- The unit is designed for outdoor installation only.
- Only for installation in locations not accessible to the general public.
- Condenser coils must have an unlimited supply of air. Where a choice of location is possible, position the unit on either the north or east side of the building.
- Suitable for mounting on roof curb.
- For ground level installation, use a level concrete slab with a minimum thickness of 4 in. The length and width must be at least 6 in. greater than the unit base rails. Do not tie the slab to the building foundation.
- Roof structures must be able to support the weight of the unit and its options and accessories. The unit must be installed on a solid, level roof curb or appropriate angle iron frame.

Maintain level tolerance to 1/2 in. across the entire width and length of the unit.

WARNING

Excessive exposure of the furnace to contaminated combustion air will result in safety and performance related problems. Typical contaminates include the following items:

- Permanent wave solution
- Chlorinated waxes and cleaners
- Chlorine based swimming pool chemicals
- Water softening chemicals
- Carbon tetrachloride
- Halogen type refrigerants
- Cleaning solvents (for example, perchloroethylene)
- Printing inks
- Paint removers
- Varnishes
- Hydrochloric acid
- Cements and glues
- Anti static fabric softeners for clothes dryers
- Masonry acid washing materials

Clearances

All units require particular clearances for correct operation and service. The installer must make provisions for adequate combustion and ventilation air in accordance with section *5.3 of Air for Combustion and Ventilation of the National Fuel Gas Code, ANSI Z223.1 – latest edition* (in the U.S.A.), or *Sections 7.2, 7.3, or 7.4 of Gas Installation Codes, CSA-B149.1 (in Canada) - latest edition*, and applicable provisions of the local building codes. See the unit clearances table for the clearances required for combustible construction, servicing, and correct unit operation.

Detailed unit clearances are available in the Unit weights and dimensions section.

WARNING

Do not permit overhanging structures or shrubs to obstruct the condenser air discharge outlet, combustion air inlet, or vent outlets.

Rigging and handling the unit

Exercise care when you move the unit. Do not remove any packaging until the unit is near the place of installation.

1. To rig the unit, attach chain or cable slings to the lifting holes provided in the base rails.
2. Use spreader bars across the top of the unit. The spreader bars must have a length that exceeds the largest dimension across the unit.

CAUTION

If a unit is installed on a roof curb other than a Ducted Systems roof curb, you must apply gasketing to all surfaces that come in contact with the unit underside.

CAUTION

Before lifting the unit, make sure that the unit weight is distributed equally on the rigging cables so that it lifts evenly.

⚠ CAUTION

All panels must be secured in place when the unit is lifted. The condenser coils must be protected from rigging cable damage with plywood or other suitable material.

Unit weights and dimensions

Figure 3: KV27/KH27 to KV35/KH35 physical dimensions

TONNAGE	OPERATING WEIGHT LBS [KG] (BASE UNIT)	CENTER OF GRAVITY LOCATION IN [MM] (BASE UNIT)		4 POINT LOAD LOCATION LBS [KG] (BASE UNIT)				6 POINT CORNER LOADS LBS [KG] (BASE UNIT)					
		X	Y	A	B	C	D	A	B	C	D	E	F
27.5	4078 [1849]	100.1 [2543.3]	43.2 [1097.8]	869 [394]	1089 [494]	1179 [535]	940 [426]	558 [253]	755 [342]	817 [370]	604 [274]	645 [293]	698 [317]
30	4105 [1862]	100.6 [2555.0]	43.2 [1098.0]	870 [394]	1102 [500]	1192 [541]	941 [427]	558 [253]	765 [347]	827 [375]	604 [274]	644 [294]	702 [318]
35	4191 [1900]	99.8 [2535.1]	43.2 [1098.2]	891 [404]	1116 [506]	1207 [548]	970 [440]	577 [262]	772 [350]	835 [379]	624 [283]	664 [301]	710 [322]

NOTES:
1. FOR OUTDOOR USE ONLY.
2. WEIGHTS SHOWN ARE FOR COOLING ONLY UNITS.
3. RECOMMENDED MIN. CLEARANCES:
   RIGHT SIDE: 96 [2438]
   LEFT SIDE: 60 [1524]
   FRONT: 96 [2438]
   REAR: 96 [2438]
   TOP: 120 [3048]
   W/ECONOMIZER/POWER EXHAUST: 72 [1829]
4. FOR SMALLER SERVICE AND OPERATIONAL CLEARANCES CONTACT YORK APPLICATION ENGINEERING DEPARTMENT.
5. DOWNFLOW DUCTS DESIGNED TO BE ATTACHED TO ACCESSORY ROOF CURB ONLY. IF UNIT IS MOUNTED SIDE SUPPLY, IT IS RECOMMENDED THAT THE DUCTS ARE SUPPORTED BY ADDITIONAL MEANS AND NOT THE ACCESSORY ROOF CURBS.
6. MINIMUM CONDENSATION TRAP HEIGHT SHALL BE 1.5 TIMES THE LOWEST NEGATIVE STATIC.
7. DIMENSIONS IN [ ] ARE IN MILLIMETERS.
8. OPTIONAL GAS HEAT - DISCONNECT SWITCH SHOWN.
9. HEAT EXCHANGER IS TYPICAL OF HIGH GAS HEAT OPTION.

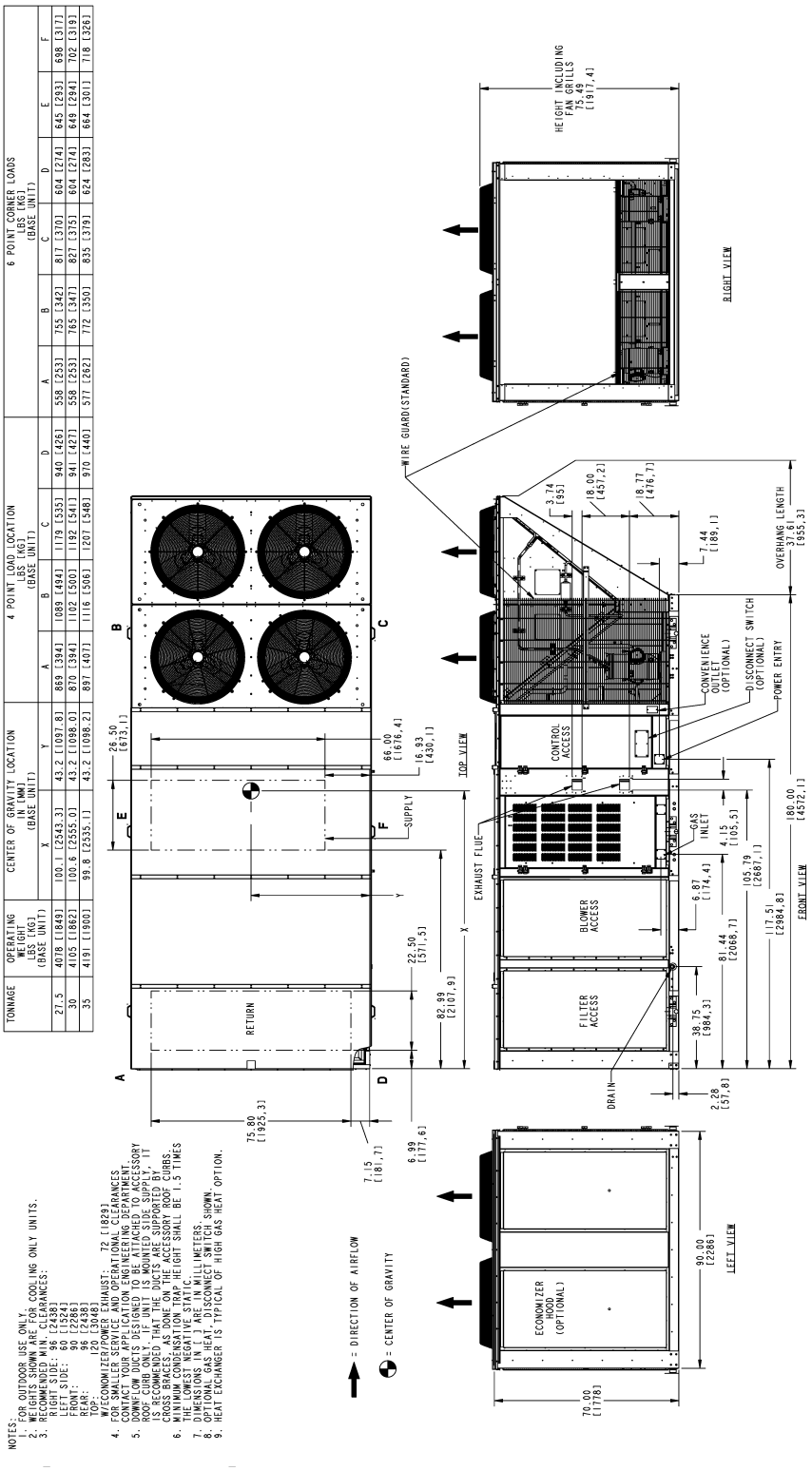


Figure 4: KV27/KH27 to KV35/KH35 physical dimensions continued

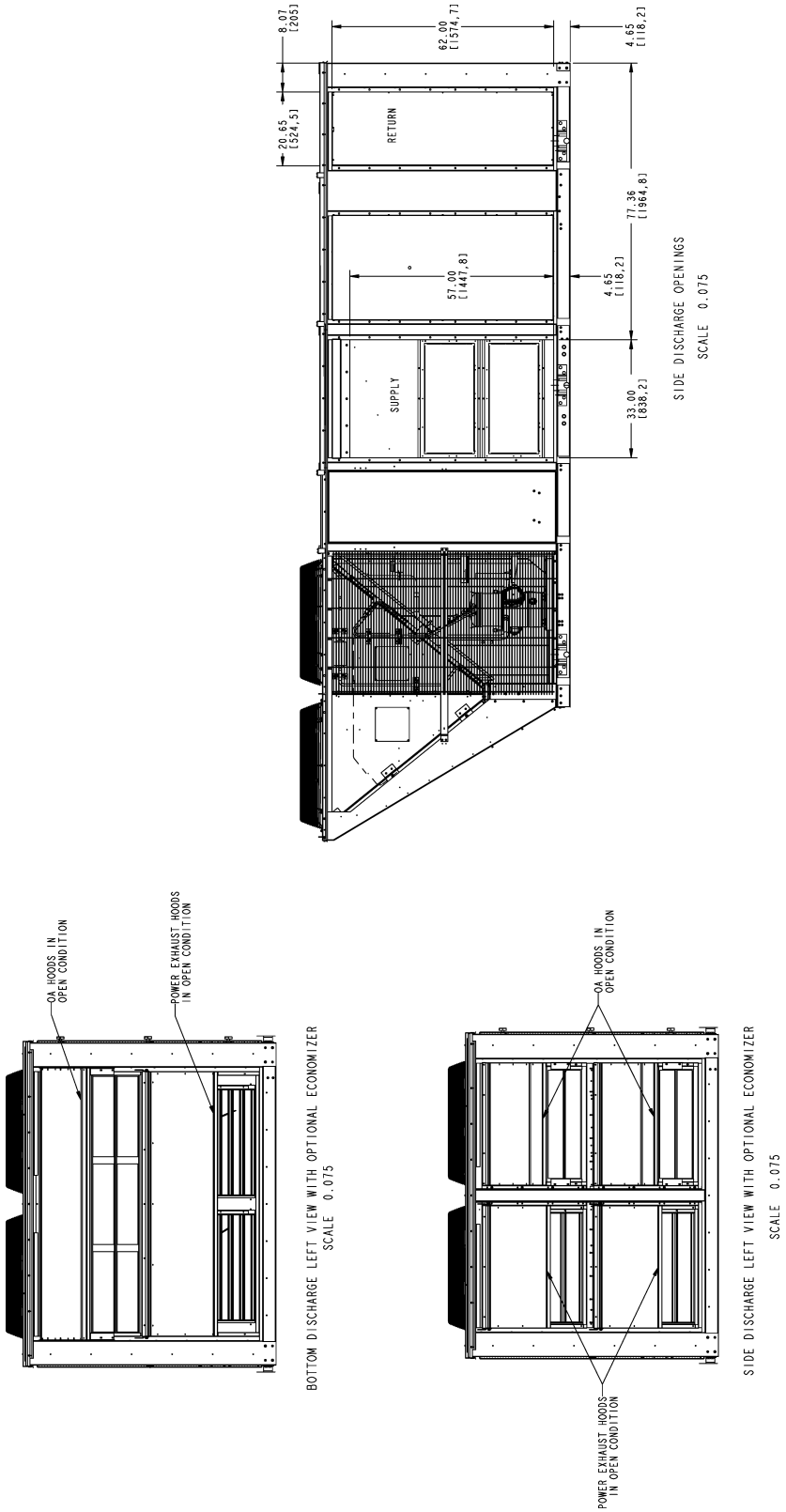


Figure 5: KX27 to KX35 physical dimensions

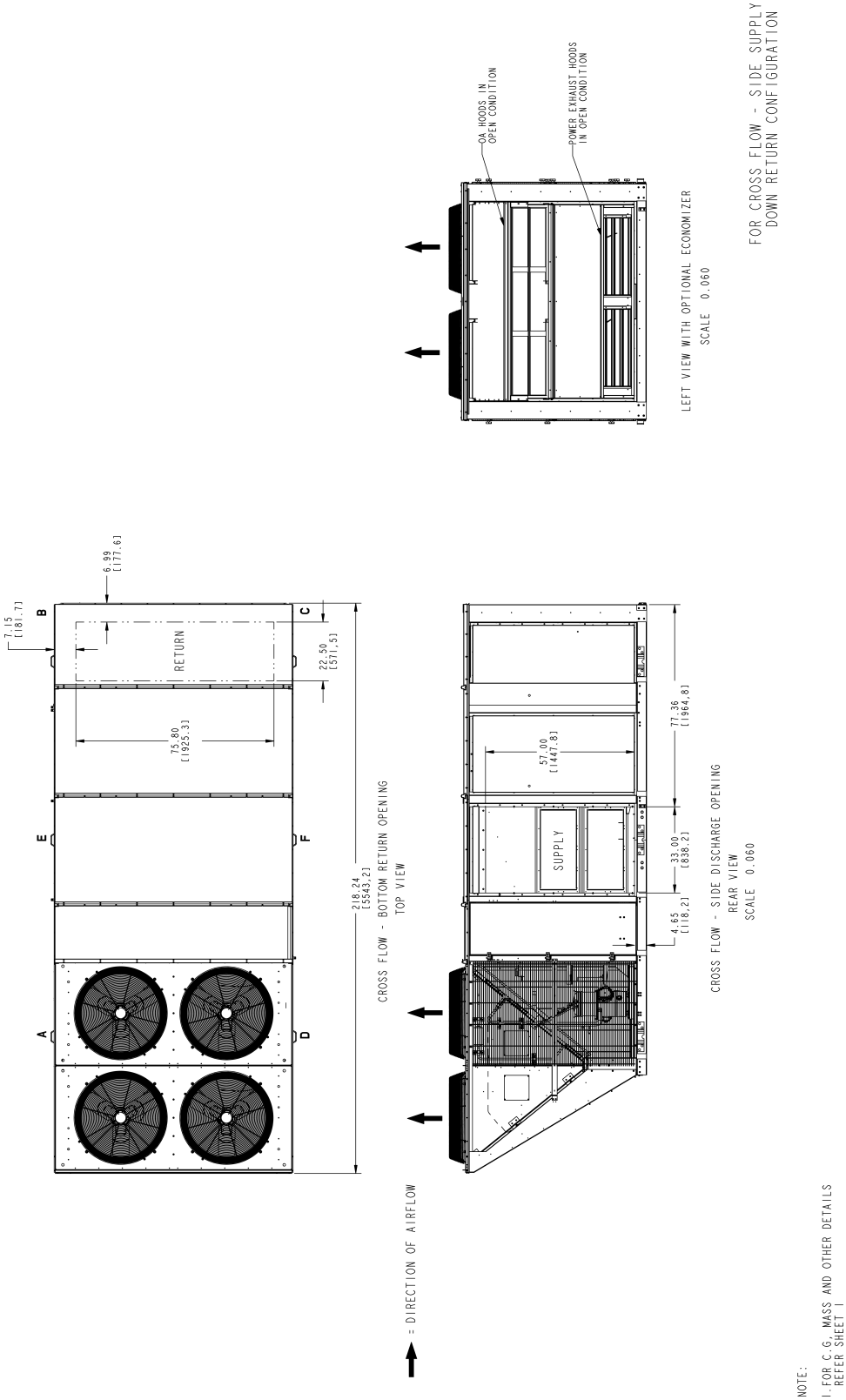


Figure 6: KY27 to KY35 physical dimensions

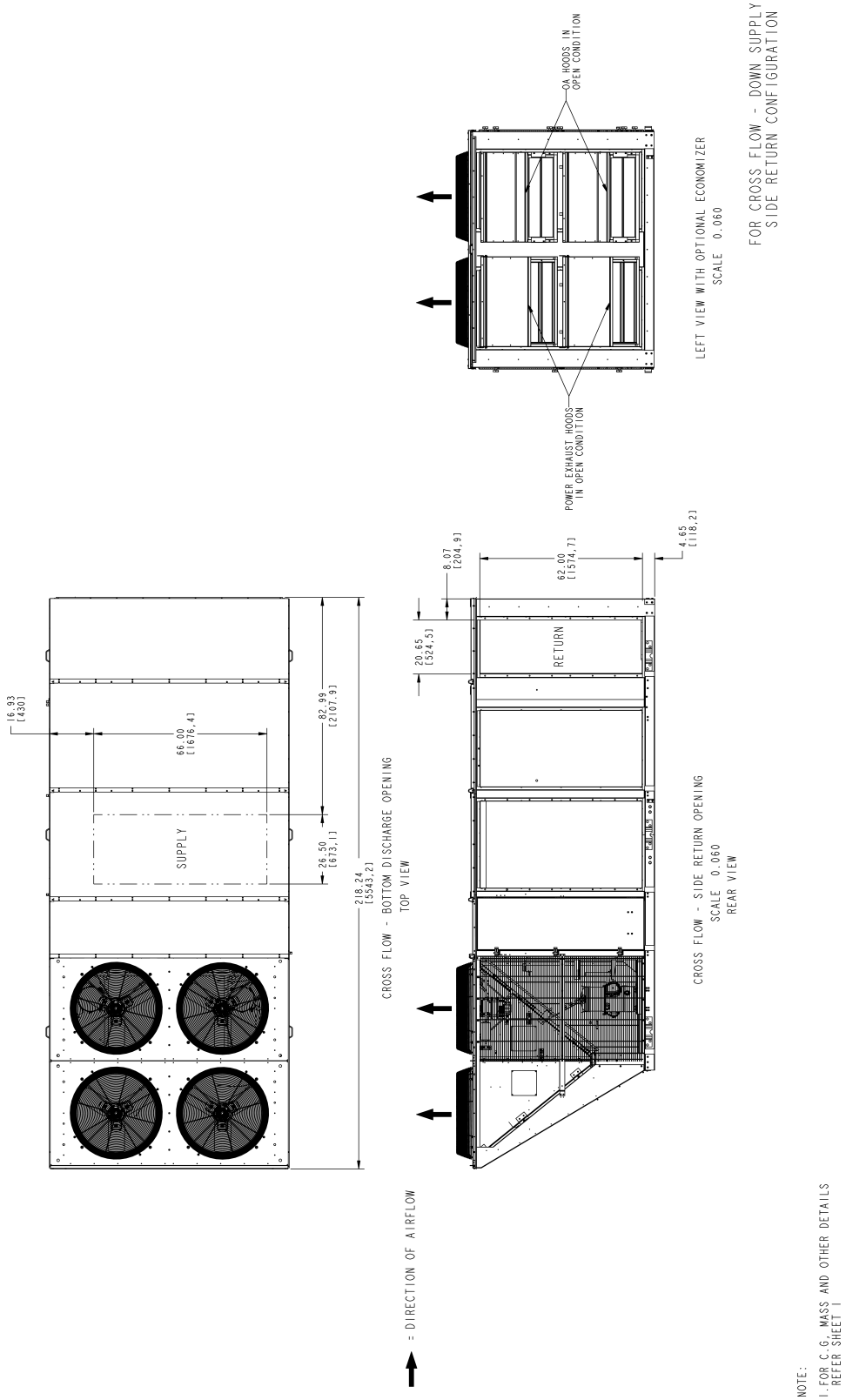


Figure 7: KV40/KH40 to KV50/KH50 physical dimensions

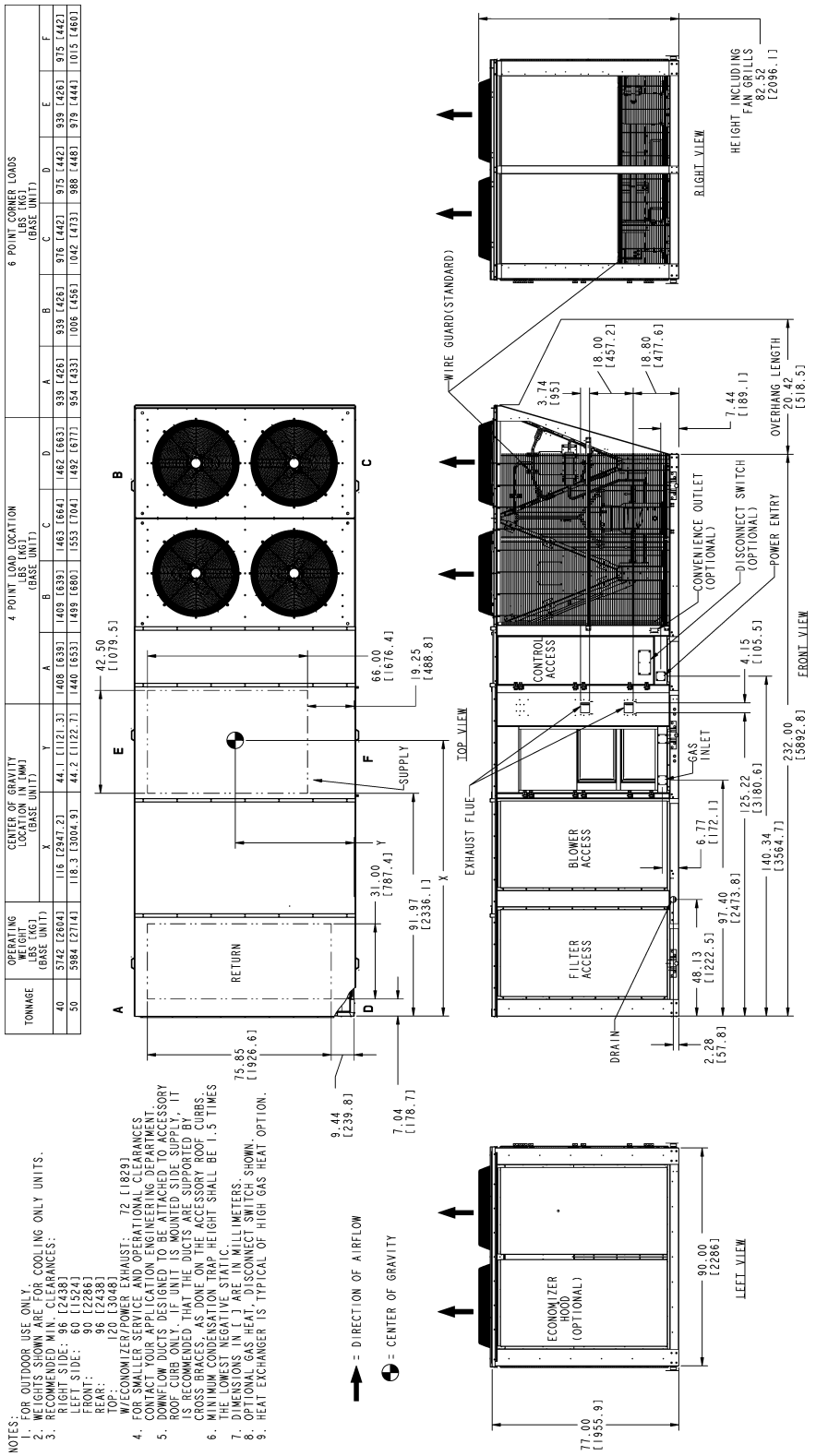


Figure 8: KV40/KH40 to KV50/KH50 physical dimensions continued

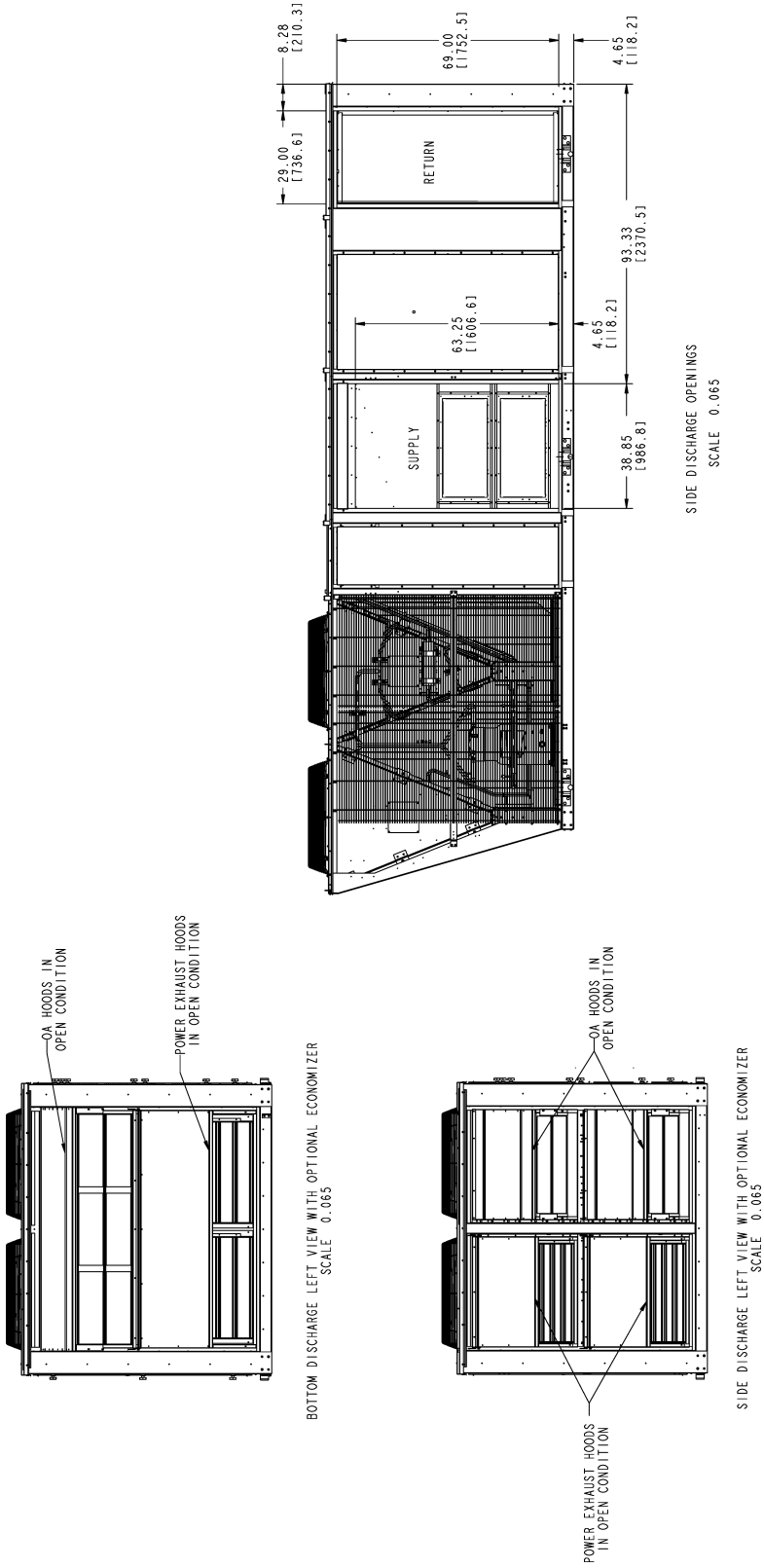


Figure 9: KX40 to KX50 physical dimensions

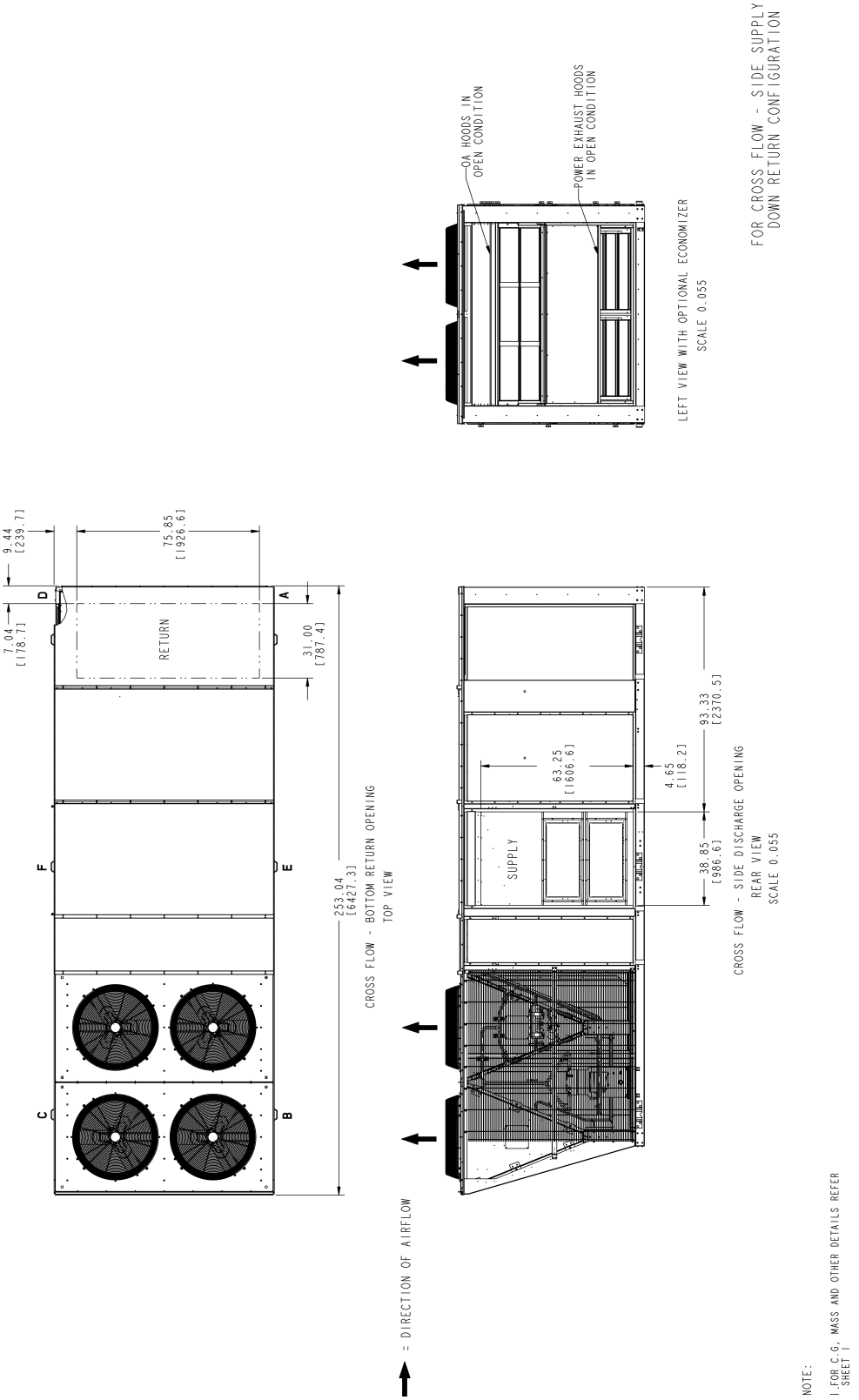
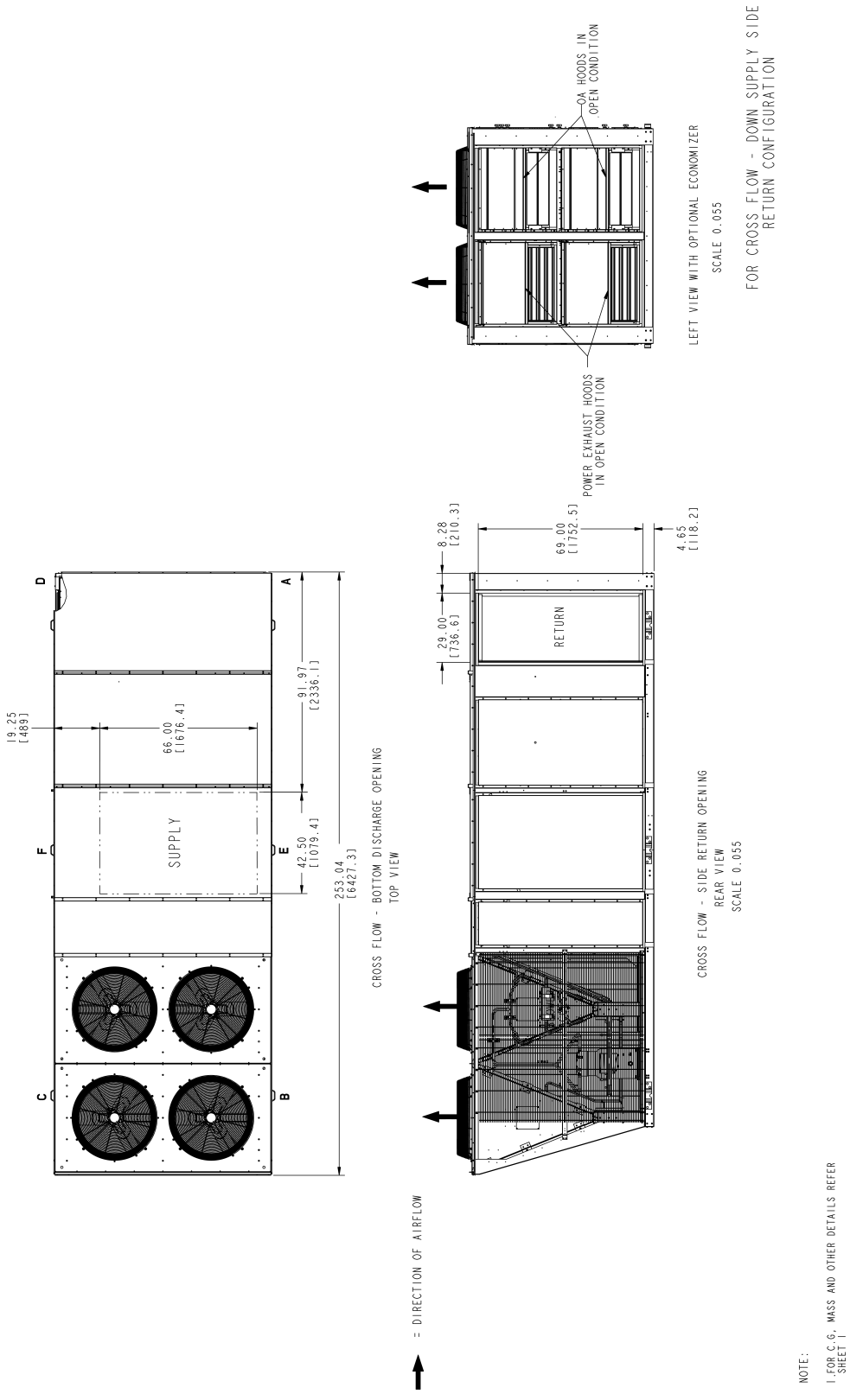


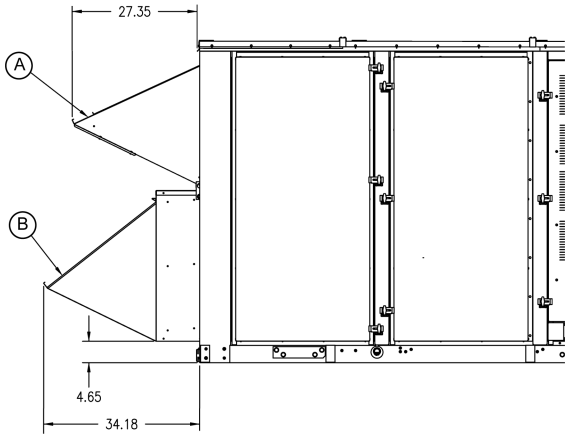
Figure 10: KY40 to KY50 physical dimensions



Rain hood dimensions

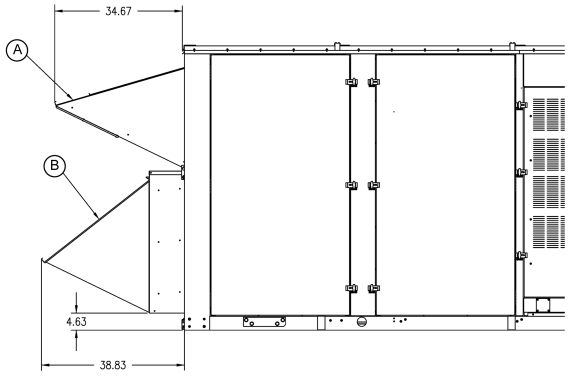
Vertical return rain hood dimensions

Figure 11: 27.5 ton to 35 ton rain hood dimensions



Item	Description
A	Economizer and manual damper rain hood
B	Power exhaust rain hood

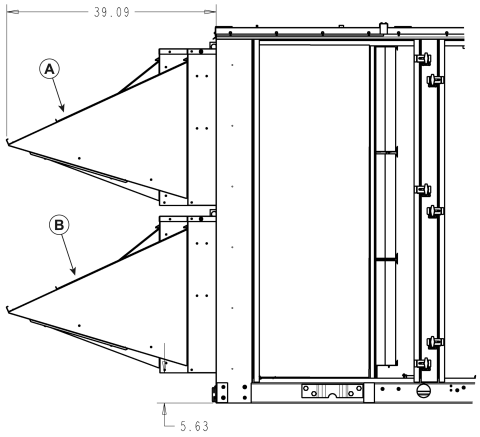
Figure 12: 40 ton to 50 ton rain hood dimensions



Item	Description
A	Economizer and manual damper rain hood
B	Power exhaust rain hood

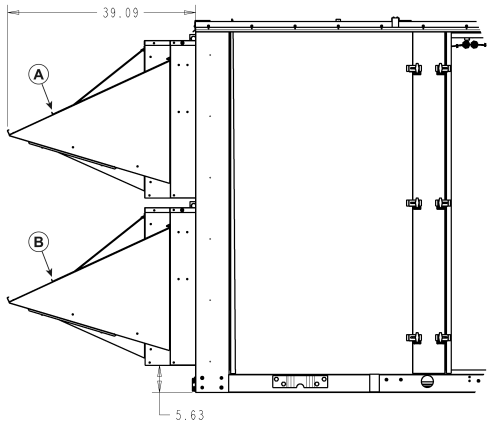
Horizontal return rain hood dimensions

Figure 13: 27.5 ton to 35 ton horizontal return economizer hood



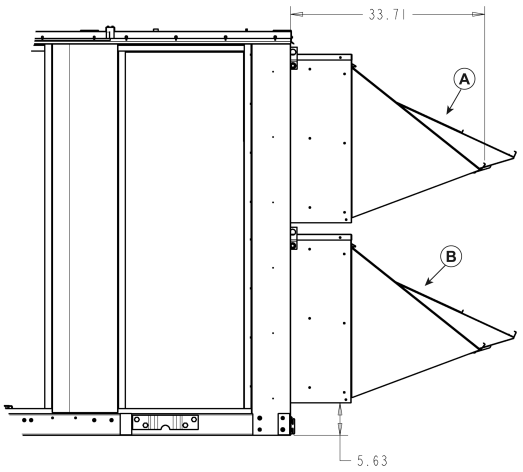
Item	Description
A	Top economizer outdoor air hood
B	Bottom economizer outdoor air hood

Figure 14: 40 ton to 50 ton horizontal return economizer hood



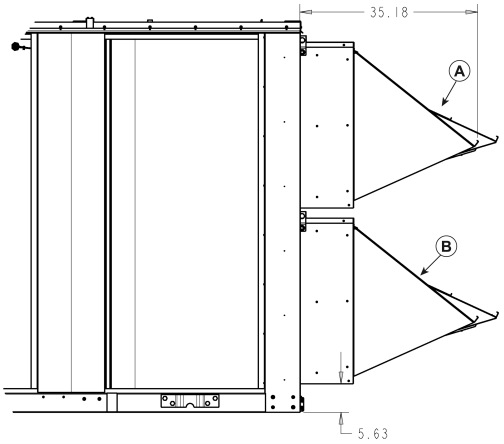
Item	Description
A	Top economizer outdoor air hood
B	Bottom economizer outdoor air hood

Figure 15: 27.5 ton to 35 ton horizontal return exhaust hood



Item	Description
A	Top exhaust hood
B	Bottom exhaust hood

Figure 16: 40 ton to 50 ton horizontal return exhaust hood



Item	Description
A	Top exhaust hood
B	Bottom exhaust hood

Accessory weights

Table 3: Unit accessory weights for vertical supply units

Unit accessory	Unit size				
	27.5 ton	30 ton	35 ton	40 ton	50 ton
Economizer, efficiency = V	307	307	307	359	359
Economizer, efficiency = Y	398	398	398	425	425
Power exhaust, efficiency = V	314	314	314	390	390
Power exhaust, efficiency = Y	211	211	211	225	225
Manual damper	85	85	85	120	120
Barometric damper, efficiency = V	230	230	230	285	285
Barometric damper, efficiency = Y	90	90	90	104	104
Gas heat (largest)	155	155	220	220	220
Hail guard	80	80	80	121	121
Roof curb	475	475	475	520	520
Electric heat (largest)	80	80	80	90	90
Hot gas reheat	56	56	56	75	79

Table 4: Unit accessory weights for horizontal supply units

Unit accessory	Unit size				
	27.5 ton	30 ton	35 ton	40 ton	50 ton
Economizer, efficiency = H	398	398	398	425	425
Economizer, efficiency = X	307	307	307	359	359
Power exhaust, efficiency = H	211	211	211	225	225
Power exhaust, efficiency = X	314	314	314	390	390
Manual damper	85	85	85	120	120
Barometric damper efficiency = H	90	90	90	104	104
Barometric damper, efficiency = X	230	230	230	285	285
Gas heat (largest)	155	155	220	220	220
Hail guard	80	80	80	121	121
Roof curb	475	475	475	520	520
Electric heat (largest)	80	80	80	90	90
Hot gas reheat	56	56	56	75	79

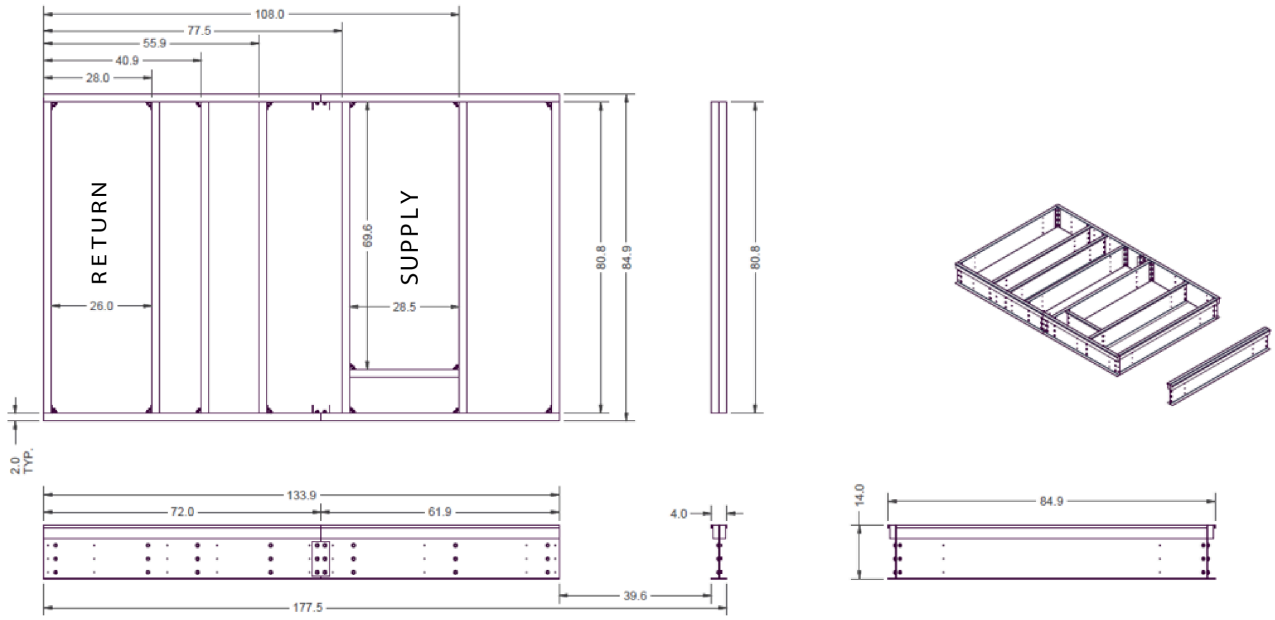
Table 5: Supply fan VFD weights

Supply fan motor	208/230 V	460 V	575 V
7.5 HP	17.4	9.9	14.6
10 HP	17.4	9.9	14.6
15 HP	20.9	17.4	26.5
20 HP	54	17.4	26.5

Roof curbs

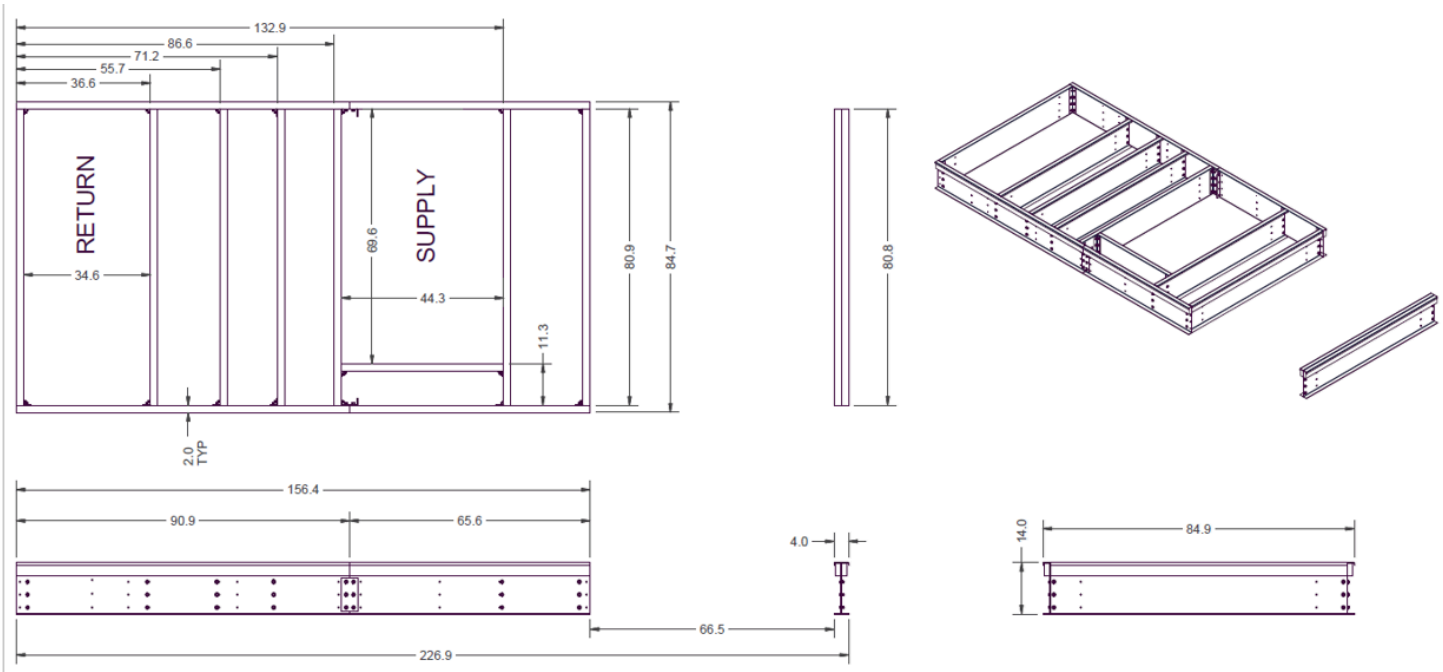
The following figures show the roof curbs for the units. All dimensions are in inches.

Figure 17: 1RC0450 roof curb dimensions



Compatible units with 1RC0450 roof curbs: 27.5 ton, 30 ton, 35 ton.

Figure 18: 1RC0451 roof curb dimensions



Compatible units with 1RC0451 roof curbs: 40 ton, 50 ton.

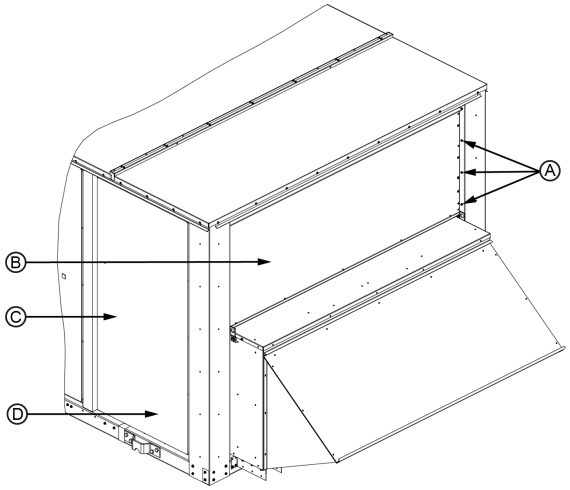
Air hood assembly

Assembling the economizer outdoor air hood for vertical return units

Note: Outdoor air hoods are not installed for ERV options. Open the hood top panel as shown in Figure 19 to remove all the outdoor air hood accessories. Outdoor air hoods and accessories can be scrapped for ERV configurations, or retained for future use. Refer to the *ERV Installation Manual* available on http://www.solutionnavigator.com.

Note: While transporting the unit, the hood top panel is used as a shipping cover attached to the unit exterior as shown in Figure 19.

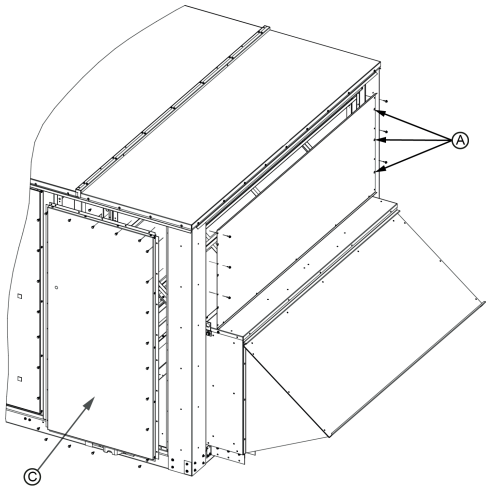
Figure 19: Hood top and side panel



Item	Description
A	Screws
B	Hood top panel
C	Side panel
D	Economizer hood assembly parts shipping location

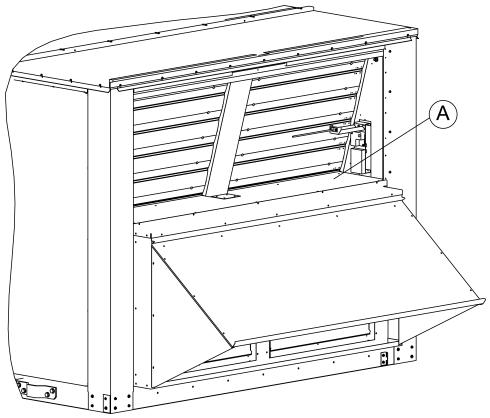
1. Remove the screws, side panel, and the hood top panel as shown in Figure 19 and Figure 20.
2. Remove the outdoor and exhaust hood parts, and attach the side panel to the original position. Keep both the screws and the top panel for use in a later step.

Figure 20: Removing the corner screws and top panel



3. The additional outdoor air hood assembly parts are shipped behind the top panel removed in the previous step. This location is shown in Figure 21.

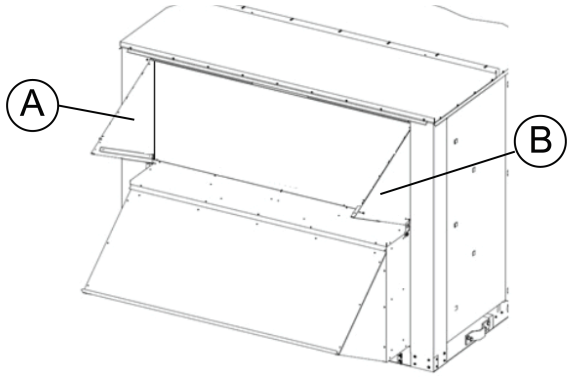
Figure 21: Economizer hood assembly parts location



Item	Description
A	Economizer hood assembly parts shipping location

4. Use the two #10 screws that were removed in Step 2, attach the left side panel and right side panel to the unit as shown in Figure 22.

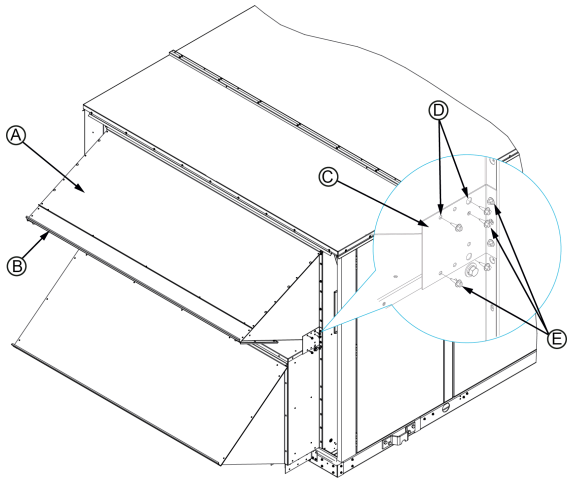
Figure 22: Left side and right side panel mounting



Item	Description
A	Left side panel
B	Right side panel

5. Take the hood top panel that was removed in Step 2, slide the flange under the lip at the top of the hood assembly. Lay the panel on top of the left side and right side panels.
6. Take the small top panel provided with the assembly components and mount it at the end of the hood top panel covering the remainder of the left side and right side panels. Starting with the small top panel, attach the two top panels to the left side and right side panels using the screws provided. See Top hood assembly and seismic bracketFigure 23.

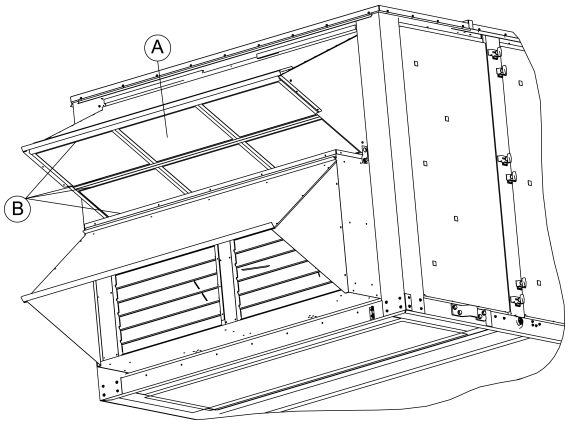
Figure 23: Top hood assembly and seismic bracket



Item	Description
A	Hood top panel
B	Small top panel
C	Stiffener bracket
D	Dimple to locate stiffener brackets
E	1/4 in. screw

7. To assemble the filter tracks and secure the filters, insert the first filter track so that the channel is facing away from the unit.
8. **Optional:** On seismic units, use two dimples and one hole with three 1/4 in. screws to locate each stiffener bracket on the left and right side panel. Attach the bracket with four 1/4 in. screws, using two on the power exhaust and two on the corner post.
9. Place the first three filters in the assembly as shown in Figure 24. Make sure that the filters rest within the first filter track with the outdoor edges on top of the L brackets attached to the inside of the left side and right side panels.

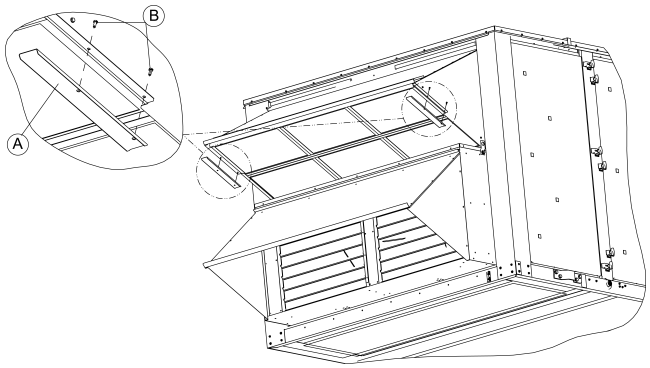
Figure 24: Filter assembly



Item	Description
A	Filters
B	Filter tracks

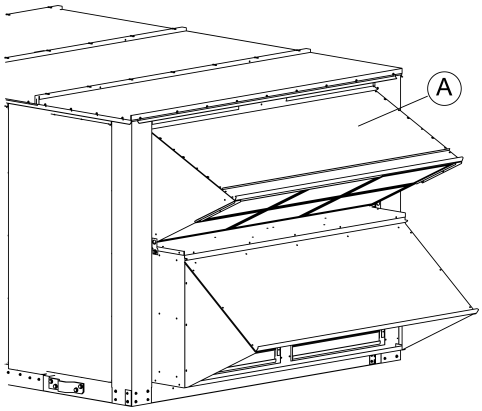
10. Place the next filter track with the channel facing the filters just installed, to secure them in place.
11. Repeat Step 7 through Step 9 with the second set of filter tracks and filters. The final assembly can be seen in Figure 24.
12. Attach the left side and right side filter supports as shown in Figure 25. The completed assembly resembles Figure 26.

Figure 25: Filter support assembly



Item	Description
A	Filter support
B	Screws

Figure 26: Completed economizer outside air hood assembly



Item	Description
A	Economizer outdoor air hood assembly

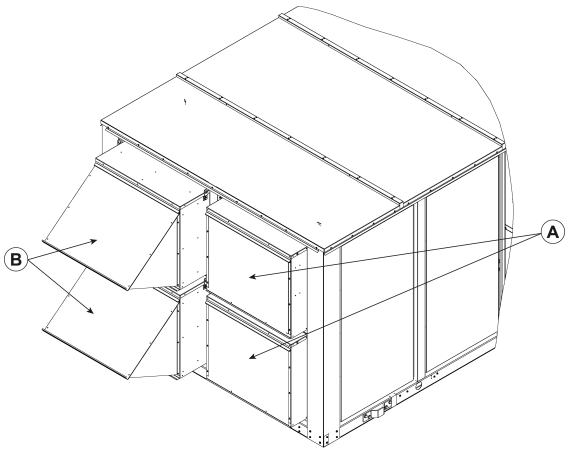
Assembling the economizer outdoor air hood for horizontal return units

After you install a unit with an economizer in the field, you must assemble the economizer outdoor air hoods. The hoods are identical and will both follow the outlined installation process.

To install the outdoor air hoods, complete the following steps for each hood.

1. The hood top panel is used as a shipping cover when the unit is in transit. You can find the hood top panel attached to the unit exterior as shown in Figure 27.

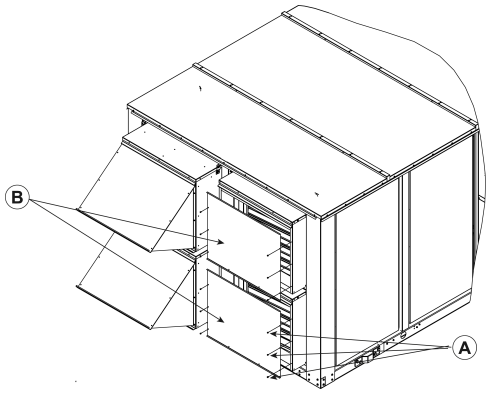
Figure 27: Hood top panel



Item	Description
A	Economizer hood top panel
B	Exhaust hood assembly (separate instructions)

2. Remove the screws and the hood top panel as shown in Figure 27 and Figure 28. Keep both the screws and the top panel for use in a later step.

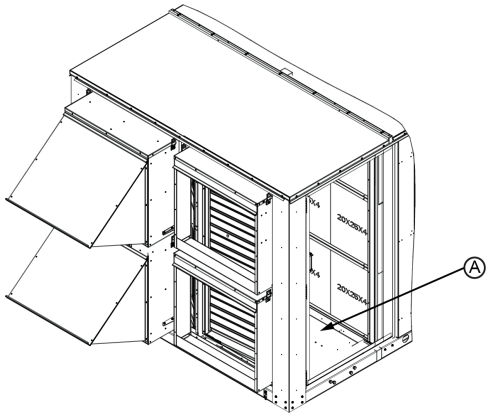
Figure 28: Removing the corner screws and top panel



Item	Description
A	Screws, 6 on each panel
B	Hood top panel

3. You can find the additional outdoor air hood assembly parts behind the side panel, as shown in Figure 29.

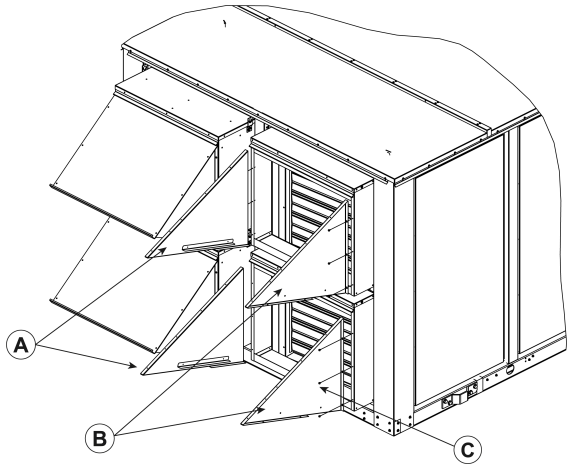
Figure 29: Economizer hood assembly parts location



Item	Description
A	Additional hood assembly parts and screws location

4. Use the #10 screws that you removed in Step 2 and attach the left side panel and right side panel to the unit as shown in Figure 30.

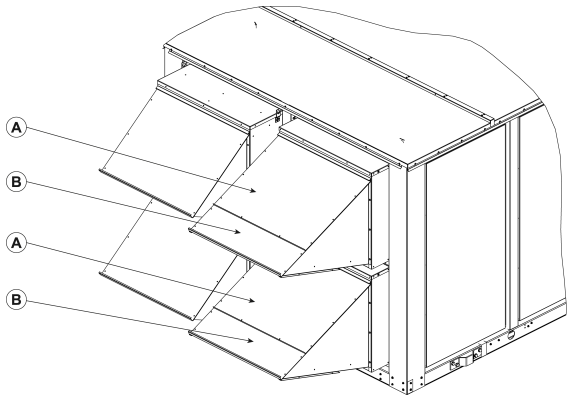
Figure 30: Left side and right side panel mounting



Item	Description
A	Left side panels
B	Right side panels
C	Screws

5. Take the hood top panel that you removed in step 2 and slide the flange under the lip at the top of the hood assembly. Lay the panel on top of the left side and right side panels.
6. Take the small top panel provided with the assembly components and mount it at the end of the hood top panel covering the remainder of the left side and right side panels. Start with the small top panel and attach the two top panels to the left side and right side panels using the screws provided. See Figure 31.

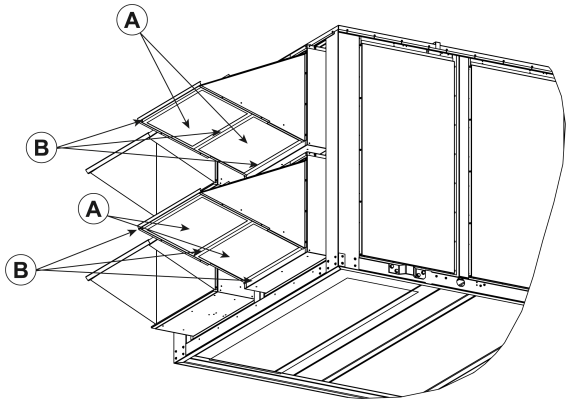
Figure 31: Top hood assembly



Item	Description
A	Hood top panel
B	Small top panel

7. To assemble the filter tracks and secure the filters, insert the first filter track so that the channel is facing away from the unit.
8. Place the first filter in the assembly as shown in Figure 32. Make sure that the filter rests within the first filter track with the outdoor edge on top of the L brackets attached to the inside of the left side and right side panels.

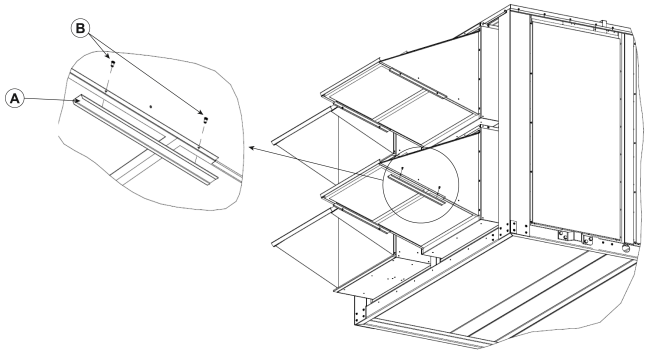
Figure 32: Filter assembly



Item	Description
A	Filter
B	Filter track

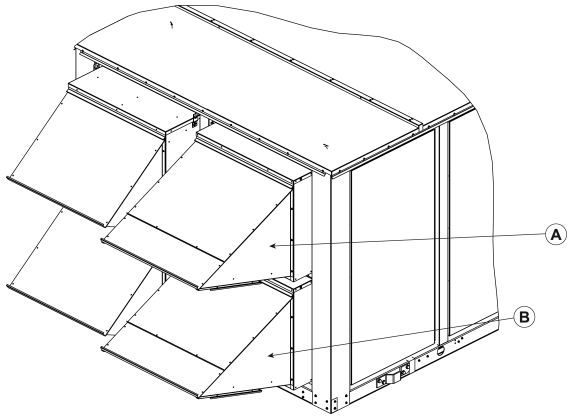
9. Place the next filter track with the channel facing the filter just installed, to secure it in place.
10. Repeat Step 7 through Step 9 with the second set of filter tracks and filters. You can see the final assembly in Figure 32.
11. Attach the left side and right side filter supports as shown in Figure 33. The completed assembly will resemble Figure 34.

Figure 33: Filter support assembly



Item	Description
A	Filter support
B	Screws

Figure 34: Completed economizer outside air hood assembly



Item	Description
A	Top economizer outdoor air hood assembly
B	Bottom economizer outdoor air hood assembly

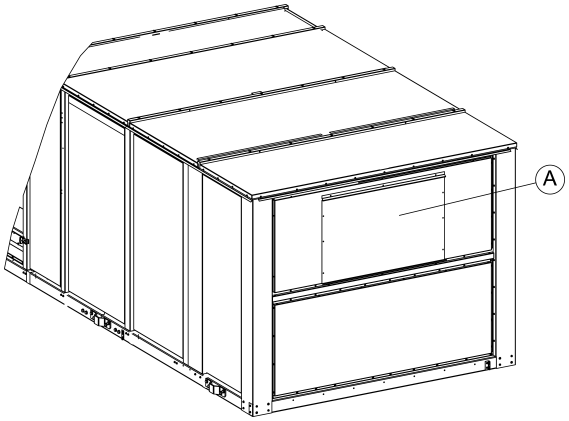
Assembling the manual damper outdoor air hood for vertical return units

After a unit with a manual damper is installed in the field, assemble the manual damper outdoor air hood.

To install the outdoor air hood, complete the following steps.

Note: While transporting the unit, the hood top panel is used as a shipping cover attached to the unit exterior as shown in Figure 35.

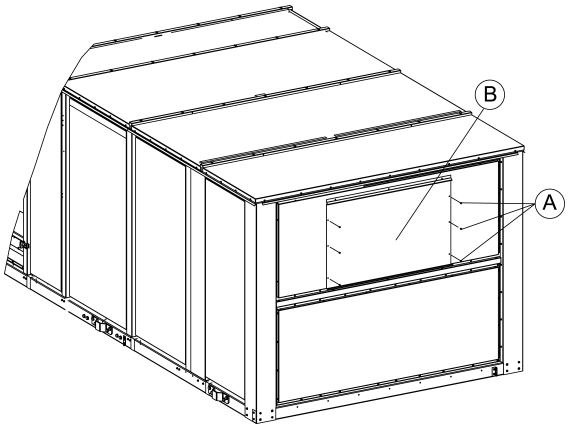
Figure 35: Manual damper hood top panel



Item	Description
A	Hood top panel

1. Remove the screws and the hood top panel as shown in Figure 35 and Figure 36. Keep both the screws and the top panel for use in a later step.

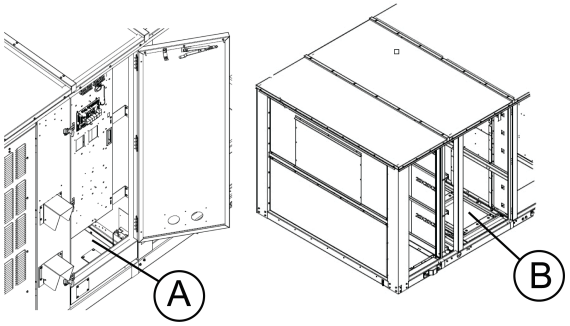
Figure 36: Removing the screw and top panel



Item	Description
A	Screws
B	Hood top panel

2. The additional outdoor air hood assembly parts and filters are shipped inside the unit's return air section. The hardware bag is shipped in the base of the unit control box. These locations are shown in Figure 37.

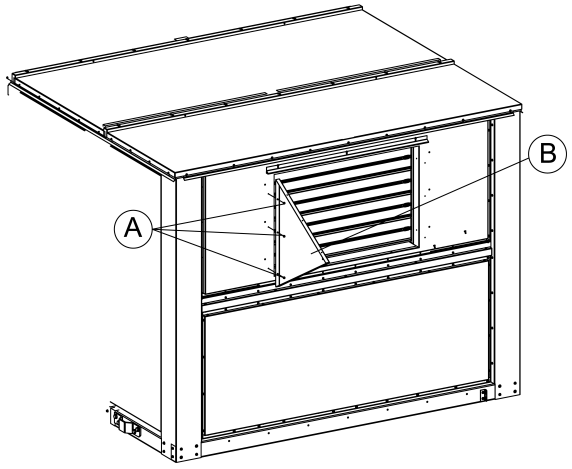
Figure 37: Manual damper hood assembly parts location



Item	Description
A	Hardware bag shipping location
B	Filter and assembly components shipping location

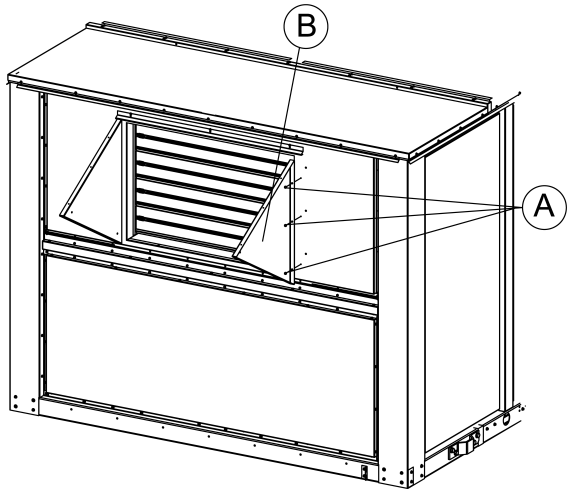
3. Using three of the #10 screws that were removed in Step 2, attach the left side panel and right side panel to the unit as shown in Figure 38 and Figure 39.

Figure 38: Left side panel mounting



Item	Description
A	Screws
B	Left side panel

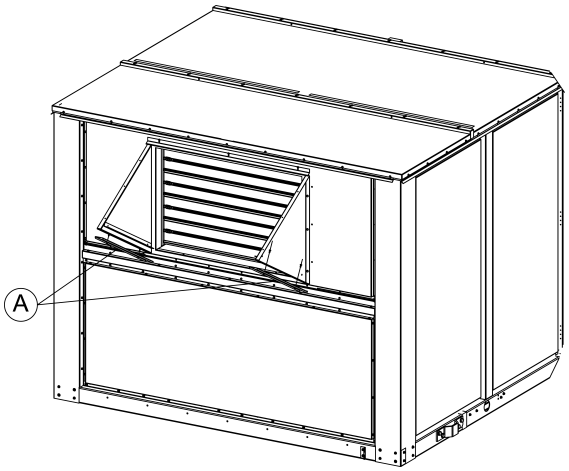
Figure 39: Right side panel mounting



Item	Description
A	Screws
B	Right side panel

4. As shown in Figure 40, attach the left side and right side filter support brackets to the bottom of the side panels using the screws provided in the hardware bag.

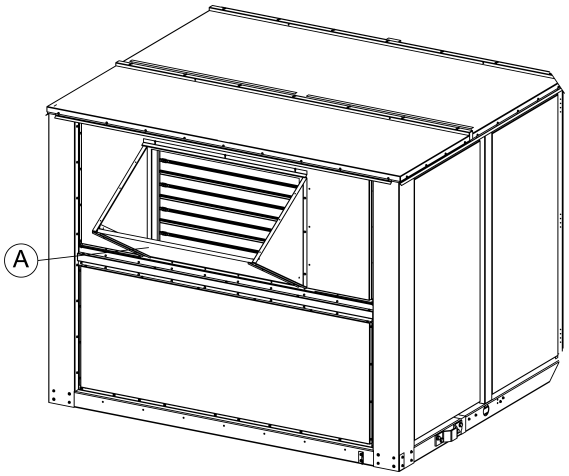
Figure 40: Filter support bracket mounting



Item	Description
A	Filter support brackets

5. Insert the filters into the channel created between the side panel and the filter support bracket.

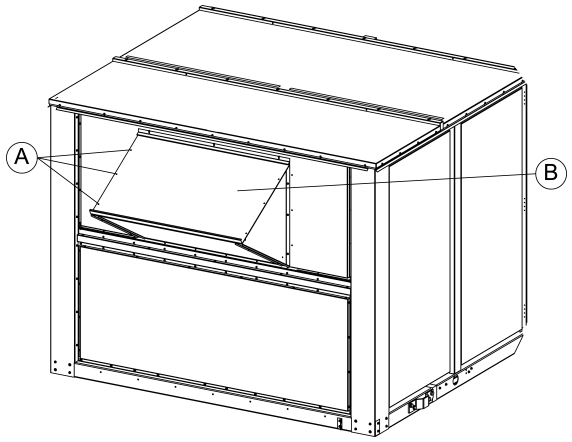
Figure 41: Filter assembly



Item	Description
A	Filters

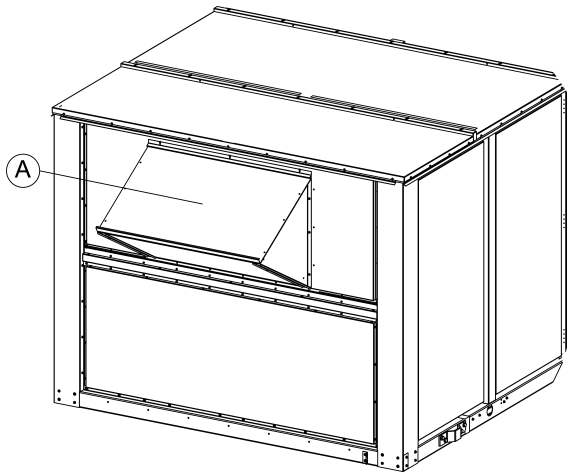
6. Take the hood top panel that was removed in Step 2, slide the flange under the lip at the top of the hood assembly and lay the panel on top of the left side and right side panels.
7. Secure the top panel to the side panels using the remaining screws in the hardware bag as shown in Figure 42. The completed assembly resembles Figure 43.

Figure 42: Attaching the hood top panel



Item	Description
A	Screws
B	Hood top panel

Figure 43: Completed manual damper outdoor air hood assembly



Item	Description
A	Manual damper outdoor air hood assembly

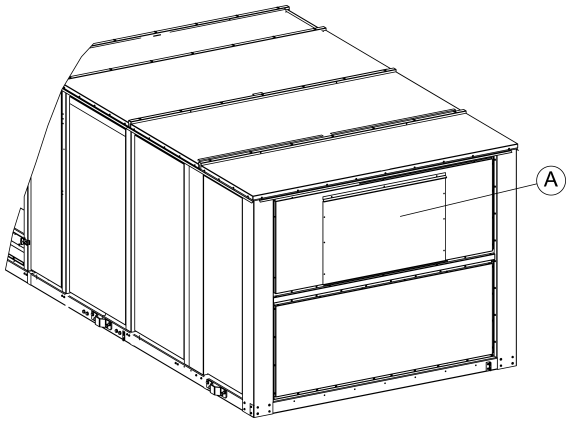
Assembling the manual damper outdoor air hood for horizontal return units

After you install a unit with a manual damper in the field, you must assemble the manual damper outdoor air hood.

To install the outdoor air hood, complete the following steps.

1. The hood top panel is used as a shipping cover when the unit is in transit. The hood top panel is attached to the unit exterior as shown in Figure 44.

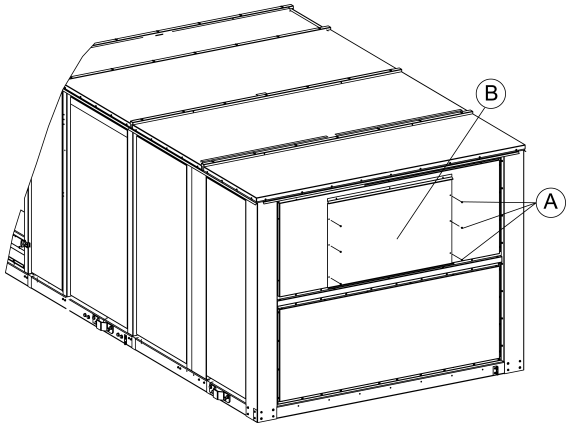
Figure 44: Manual damper hood top panel



Item	Description
A	Hood top panel

2. Remove the screws and the hood top panel as shown in Figure 44 and Figure 45. Keep both the screws and the top panel for use in a later step.

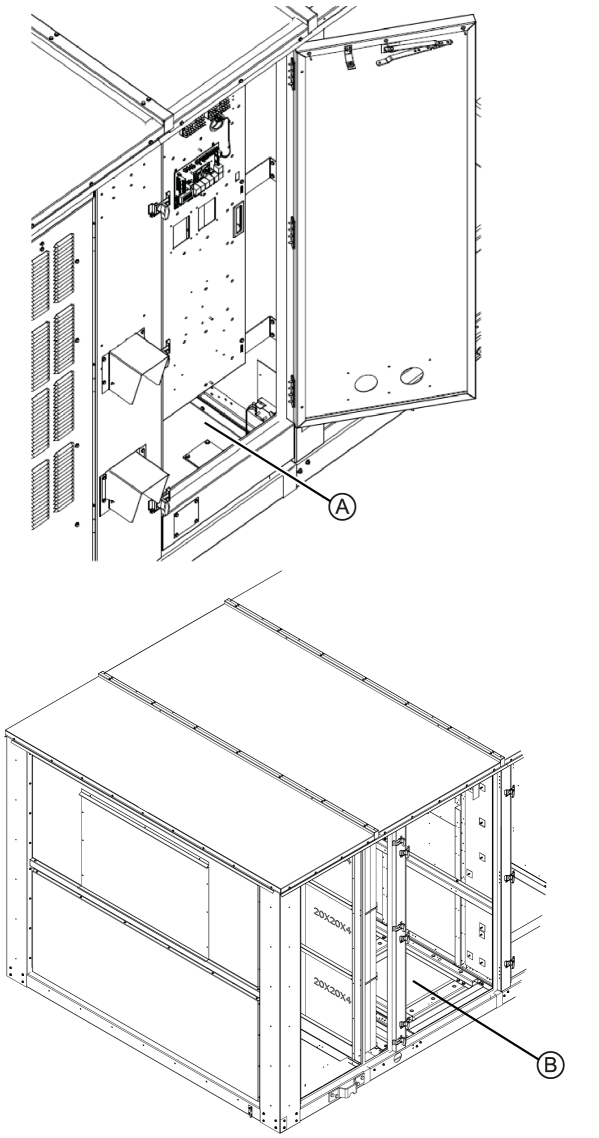
Figure 45: Removing the screw and top panel



Item	Description
A	Screws
B	Hood top panel

3. The additional outdoor air hood assembly parts and filters are shipped inside the unit's return air section. The hardware bag is shipped in the base of the unit control box. These locations are shown in Figure 46.

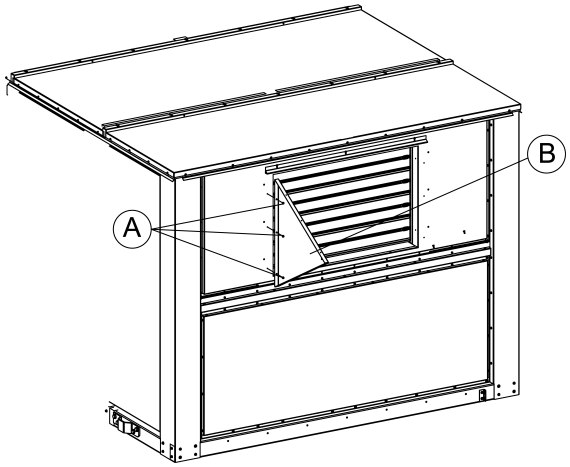
Figure 46: Manual damper hood assembly parts location



Item	Description
A	Hardware bag shipping location
B	Filter and assembly components shipping location

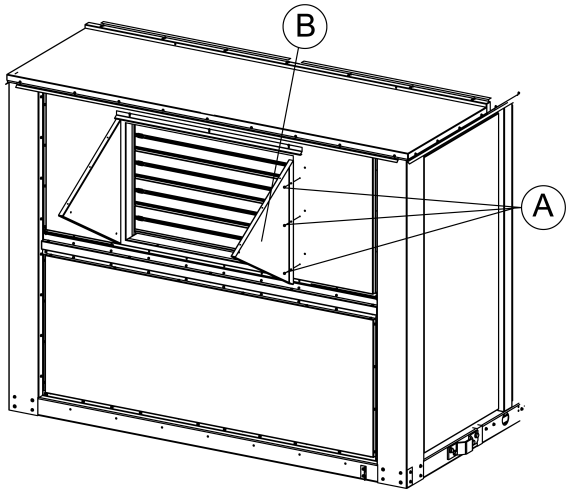
4. Use three of the #10 screws that you removed in Step 2 and attach the left side panel and right side panel to the unit as shown in Figure 47 and Figure 48.

Figure 47: Left side panel mounting



Item	Description
A	Screws
B	Left side panel

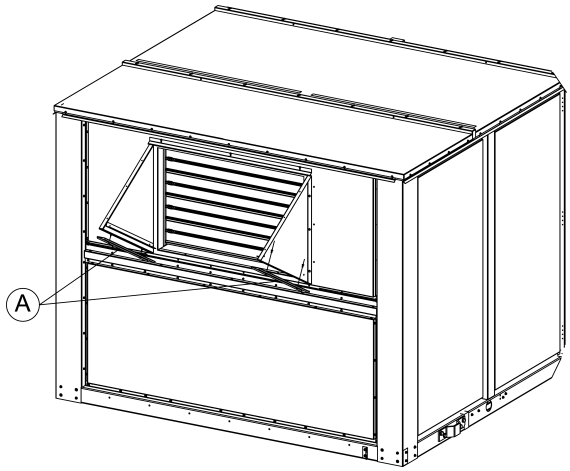
Figure 48: Right side panel mounting



Item	Description
A	Screws
B	Right side panel

5. Attach the left side and right side filter support brackets to the bottom of the side panels using the screws provided in the hardware bag, as shown in Figure 49

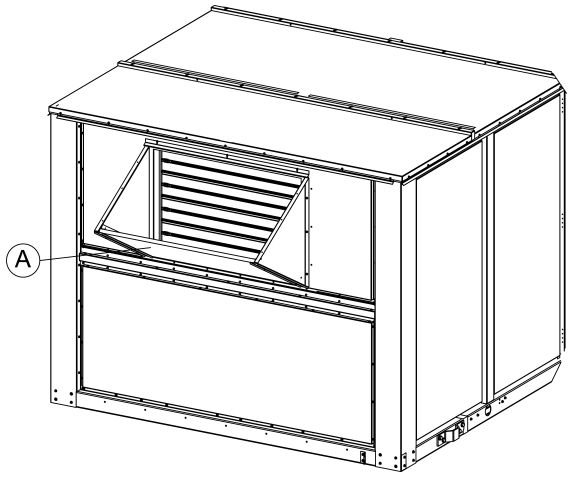
Figure 49: Filter support bracket mounting



Item	Description
A	Filter support brackets

6. Insert the filters into the channel created between the side panel and the filter support bracket.

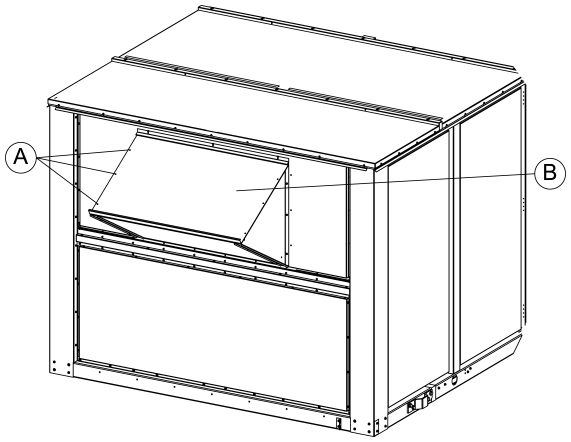
Figure 50: Filter assembly



Item	Description
A	Filters

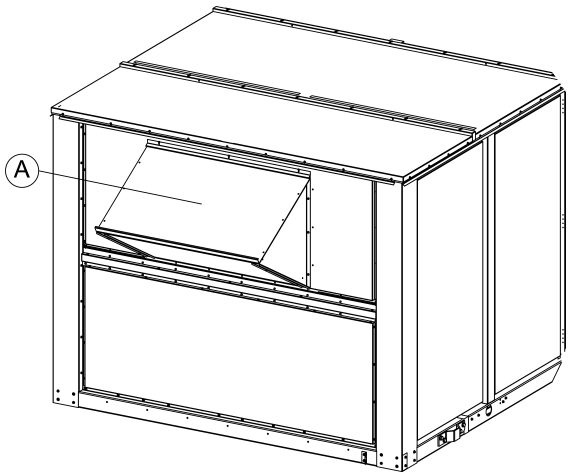
7. Take the hood top panel that you removed in Step 2, slide the flange under the lip at the top of the hood assembly and lay the panel on top of the left side and right side panels. Use the remaining screws in the hardware bag to secure the top panel to the side panels, as shown in Figure 51. The completed assembly will resemble Figure 52.

Figure 51: Attaching the hood top panel



Item	Description
A	Screws
B	Hood top panel

Figure 52: Completed manual damper outdoor air hood assembly



Item	Description
A	Manual damper outdoor air hood assembly

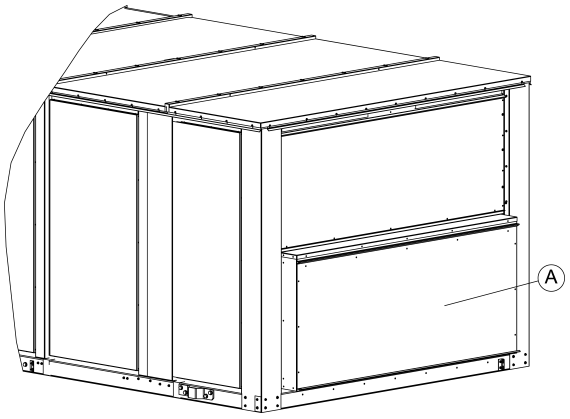
Assembling the exhaust air hood for vertical return units

After a unit with barometric relief or power exhaust is installed in the field, assemble the exhaust hood.

To install the exhaust hood, complete the following steps:

1. While transporting the unit, the exhaust hood top panel is used as a shipping cover attached to the unit exterior as shown in Figure 53.

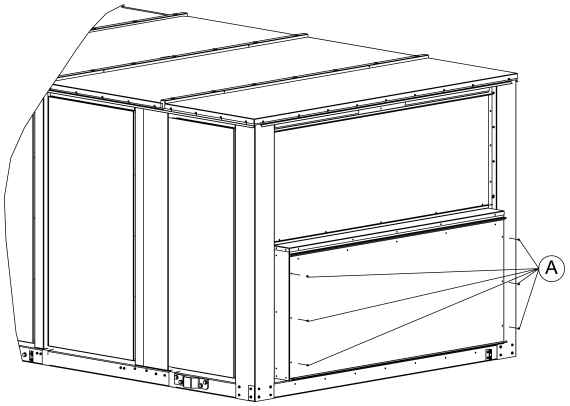
Figure 53: Exhaust hood top panel



Item	Description
A	Exhaust hood top panel

2. Remove the screws and the hood top panel as shown in Figure 54. Keep both the screws and the top panel for use in a later step.

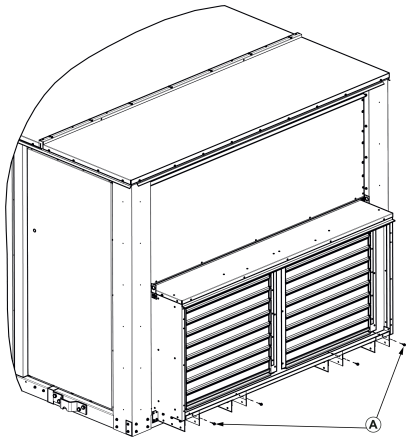
Figure 54: Removing the top panel



Item	Description
A	Screws

3. On seismic units install four 1/4 in. screws on the bottom of the power exhaust. This location is shown in Figure 55. The additional exhaust air hood assembly parts needed for the installation are shipped with the outdoor air hoods. Additional hardware that is needed for the installation is located with the hardware for mounting the outdoor air hood. See those instructions for more information.

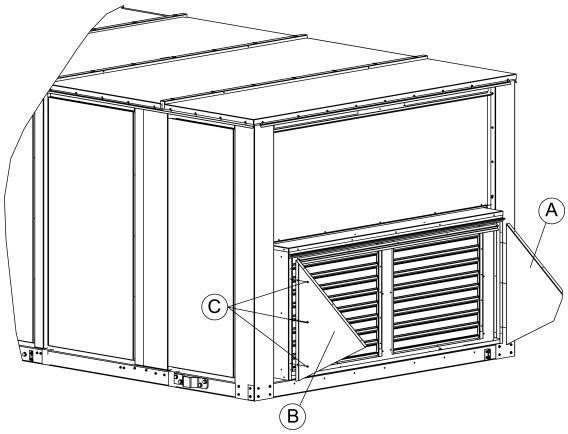
Figure 55: Side hood location



Item	Description
A	Screws

4. Using three #10 screws from the hardware bag on each, attach the left side panel and right side panel to the unit as shown in Figure 56.

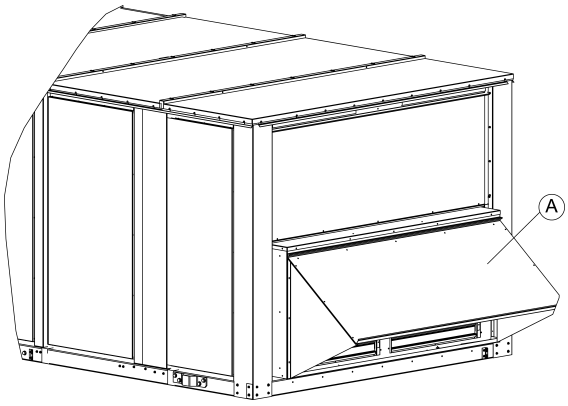
Figure 56: Left side and right side panel mounting



Item	Description
A	Right side hood
B	Left side hood
C	Screws

5. Take the hood top panel that was removed in Step 2, slide the flange under the lip at the top of the hood assembly and lay the panel on top of the left side and right side panels. Attach the hood top panel to the side panels using the screws removed in Step 2. The completed assembly resembles Figure 57.

Figure 57: Completed exhaust air hood assembly



Item	Description
A	Exhaust air hood assembly

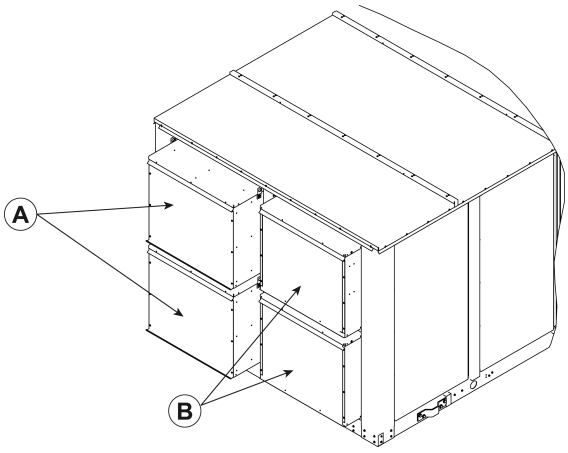
Assembling the exhaust air hood for horizontal return units

After you install a unit with barometric relief or a power exhaust in the field, you must assemble the exhaust hoods. The hoods are identical and both follow the outlined installation process.

To install the exhaust hoods, complete the following steps for each hood.

1. The exhaust hood top panel is used as a shipping cover when the unit is in transit. You can find the exhaust hood top panel attached to the unit exterior as shown in Figure 58.

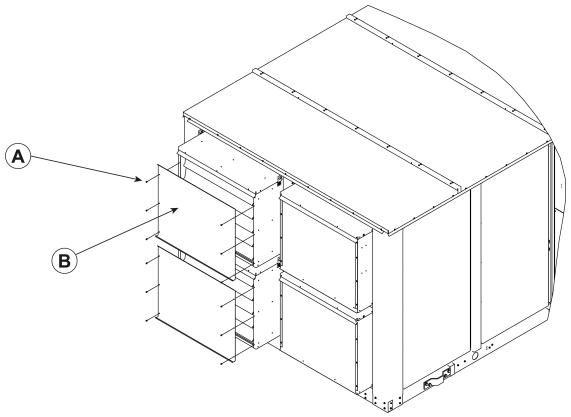
Figure 58: Exhaust hood top panel



Item	Description
A	Exhaust hood top panel
B	Economizer hood assembly (separate instructions)

2. Remove the screws and the hood top panel as shown in Figure 59. Keep both the screws and the top panel for use in a later step.

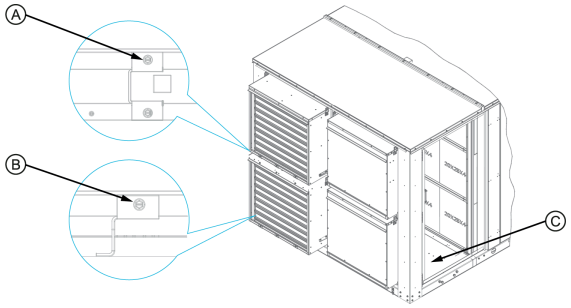
Figure 59: Removing the top panel



Item	Description
A	Screws, 6 on each panel
B	Hood top panel

3. You can find the additional outdoor air hood assembly parts behind the side panel, as shown in Figure 60. On seismic units use 1/4 in. screws to attach the brackets to the top and bottom exhaust assembly as shown in Figure 60. You can find the additional hardware that you need for the installation with the hardware for mounting the outdoor air hood. See those instructions for location.

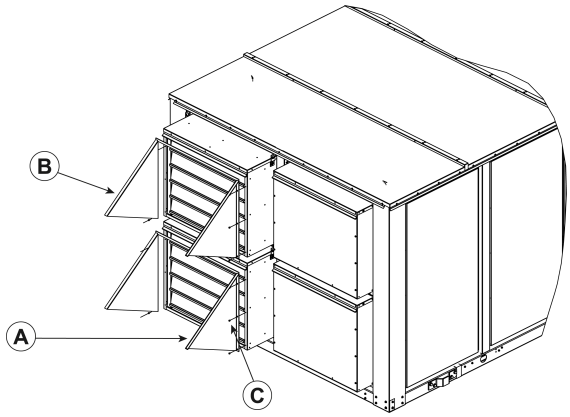
Figure 60: Side hood location



Item	Description
A	Six 1/4 in. screws on brackets between the exhaust assembly on seismic units
B	Three 1/4 in. screws on the bottom tracks of the exhaust assembly on seismic units
C	Additional home assembly parts and screws location

4. Use the three #10 screws from the hardware bag on each panel and attach the left side panel and right side panel to the unit as shown in Figure 61.

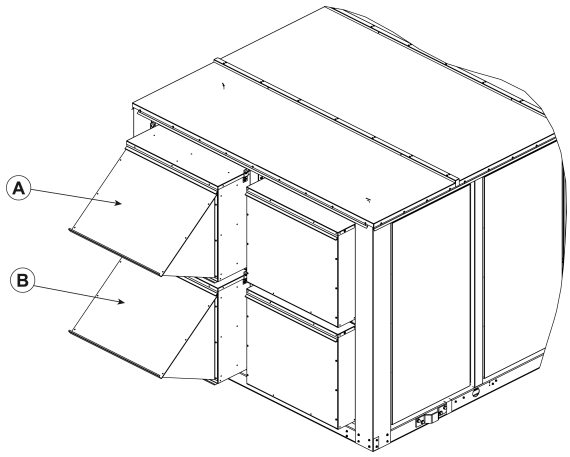
Figure 61: Left side and right side panel mounting



Item	Description
A	Right side panels
B	Left side panels
C	Screws

5. Take the hood top panel that was removed in Step 2, slide the flange under the lip at the top of the hood assembly and lay the panel on top of the left side and right side panels. Attach the hood top panel to the side panels using the screws removed in Step 2. The completed assembly resembles Figure 62.

Figure 62: Completed exhaust air hood assembly



Item	Description
A	Top exhaust air hood assembly
B	Bottom exhaust hood assembly

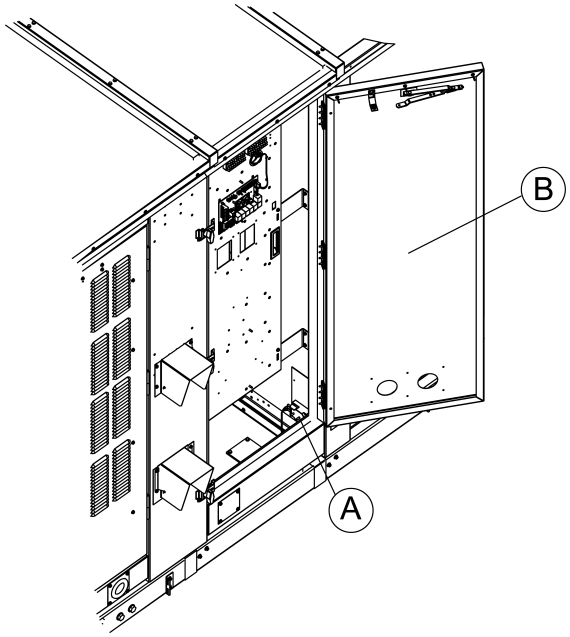
Field tubing for VAV unit operation

For VAV unit operation, field setup of the pressure lines is required to obtain readings of the supply duct pressure and building space pressure. To set up the pressure lines, complete the following steps:

Return air static pressure connections

1. Open the control panel access door. The static pressure transducer (SPT) is located on the mounting plate in the bottom right corner of the control box as shown in Figure 63.

Figure 63: Static pressure transducer location

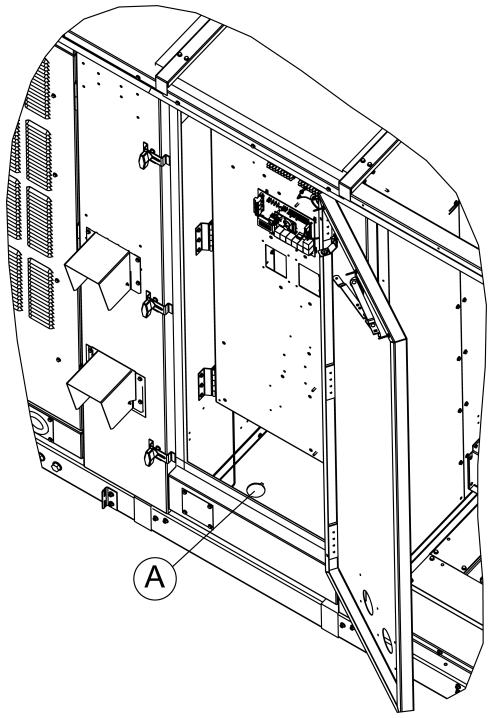


Item	Description
A	Static pressure transducer (SPT)
B	Control panel door

2. For best results, use a pressure-transmitting tubing with 3/16 in. I.D. for tubing lengths of up to 100 ft, 1/4 in. I.D. for tubing lengths up to 300 ft, and 3/8 in. I.D. for tubing lengths up to 900 ft.
3. Drill a hole in the knock-out in the bottom of the control box shown in Figure 64. Drill the hole in a size that fits both the building pressure and supply-air pressure tubes.

   Note: Use protective measures to ensure that the tubing does not develop a cut from contact with any sharp edges.

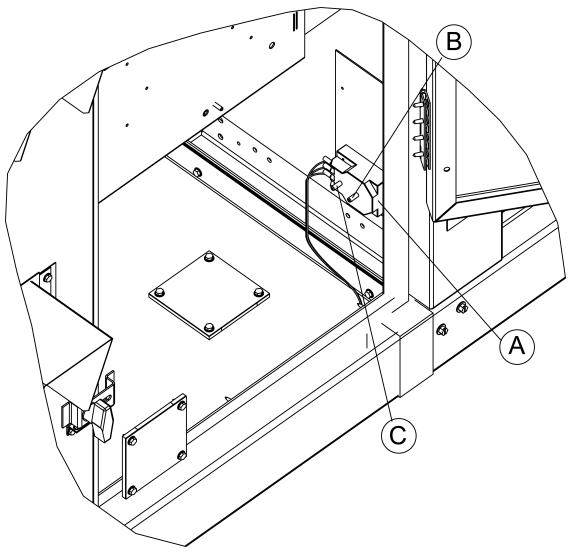
Figure 64: Knock-out location



Item	Description
A	Knock-out for pressure tubes

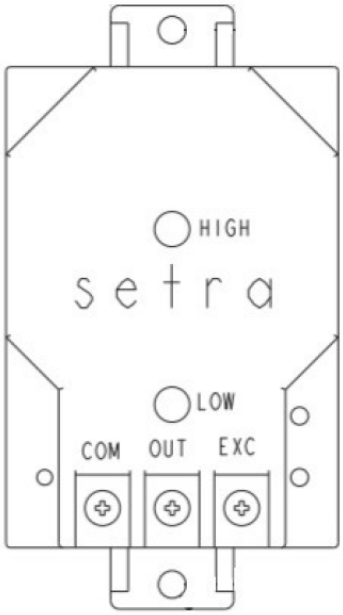
4. Determine the length of tubing required to run from the SPT as show in Figure 63, down through the hole in the knock-out in the bottom of the control box, and to the chosen location for obtaining the building pressure.
5. Connect the field-supplied tubing to the low pressure port of the SPT. The low and high pressure ports can be identified by the sticker and embossment on the sensor and are shown in Figure 65 and Figure 66.

Figure 65: SPT detail



Item	Description
A	SPT
B	High pressure port
C	Low Pressure port

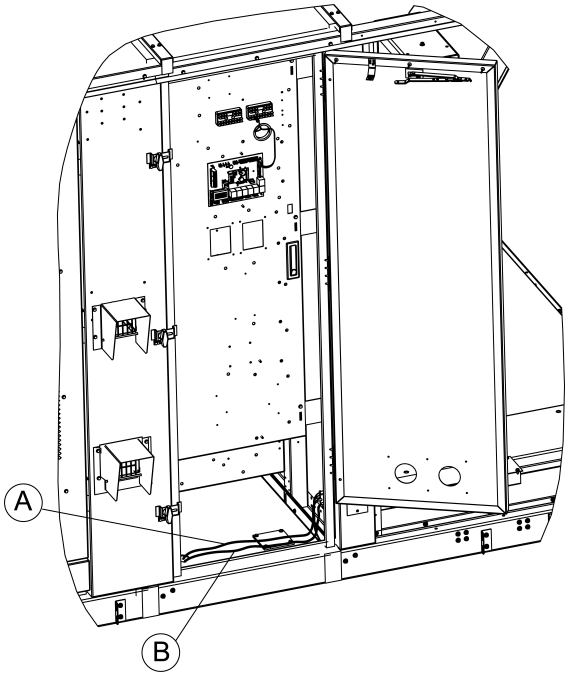
Figure 66: SPT port locations



6. Route the tubing through the control box and down through the hole in the control box base knock out, as shown in Figure 67. After exiting the unit base, route the tubing to the chosen location for obtaining a constant building pressure reading.

   Note: An outdoor pressure reference kit is shipped loose in the unit for field installation. The tubing would be routed from the outdoor pressure reference to the low side of all differential pressure transducers (duct static and building pressure transducers). Refer to the instructions provided with the outdoor pressure reference for correct installation.

Figure 67: Routing the tubing



Item	Description
A	High pressure tube
B	Low pressure tube

Discharge air static pressure connections

1. Determine the length of tubing required to run from the SPT down through the hole in the knock-out in the bottom of the control box as shown in Figure 64, and to the required location for obtaining the supply-air duct pressure. The ideal location for the discharge air static probe is two-thirds of the way between the unit outlet and the first duct take-off or tee.
2. Connect the field-supplied tubing to the high pressure port of the SPT. The low and high pressure ports can be identified by the sticker and embossment on the sensor and are shown in Figure 65 and Figure 66.
3. Following the same path as the building-pressure tubing in Step 6 of Return air static pressure connections, route the tubing through the control box and down through the hole in the control box base, as shown in Figure 67.
4. After exiting the unit base, route the tubing to a field-supplied static pressure tap in the supply duct located at a point where constant pressure is expected. An example of the full-tubing routing can be seen in Figure 68.

Figure 68: Routing the tubing for vertical supply unit

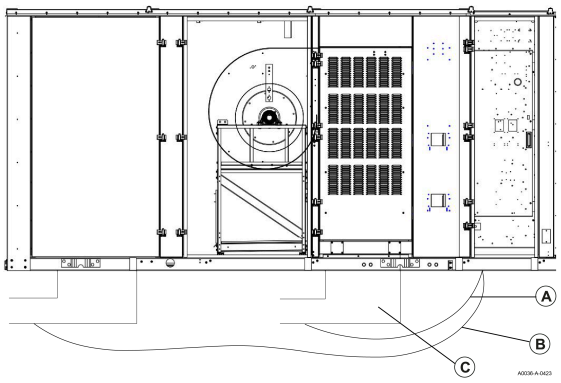
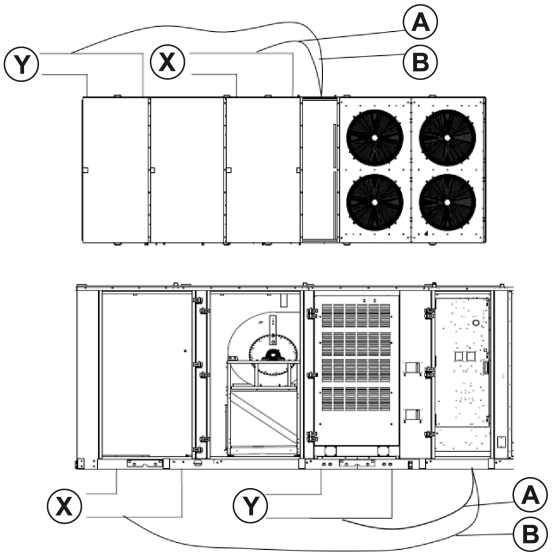


Figure 69: Routing the tubing for horizontal supply unit



Item	Description
A	High SA duct pressure
B	Low building pressure
C	Supply air duct

Note: To prevent an unstable signal due to air turbulence, make sure that there are no obstructions, turns, or VAV terminal boxes upstream or downstream of the sensing tube location for at least a distance of 6 to 10 times the duct diameter.

Utilities entry

Table 6: Utilities entry

Entry description		Opening size diameter (in.)
Control wiring	Bottom	1 in. knockout for field drilling
Power wiring	Front	Field drilled to maximum of 3 in.
	Bottom	Field drilled to maximum of 3 in.

Table 6: Utilities entry

Entry description		Opening size diameter (in.)
Gas piping	Front [1,2]	2 5/8 in. hole with 1 1/2 in. grommet
	Bottom[3]	1/4 in. pilot hole in gas heat base pan
Condensate drain	Front[2,4]	2 1/2 in. hole with 1 1/2 in. grommet

Note:

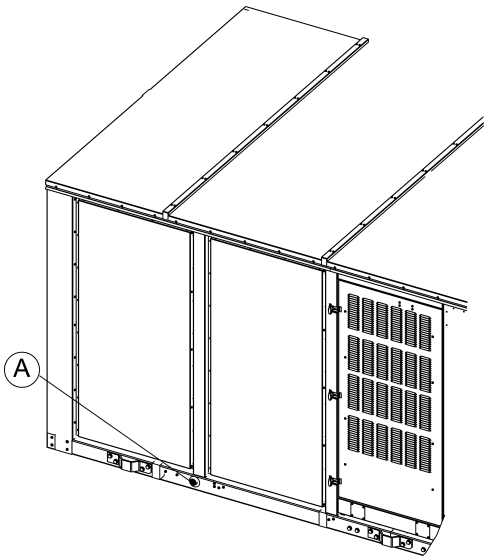
1. 1 in. to 1/4 in. NPT gas piping is required.
2. Insert the piping through the factory-installed grommet for a watertight seal.
3. Factory provided pilot hole shows the hole location to facilitate the drilling of entry holes.
4. 1 in. NPT male connection piping is required.

Note: Field seal all entry holes to prevent rainwater entry into the building.

Installing the condensate drain line

After the unit is installed in the field, the condensate drain line must be connected to the field supplied drain line. The condensate drain connection is oriented for a through the side connection as shown in Figure 70.

Figure 70: Condensate drain connection location

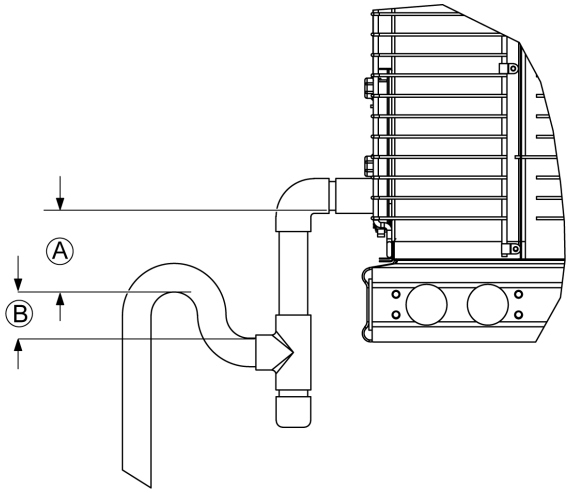


Item	Description
A	Condensate drain outlet

1. Using field supplied pipe with a 1 in. NPT male thread connection, trap the condensate drain line as shown in Figure 71. Use a sealing compound on the 1 in. NPT female thread.

Note: The trap and drain lines must be protected from freezing and the plumbing must conform to local codes.

Figure 71: Trap and drain lines



Item	Description
A	3 in. minimum
B	2 in. minimum

2. Use caulk, gasket, or other means to create a water-tight seal around the drain line and trap connection.
3. Ensure that the drain line is installed horizontally level for adequate drainage. If the drain line sags outside of the unit, then it can prevent the assembly inside from allowing adeqaute drainage.

Ductwork

Design and size ductwork according to the methods in Manual D of the Air Conditioning Contractors of America (ACCA) or as recommended by any other recognized authority such as ASHRAE or SMACNA. When you design the duct system, apply the following recommendations:

- Use a closed return duct system. This does not preclude the use of economizers or outdoor fresh air intake.
- Make the supply and return air duct connections at the unit with flexible joints to minimize noise.
- Design the supply and return air duct systems for the CFM and static pressure requirements of the job. Do not size them to match the dimensions of the duct connections on the unit.

See the duct openings section for information on side and bottom air duct openings.

Note: In Canada, it is recommended that the outlet duct be provided with a removable access panel. It is recommended that this opening is accessible when the unit is installed in service, and of a size such that smoke or reflected light may be observed inside the casing to indicate the presence of leaks in the heat exchanger. Attach the cover in a manner adequate to prevent leakage.

CAUTION

All models are manufactured with a dedicated duct configuration for vertical, horizontal or crossflow airflow operation, allowing for quick and easy installation without removing or relocating panels. The desired duct configuration must be selected when the model is ordered from the factory.

Placing the equipment over a Trane curb

Note: This section only applies to vertical supply units.

When using this product to directly replace select Trane branded equipment, the placement of the unit on the existing Trane roof curb is required to follow the manufacturer's placement guidelines. Each of the kits includes installation instructions particular to that kit.

When replacing Trane units that are 27.5 ton, 30 ton, or 35 ton with high heat gas heat the roof curb block off kit, *1BP0405*, is required to cover an opening in the remaining Trane roof curb. This kit is only applicable in replacing high heat gas heat models in the 27.5 ton to 35 ton cabinet.

When replacing all other Trane units, use the roof curb alignment kit, *1RB0401*. This kit helps to correctly aligning the new unit with the existing roof curb.

Compressors

The scroll compressor used in this product is specifically designed to operate with R-454B refrigerant and cannot be interchanged.

CAUTION

This system uses R-454B refrigerant that operates at lower pressures than R-410A. No other refrigerant may be used in this system.

The compressor also uses oil (refer compressor nameplate or label for oil grade). Take all the necessary precautions to avoid exposure of the oil to the atmosphere.

CAUTION

Do not leave the system open to the atmosphere. Unit damage could occur due to moisture being absorbed by the POE oil in the system. This type of oil is highly susceptible to moisture absorption

POE compressor lubricants are known to cause long term damage to some synthetic roofing materials.

CAUTION

Exposure, even if immediately cleaned up, may cause embrittlement (leading to cracking) to occur in one year or more. When you perform any service that may risk exposure of compressor oil to the roof, take precautions to protect the roofing.

Procedures that risk oil leakage include, but are not limited to the following:

- Compressor replacement
- Repairing refrigerant leaks
- Replacing refrigerant components such as the filter drier, pressure switch, metering device or coil

Units are shipped with compressor mountings that are factory-adjusted and ready for operation.

CAUTION

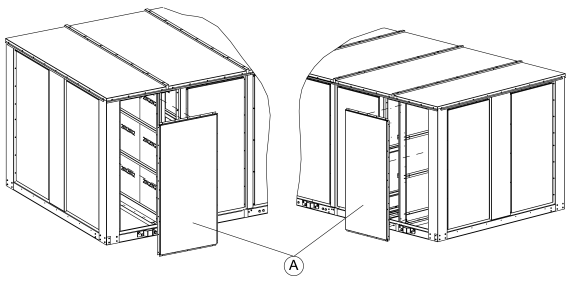
Do not loosen compressor mounting bolts.

Converting between 2 in. and 4 in. filters

To convert a unit from the 4 in. filter configuration to the 2 in. filter configuration, complete the following steps:

1. Remove the return air access panels from both sides of the unit as shown in Figure 72.

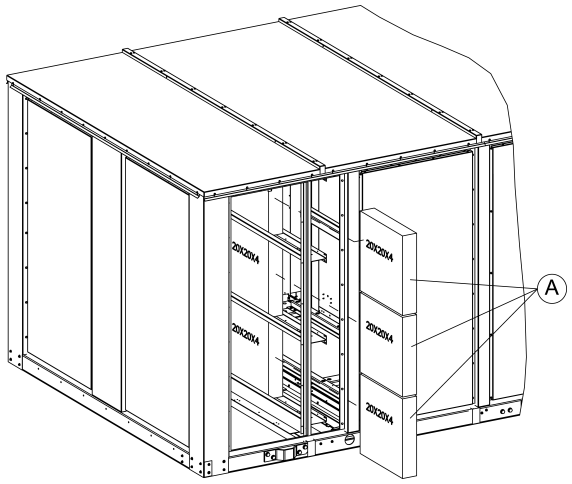
Figure 72: Return air access panel locations



Item	Description
A	Return air access panels

2. Remove the first filter of each of the three racks from the right side of the unit as shown in Figure 73.

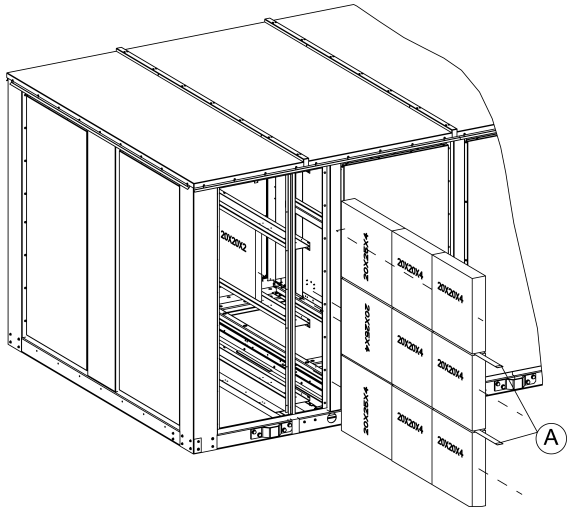
Figure 73: Filter removal



Item	Description
A	Filters

3. Locate the metal strip on each filter rack that is exposed after removing the filters in Step 2. Slide each metal strip out of the unit to remove the remaining filters from each rack as shown in Figure 74. Keep the metal strips to replace in a later step.

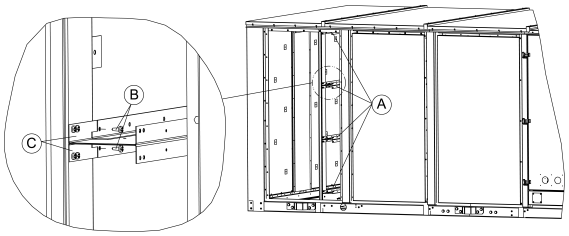
Figure 74: Removal of remaining filters



Item	Description
A	Metal strips for filter removal

4. For each filter rack, remove the metal bracket from both the top and bottom channel of the rack. There are six metal brackets, each held in place by a single screw. To remove the brackets, take out the screw from each metal bracket on both the left and right side of the unit. The bracket and screw locations are shown in Figure 75.

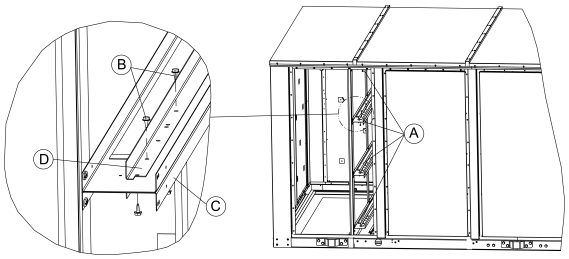
Figure 75: Metal bracket removal



Item	Description
A	Metal bracket location
B	Screws
C	Metal bracket

5. Install the six metal brackets into the top and bottom channel of each filter rack in the new orientation shown in Figure 76. Use the screws removed in Step 4 to secure the metal brackets.

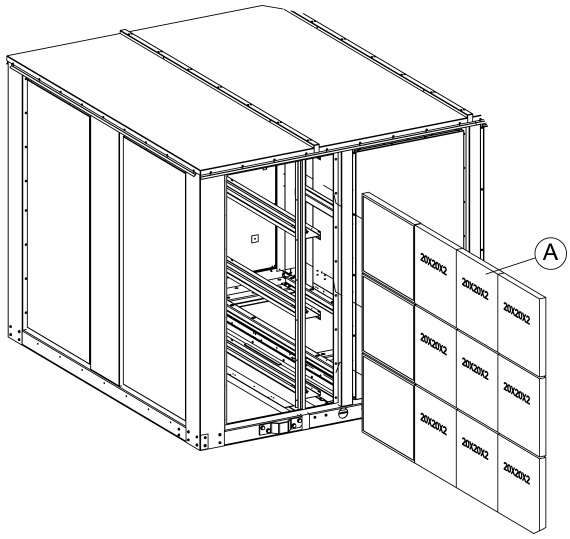
Figure 76: Bracket installation in 2 in. configuration



Item	Description
A	Metal bracket locations
B	Screws
C	Bottom face of filter rack channel
D	Filter removal metal strip

6. Place the filter removal metal strip from Step 3 between the rear flange of the filter rack and the metal bracket installed in the previous step. This location is shown in Figure 76.
7. Insert the new 2 in. filters one by one over the filter removal metal strips as shown in Figure 77.

Figure 77: New filter installation



Item	Description
A	Filters

8. Replace the return air access panels that were removed in Step 1.
9. **Optional:** To convert a unit from the 2 in. filter configuration to the 4 in. filter configuration, refer to Converting between 2 in. and 4 in. filters and complete the following steps:
   a. Follow steps 1 through 3 described in Converting between 2 in. and 4 in. filters.
   b. Remove the screws holding the brackets in place from the 2 in. filter configuration as shown in Figure 76 .
   c. Install the six metal brackets, using the screws removed in previous step, into the top and bottom channel of each filter rack in the orientation shown in Figure 75.
   d. Complete step 6.
   e. Insert the new 4 in. filters over the filter removal metal strips as shown in Figure 77.
   f. Complete step 8 to finish the installation.

Refrigerant Detection System (RDS)

Integrated sensors providing R-454B leak detection. The RDS shall be connected into unit controls and automatically start a sequence to dilute refrigerant gas as well as alarm upon sensing the presence of refrigerant in the cabinet, indicating a leak equal to 25% of the Lower Flammability Limit. The RDS shall contain factory or field installed sensors that are located to ensure accurate and timely sensing of a leak.

Setting the dirty filter switch pressure

If a factory-installed dirty filter switch is present, the pressure setting of the switch can be changed using the adjustment screw that is accessible when the metal cover is removed.

A setting of 0.5 in. WC serve as a general starting point but must be adjusted for the specific application to detect the increased pressure drop associated with a dirty filter.

Power and control wiring

Field wiring to the unit, fuses, and disconnects must conform to provisions of *National Electrical Code (NEC), ANSI/NFPA No. 70 – Latest Edition (in U.S.A.), current Canadian Electrical Code C221*, and local ordinances. The unit must be electrically grounded in accordance with NEC and CEC as specified and local codes.

Voltage tolerances must be maintained at the compressor terminals during starting and running conditions. The voltage tolerances are indicated on the unit rating plate and in the unit limitations table.

CAUTION

208/230-3-60 units control transformers are factory wired for 230 V power supply. Change the tap on the transformer for 208-3-60 operation. Refer to the unit wiring diagram.

The internal wiring harnesses furnished with this unit are an integral part of the design certified unit. The unit does not require field alteration to comply with electrical codes.

If any of the wire supplied with the unit must be replaced, the replacement wire must be of the type shown on the wiring diagram and the same minimum gauge as the replaced wire.

A disconnect must be used with these units. Factory-installed disconnects are available.

CAUTION

Avoid damage to internal components if you drill holes to install a disconnect.

Note: Not all local codes allow the installation of a disconnect on the unit. Confirm compliance with local code before you install a disconnect on the unit.

Electrical line must be sized correctly to carry the load.

Note: Use copper conductors only.

Each unit must be wired with a separate branch circuit fed directly from the meter panel and be correctly fused.

See the following figures for typical field wiring. Refer to the appropriate unit wiring diagram mounted inside the control doors for control circuit and power wiring information.

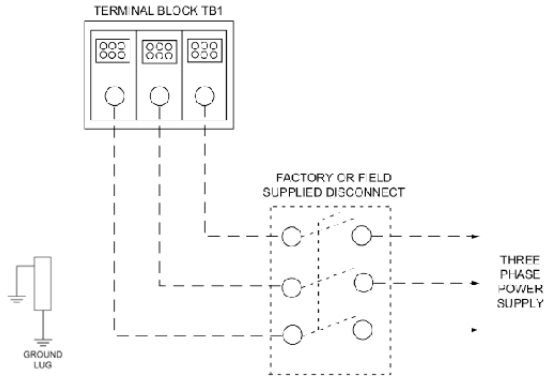
CAUTION

When you connect electrical power and control wiring to the unit, you must use waterproof connectors so that water or moisture cannot be drawn into the unit during normal operation. These waterproofing conditions also apply when you install a field-supplied disconnect switch.

Power wiring detail

Units are factory wired for the voltage shown on the unit nameplate. See the electrical data tables to size power wiring, fuses, and the disconnect switch. Power wiring is brought into the unit through the side of the unit or the basepan inside the curb.

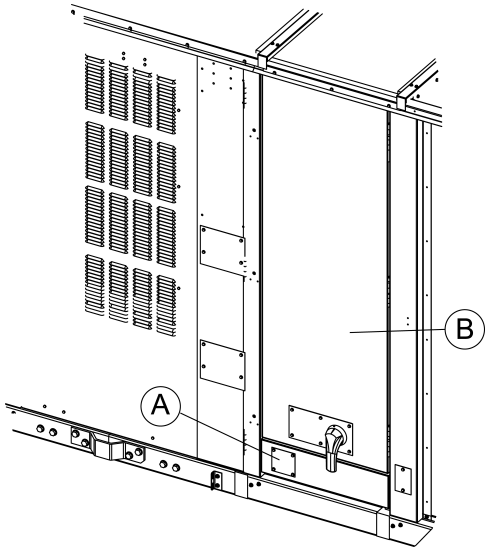
Figure 78: Field wiring disconnect



Units ship with a patch plate covering the power wire entry locations on the unit side and unit base. Figure 79 shows the side entry location and Figure 80 shows the base entry location. Remove the patch plate for the desired entry location and route power wires to the unit's main power terminal block.

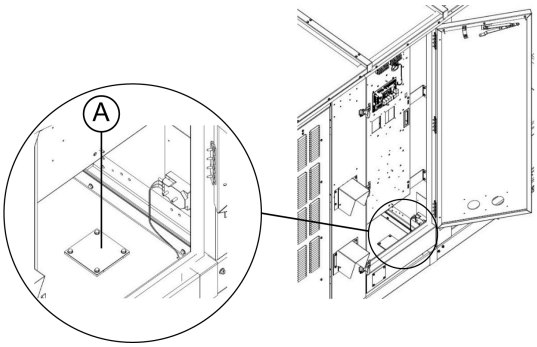
Use caulk, gasket, or other suitable means to create a watertight seal around the power wires as they enter the unit.

Figure 79: Power wiring side entry location



Item	Description
A	Side entry patch plate
B	Control box door

Figure 80: Power wiring bottom entry location



Item	Description
A	Bottom entry patch plate
B	Open control box door

Wiring the thermostat wiring

Install the thermostat on an inside wall approximately 56 in. above the floor. The thermostat must not be subject to drafts, sun exposure, or heat from electrical fixtures or appliances.

Follow the manufacturer's instructions enclosed with thermostat for the general installation procedure. Use color coded, insulated wires to connect the thermostat to the unit. See the following table for control wire sizing and maximum length.

Table 7: Control wire sizes

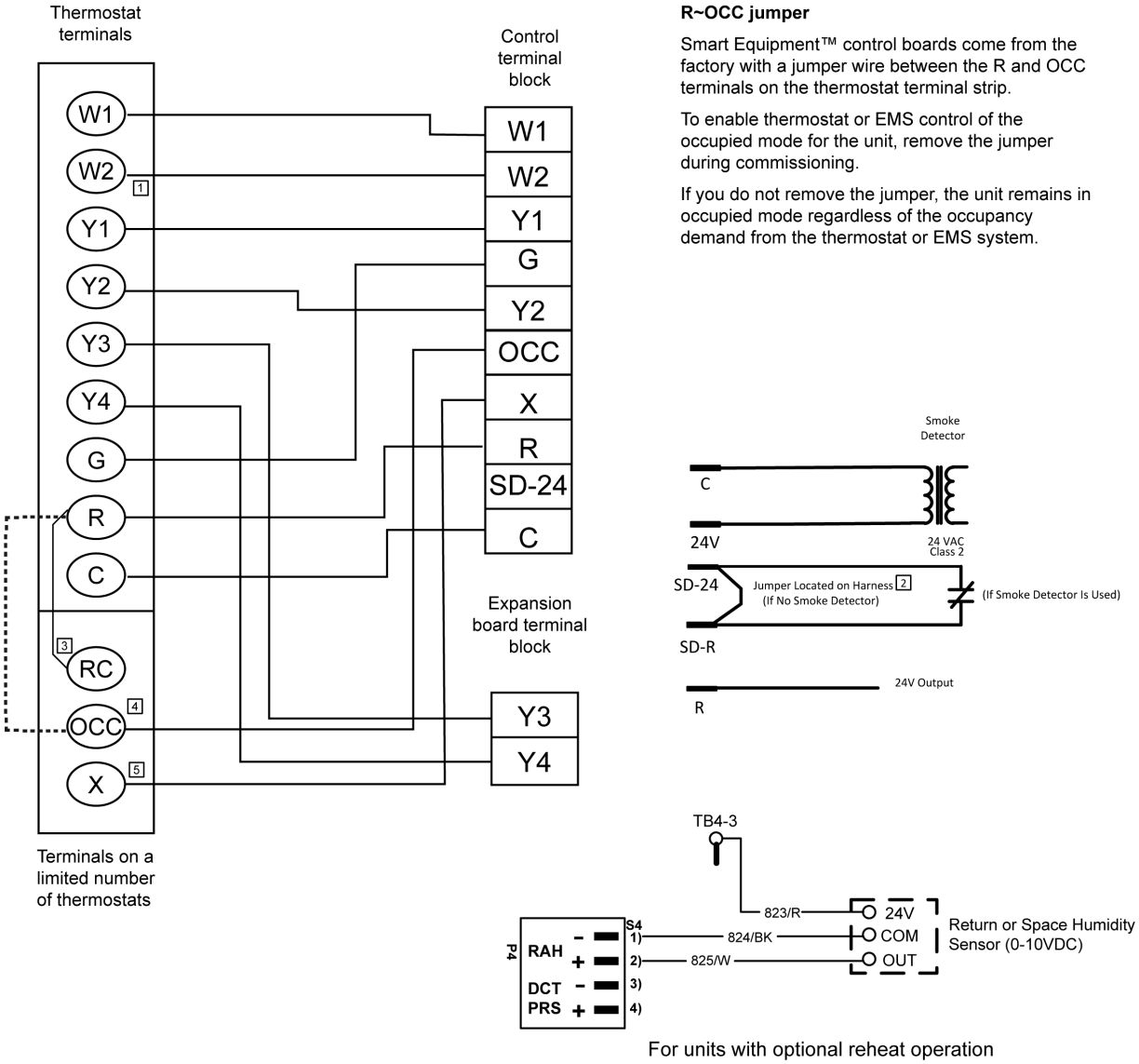
Wire size	[1]Maximum length[1]
18 AWG	150 ft

1 From the unit to the thermostat and back to the unit.

CAUTION

The control transformers in 208/230-3-60 units are factory wired for 230 V and 415 V power supply respectively. Change the tap on the transformer for 208-3-60 operation. See the unit wiring diagram.

Figure 81: Typical electronic thermostat field wiring



For units with optional reheat operation

1 Second stage heating not required on single stage heating units.

2 Jumper is required if there is no Smoke Detector circuit.

3 Jumper is required for any combination of R, RC, or RH.

4 OCC is an output from the thermostat to indicate the Occupied condition.

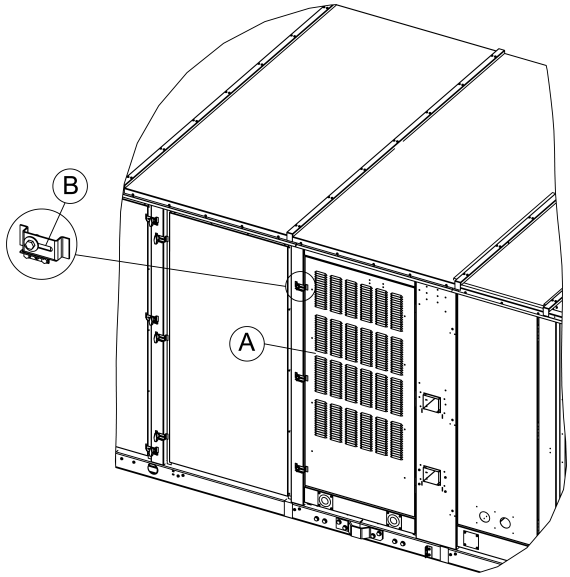
5 X is an input to the thermostat to display Error Status conditions.

Installing the toolless access handle

All hinged panels on the unit, such as the gas heat and control box access panels, are provided with toolless access handles to be installed in the field. The panels are secured with a bolt and washer for shipping only.

1. Locate the hinged panels on the unit that need the toolless access handles installed. You can identify these by the latching mechanism visible on the outside of the unit as seen in Figure 82.

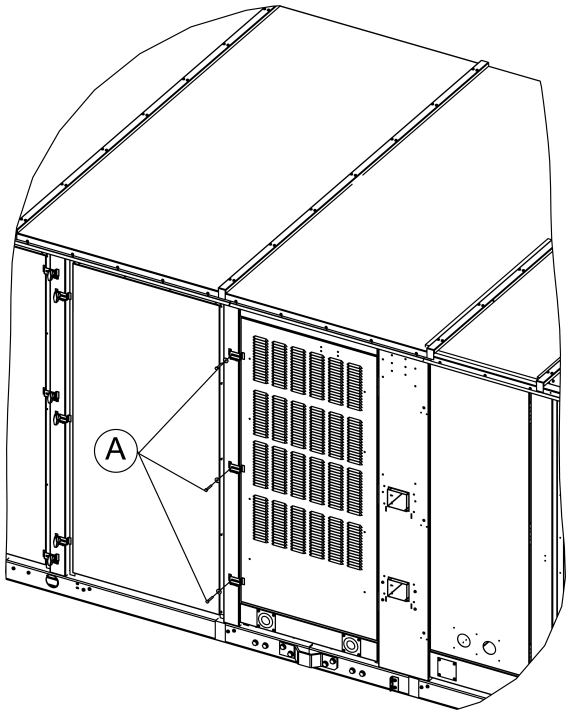
Figure 82: Identifying hinged panels



Item	Description
A	Gas heat access panel
B	Latch with bolt in shipping configuration

2. Remove the bolt and washer from all three latches of each hinged access panel. See Figure 83. Retain the removed latches for reinstallation in a later step.

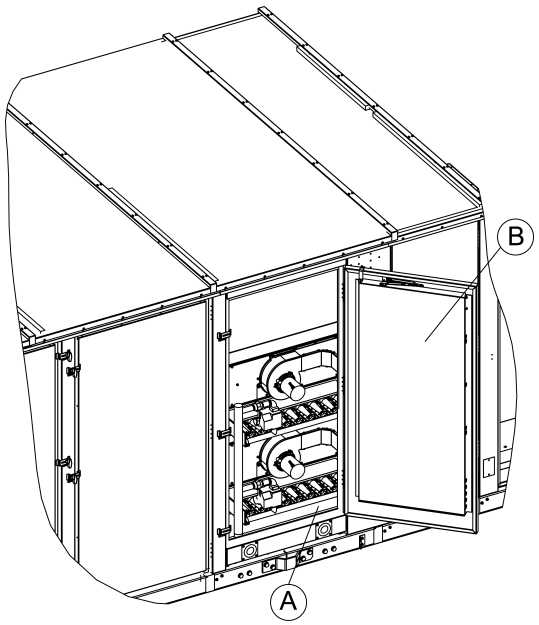
Figure 83: Removing bolts and washers



Item	Description
A	Bolt removal

3. Locate the hardware back with the toolless access handles. These black T-handles are all located in the gas heat section as shown in Figure 84.

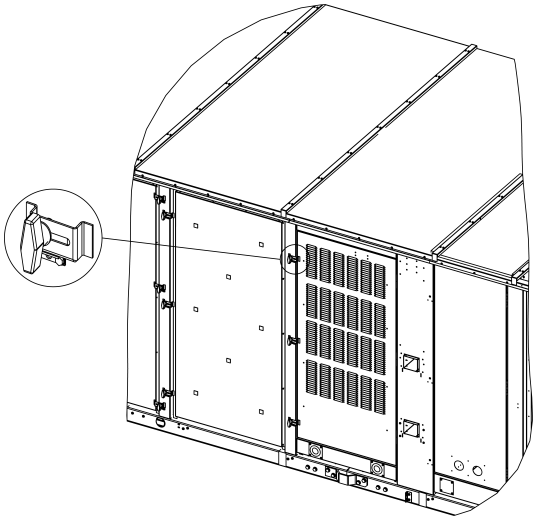
Figure 84: Door knob location



Item	Description
A	Toolless access handle location
B	Gas heat access panel

4. Reinstall the latches to the unit using the toolless access handles in place of the bolts removed in Step 2. A completed latch assembly can be seen in Figure 85.

Figure 85: Toolless access handle assembly



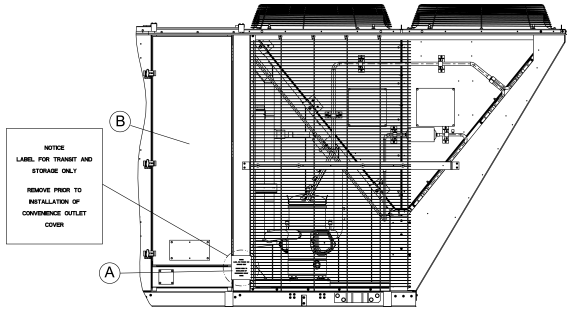
Installing the convenience outlet cover

For units with a powered or non-powered convenience outlet, the convenience outlet cover must be installed in the field after the unit is installed.

To install the convenience outlet cover, complete the following steps:

1. The unit ships from the factory with a transit label covering the convenience outlet receptacle as shown in Figure 86. Remove and discard the convenience outlet transit label.

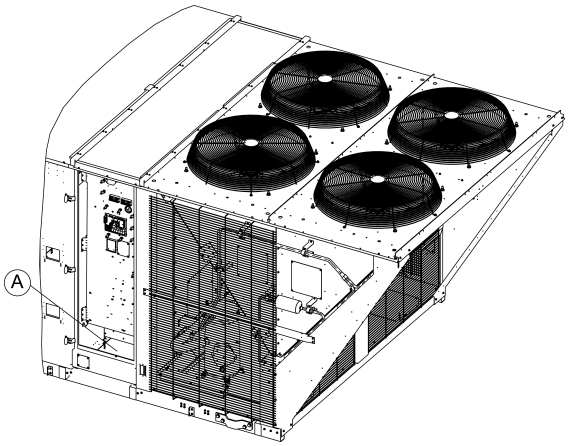
Figure 86: Convenience outlet transit label



Item	Description
A	Convenience outlet transit label

2. The convenience outlet cover is shipped in the floor of the control box as shown in Figure 87.

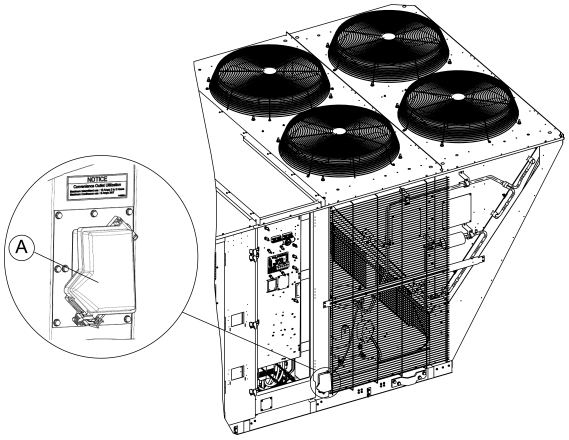
Figure 87: Location of convenience outlet cover



Item	Description
A	Location of Convenience Outlet Cover

3. To mount the cover, follow the cover manufacturer's installation instructions that are provided with the cover. The final assembly is shown in Figure 88.

Figure 88: Convenience outlet cover



CAUTION

208/230-3-60 units with a factory-installed powered convenience outlet option are wired for 230 V power supply. Change the tap on the transformer for 208-3-60 operation. Refer to the unit wiring diagram.

Electrical data

Electrical service sizing

In order to determine the electrical service required for the Select rooftop unit, refer to the appropriate calculations from *U.L. 60335-2-40* listed in this section. Based on the configuration of the unit, the calculations yield different minimum circuit ampacity (MCA) and maximum overcurrent protection (MOP).

Using the following load definitions and calculations, determine the correct electrical sizing for the unit. All concurrent load conditions must be considered in the calculations, and the highest value for any combination of loads must be used.

LOAD definitions:

- LOAD1 is the current of the largest motor – compressor or fan motor.
- LOAD2 is the sum of the remaining motor currents that may run concurrently with LOAD1.
- LOAD3 is the current of the electric heaters – zero for cooling only units.
- LOAD4 is the sum of any remaining currents greater than or equal to 1.0 amp.

Use the following calculations to determine MCA and MOP for units:

For units without an Electric heater, use the following formulae to calculate the MCA and MOP Values.

MCA = (1.25 x LOAD1) + LOAD2 + LOAD4

For units with an Electric heater, use the following formulae to calculate the MCA and MOP Values.

Step 1: MCA Cooling = (1.25 x LOAD1) + LOAD2 + LOAD4

Step 2: MCA Heating = (1.25 x LOAD1) + LOAD2 + (1.25 x LOAD3) + LOAD4

ⓘ **Note:** Exception: LOAD3 should be multiplied by 1 if the electric heater is greater than 50kW

Step 3: For units with electric heaters, the MCA of the unit is the highest of the MCA heating/ MCA cooling values calculated in Step 1 and 2.

Use the following formulae to calculate MOP:

MOP = (2.25 x LOAD1) + LOAD2 + LOAD3 + LOAD4

ⓘ **Note:** For electric heat applications, the nameplate MCA/MOP value is the larger of the cooling mode or the heating mode value calculated.

If the MOP does not equal a standard current rating of an overcurrent protective device, then the marked maximum rating is to be the next lower standard rating. However, if the device selected for MOP is less than the MCA, then select the lowest standard maximum fuse size greater than or equal to the MCA.

Compressor data

Table 8: Two-stage Intellispeed/constant volume compressor data

Model	Compressor	Nominal voltage					
		208-230/3/60		460/3/60		575/3/60	
		RLA	LRA	RLA	LRA	RLA	LRA
27.5	Compressor 1	45.7	304	21.4	147	18.6	122
	Compressor 2	45.7	304	21.4	147	18.6	122
30	Compressor 1	49.3	315	23.6	158	20.7	136
	Compressor 2	49.3	315	23.6	158	20.7	136
35	Compressor 1	53.6	351	27.6	197	25	135
	Compressor 2	53.6	351	27.6	197	25	135
40	Compressor 1	53.6	351	27.6	197	25	135
	Compressor 2	53.6	351	27.6	197	25	135
50	Compressor 1	75.0	485	36.0	227	28.0	175
	Compressor 2	75.0	485	36.0	227	28.0	175

Table 9: Four-stage Intellispeed/constant volume compressor data

Model	Compressor	Nominal voltage					
		208-230/3/60		460/3/60		575/3/60	
		RLA	LRA	RLA	LRA	RLA	LRA
27.5	Compressor 1	45.7	304	21.4	147	18.6	122
	Compressor 2	22.4	166.2	8.8	74.6	7.5	54
	Compressor 3	22.4	166.2	8.8	74.6	7.5	54
30	Compressor 1	49.3	315	23.6	158	20.7	136
	Compressor 2	25	200	11.9	103	9.4	78
	Compressor 3	25	200	11.9	103	9.4	78
35	Compressor 1	53.6	351	27.6	197	25	135
	Compressor 2	28.7	207.5	12.4	100.2	9.0	78
	Compressor 3	28.7	207.5	12.4	100.2	9.0	78
40	Compressor 1	53.6	351	27.6	197	25	135
	Compressor 2	28.7	207.5	12.4	100.2	9.0	78
	Compressor 3	28.7	207.5	12.4	100.2	9.0	78
50	Compressor 1	75	485	36.0	227	28.0	175
	Compressor 2	43.6	267	20.7	142	17.1	103
	Compressor 3	43.6	267	20.7	142	17.1	103

Electric heat

Note: Only applicable for standard horizontal and standard vertical airflow.

Table 10: Electric heat amp draw

Capacity	Type of heat	Heater nominal kW	Stage 1 kW	Stage 2 kW	Steps	208V/3Ph/60Hz	230V/3Ph/60Hz	460V/3Ph/60Hz	575V/3Ph/60Hz
						Amps	Amps	Amps	Amps
27.5-35 ton	Low heat	36	18	18	2	74.9	86.6	43.3	-
	Med heat	54 (208V/230V)	36	18	2	112.7	129.9	-	-
		54 (460V/575V)	27	27	2	-	-	65.0	52.0
	High heat	72	36	36	2	-	-	86.6	69.3
	Ultra high heat	90 (480V)	60	30	2	-	-	108.3	86.6
		90 (600V)	45	45	2	-	-	108.3	86.6
40-50 ton	Low heat	54 (208V/230V)	36	18	2	112.7	129.9	-	-
		54 (460V/575V)	27	27	2	-	-	65.0	52.0
	Med heat	72	36	36	2	-	-	86.6	69.3
	High heat	90 (480V)	60	30	2	-	-	108.3	86.6
		90 (600V)	45	45	2	-	-	108.3	86.6
	Ultra high heat	108	72	36	2	-	-	129.9	103.9

Condenser fan motor

Table 11: Condenser fan motor standard ambient

Unit configurations			Each motor data	208V/3Ph/60Hz		230V/3Ph/60Hz		460V/3Ph/60Hz		575V/3Ph/60Hz	
				SS FLA	SS LRA	SS FLA	SS LRA	SS FLA	SS LRA	SS FLA	SS LRA
			27.5 ton - 40 ton	4	24.8	4.2	24.8	2.1	12.7	1.6	8.8
			50 ton	7.2	40.7	6.8	40.7	3.4	20.4	2.7	16.4
Condenser fan option	**Unit size (ton)**	**Total quantity of fans**	**Quantity of SS fans**	**Total fan amps**							
Standard ambient	27.5	4	4	16	99.2	16.8	99.2	8.4	50.8	6.4	35.2
	30	4	4	16	99.2	16.8	99.2	8.4	50.8	6.4	35.2
	35	4	4	16	99.2	16.8	99.2	8.4	50.8	6.4	35.2
	40	4	4	16	99.2	16.8	99.2	8.4	50.8	6.4	35.2
	50	4	4	28.8	162.8	27.2	162.8	13.6	81.6	10.8	65.6

Table 12: Condenser fan motor low ambient

Unit configurations			Each VFD Data	208V/3Ph/60Hz		230V/3Ph/60Hz		460V/3Ph/60Hz		575V/3Ph/60Hz	
				VFD I/P A	LRA	VFD I/P A	LRA	VFD I/P A	LRA	VFD I/P A	LRA
			27.5 ton - 40 ton	8.6	24.8	7.2	24.8	3.9	12.7	3.5	8.8
			50 ton	14.1	40.7	12.0	40.7	6.8	20.4	5.6	16.4
Condenser fan option	**Unit size (ton)**	**Total quantity of fans**	**Quantity of SS fans**	**Total VFD input amps**							
Low ambient	27.5	4	2	17.2	99.2	14.4	99.2	7.8	50.8	7.0	35.2
	30	4	2	17.2	99.2	14.4	99.2	7.8	50.8	7.0	35.2
	35	4	2	17.2	99.2	14.4	99.2	7.8	50.8	7.0	35.2
	40	4	2	17.2	99.2	14.4	99.2	7.8	50.8	7.0	35.2
	50	4	2	28.2	162.8	24.0	162.8	13.6	81.6	11.2	65.6

Supply fan and exhaust fan motor data

Table 13: Supply fan motor data

Motor hp		Nominal voltage						Blower static
		208-230/3/60[1]		460/3/60		575/3/60		
		FLA	LRA	FLA	LRA	FLA	LRA	
ISP/VAV unit	With VFD							
	7.5	22	144.4	11	72.2	9	59.1	Std static
	10	28	173.4	14	86.7	11	71.8	Med static
	15	42	234	21	117	18	95.9	High static
ISP/VAV unit	With VFD							
	10	28	173.4	14	86.7	11	71.8	Std static
	15	42	234	21	117	18	95.9	Med static
	20 HP - 40 ton	59.4	312	27	156	22	126	High static
	20 HP - 50 ton	74.8	312	27	156	22	126	High static

Table 14: Exhaust fan motor data without VFD

Capacity	Motor hp	Fan motor quantity	Nominal voltage							
			208/3/60		230/3/60		460/3/60		575/3/60	
			FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA
Amps without VFD[1]										
27.5-30 ton	1	2	4	24.8	4.2	24.8	2.1	12.7	1.6	8.8
35-50 ton	2	2	7.2	40.7	6.8	40.7	3.4	20.4	2.7	16.4

ⓘ **Note:**
1. Amps without VFD are shown per motor.

Table 15: Exhaust fan motor data with VFD

Capacity	Motor hp	VFD quantity	Nominal voltage							
			208/3/60		230/3/60		460/3/60		575/3/60	
			FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA
Amps with VFD[1]										
27.5-30 ton	1	2	8.6	24.8	7.2	24.8	3.9	12.7	3.5	8.8
35-50 ton	2	2	14.1	40.7	15.2	40.7	6.8	20.4	5.6	16.4

ⓘ **Note:**
1. Single VFD is provided to power both exhaust fan motors. Amps with VFD include amperage for both exhaust fan motors.

Miscellaneous data

Table 16: 27.5-50 ton data

Description	Nominal voltage			
	208/3/60	230/3/60	460/3/60	575/3/60
	Amps	Amps	Amps	Amps
Convenience outlet	14.4	13	6.5	5.2
Control transformer 27.5, 30, 35 ton cooling and electric heat	0.7	0.7	0.3	0.3
Control transformer 27.5, 30, 35 ton - gas heat	1.2	1	0.5	0.4
Control transformer 40, 50 ton - cooling, EH and gas heat	1.2	1	0.5	0.4
Crankcase heater 90 W[1,2]	0.4	0.4	0.2	0.2
Crankcase heater 70 W[3]	0.3	0.3	0.2	0.1

1. Quantity two for all 2 stage units and quantity of one for all 4 stage units
2. For 50 ton 4 stage units, quantity three of 90 W heaters are used
3. Quantity two for all 4 stage units

Physical data

Vertical supply unit physical data

Table 17: KV27, KY27, KV30, and KY30 - 27.5 ton to 30 ton vertical supply/vertical return or vertical supply/horizontal return airflow unit

Component	Models			
	KV27/KY27		KV30/KY30	
Nominal tonnage	27.5		30	
ARI cooling performance	Two stage	Four stage	Two stage	Four stage
Gross capacity at ARI A point (Btu)	312,000	314,000	340,000	336,000
ARI net capacity (Btu)	300,000	304,000	330,000	326,000
EER	11.1[1] / 10.7[2]	11.4[1] / 10.8[2]	10.7[1] / 10.6[2]	10.8[1]/ 10.5[2]
IEER with Intellispeed	15.3[1] /14.8[2]	16.2[1]/15.1[2]	14.3[1] / 14.0 [2]	15.4[1]/14.3[2]
IEER with VAV	n/a	16.3[1] / 14.8[2]	n/a	14.7[1]/14.6[2]
CFM	10,700	10,300	9,400	9,100
System power (kW)	31	24.1	32	27.9
Refrigerant type	R-454B	R-454B	R-454B	R-454B
Refrigerant charge (lb-oz)				
System 1	12-04	12-12	14-04	13-08
System 2	12-04	11-08	13-04	13-00
ARI heating performance				
Heating model	N(S)1	N(S)3	T3	N(S)1	N(S)3	T3
Heating type	Stg. Low	Stg. High	Mod. High	Stg. Low	Stg. High	Mod. High
1st stage heat input (kBtu)	320	400	140	320	400	140
2nd stage heat input (kBtu)	400	620	620	400	620	620
1st stage heat output (kBtu)	259	324	113	259	324	113
2nd stage heat output (kBtu)	324	502	502	324	502	502
Steady state efficiency (%)	81	81	81	81	81	81
Number of burners	9	9/5	9/5	9	9/5	9/5
Number of stages / Turn down	2/1.25	2/1.55	2/4.42	2/1.25	2/1.55	2/4.42
Temperature rise range (°F)	25-35	35-60	35-60	20-35	35-55	35-55
Gas limit setting (°F) (top/bottom)	150	150/150	210/210	150	150/170	210/210
Gas piping connection (in.)	3/4	1-1/4	1-1/14	3/4	1-1/4	1-1/14
Dimensions (in.)						
Length	180					
Width	90					
Height	70					
Operating weight (lb)	4,078		4,105			
Compressors	Two stage	Four stage	Two stage	Four stage		
Type	Scroll	Scroll	Scroll	Scroll		
Quantity	2	3	2	3		
Unit capacity steps (%)	50 / 100	24 / 51 / 76 /100	50 / 100	24 / 52 / 76 /100		
Condenser coil data						
Face area (sq. ft)	51.2		61.6			
Type	MCHX		MCHX			
Thickness (mm)	20		20			
FPI	23		23			
Circuitry type	2-Pass		2-Pass			

Table 17: KV27, KY27, KV30, and KY30 - 27.5 ton to 30 ton vertical supply/vertical return or vertical supply/horizontal return airflow unit

Component	Models					
	KV27/KY27			KV30/KY30		
Nominal tonnage	**27.5**			**30**		
Evaporator coil data						
Face area (sq. ft)	34.4			34.4		
Rows	3			3		
Fins per in.	15			15		
Tube diameter	3/8			3/8		
Circuitry type	Intertwined			Intertwined		
Refrigerant control	TXV			TXV		
Condenser fan data						
Quantity	4			4		
Fan diameter (in.)	30			30		
Type	Prop			Prop		
Drive type	Direct			Direct		
Number of motors	4			4		
Motor HP each	1			1		
RPM	1,140			1,140		
Nominal total CFM	28,530			29,800		
Belt drive evap fan data						
Quantity	2			2		
Fan size (in.)	18 x 18			18 x 18		
Type	Centrifugal			Centrifugal		
Static range	Std	Med	High	Std	Med	High
Motor sheave	1VP65	2VP60	2VP60	1VP60	1VP68	2VP60
Blower sheave	1B5V124	2B5V94	2B5V86	1B5V124	1B5V110	2B5V90
Belt	BX82	BX75	BX74	5VX830	5VX830	BX74
Motor HP each	7.5	10.0	15.0	7.5	10.0	15.0
Motor RPM	1,800	1,800	1,800	1,800	1,800	1,800
Frame size	213T	215T	254T	213T	215T	254T
Filters						
Quantity - size	9 - (20 x 20 x 2) [3, 4]			9 - (20 x 20 x 2)[3, 4]		
	9 - (20 x 20 x 4) [5]			9 - (20 x 20 x 4)[5]		
	3 - (20 x 25 x 2)[3, 4]			3 - (20 x 25 x 2)[3, 4]		
	3 - (20 x 25 x 4)[5]			3 - (20 x 25 x 4)[5]		
ID Blower power (kW)	2.8[1] / 3.5[2]	2.6[1] / 3.4[2]		3.1[1] / 3.4[2]	2.4[1] / 3.0[2]	

1. Cooling only unit or cooling unit with electric heat.
2. Cooling unit with gas heat.
3. 2 in. throwaway, standard, MERV (Minimum Efficiency Reporting Value) 3
4. Optional 2 in. pleated, MERV 8
5. Optional 4 in. pleated, MERV 13

Table 18: KV35, KY35, KV40, and KY40 - 35 ton to 40 ton vertical supply/vertical return or vertical supply/horizontal return airflow unit

Component	Models			
	KV35/KY35		KV40/KY40	
Nominal tonnage	**35**		**40**	
ARI cooling performance	Two stage	Four stage	Two stage	Four stage
Gross capacity at ARI A point (Btu)	400,000	405,000	435,000	435,000
ARI net capacity (Btu)	388,000	388,000	410,000	410,000
EER	11.7[1]/ 11.0[2]	11.1[1]/ 10.7[2]	10.8[1] / 10.5[2]	10.6[1] / 10.4[2]
IEER with Intellispeed	16.3[1] / 14.8[2]	16.7[1]/16.0[2]	15.5[1] / 15.2[2]	17.3[1]/ 17.0[2]
IEER with VAV	n/a	16.8[1] / 15.7[2]	n/a	16.7[1] / 16.4[2]
CFM	10,500	10,800	15,100	15,000
System power (kW)	29.6	31.1	39	32
Refrigerant type	R-454B	R-454B	R-454B	R-454B
Refrigerant charge (lb-oz)				
System 1	17-00	17-00	24-08	25-00
System 2	16-08	15-08	23-04	23-12
ARI heating performance				
Heating model	N(S)1	N(S)3	T3	N(S)1	N(S)3	T3
Heating type	Stg. Low	Stg. High	Mod. High	Stg. Low	Stg. High	Mod. High
1st stage heat input (kBtu)	320	400	140	320	400	140
2nd stage heat input (kBtu)	400	800	800	400	800	800
1st stage heat output (kBtu)	259	324	113	259	324	113
2nd stage heat output (kBtu)	324	648	648	324	648	648
Steady state efficiency (%)	81	81	81	81	81	81
Number of burners	9	9/9	9/9	9	9/9	9/9
Number of stages/turn down	2/1.25	2/2	2/5.71	2/1.25	2/2	2/5.71
Temperature rise range (°F)	20-30	35-60	35-60	15-25	35-50	35-50
Gas limit setting (°F) (top/bottom)	140	140/160	170/210	170	140/140	170/170
Gas piping connection (in.)	3/4	1-1/4	1-1/14	3/4	1-1/4	1-1/14
Dimensions (in.)				
Length	180		232	
Width	90		90	
Height	70		77	
Operating weight (lb)	4,191		5,742	
Compressors	Two stage	Four stage	Two stage	Four stage
Type	Scroll	Scroll	Scroll	Scroll
Quantity	2	3	2	3
Unit capacity steps (%)	50 / 100	25 / 50/ 75 / 100	50 / 100	25 / 50/ 75 / 100
Condenser coil data				
Face area (sq. ft)	61.6		112.4	
Type	MCHX		MCHX	
Thickness (mm)	20		20	
FPI	23		23	
Circuitry type	2-Pass		2-Pass	

Table 19: KV35, KY35, KV40, and KY40 - 35 ton to 40 ton vertical supply/vertical return or vertical supply/horizontal return airflow unit (continued)

Component	Models					
	KV35/KY35			KV40/KY40		
Nominal tonnage	**35**			**40**		
Evaporator coil data						
Face area (sq. ft)	34.4			38.9		
Rows	4			4		
Fins per in.	15			15		
Tube diameter	3/8			3/8		
Circuitry type	Intertwined			Intertwined		
Refrigerant control	TXV			TXV		
Condenser fan data						
Quantity	4			4		
Fan diameter (in.)	30			30		
Type	Prop			Prop		
Drive type	Direct			Direct		
Number of motors	4			4		
Motor HP each	1			1		
RPM	1,140			1,140		
Nominal total CFM	29,800			34,109		
Belt drive evaporator fan data						
Quantity	2			2		
Fan size (in.)	18x18			20x18		
Type	Centrifugal			Centrifugal		
Static range	Std	Med	High	Std	Med	High
Motor sheave	1VP65	2VP60	2VP60	1VP60	1VP75	2VP60
Blower sheave	1B5V124	2B5V94	2B5V86	1B5V124	1B5V136	2B5V94
Belt	BX82	BX75	BX74	5VX830	5VX880	5VX780
Motor HP each	7.5	10.0	15.0	10.0	15.0	20.0
Motor RPM	1800	1,800	1,800	1,800	1,800	1,800
Frame size	213T	215T	254T	215T	254T	256T
Filters						
Quantity - size	9 - (20 x 20 x 2)3 [3,4]			4 - (20 x 20 x 2)[3,4]		
	9 - (20 x 20 x 4)[5]			4 - (20 x 20 x 4)[5]		
	3 - (20 x 25 x 2)[3,4]			8 - (20 x 25 x 2)[3,4]		
	3 - (20 x 25 x 4)[5]			8 - (20 x 25 x 4)[5]		
ID Blower power (kW)	3.5[1] / 4.1[2]		3.9[1] / 4.4[2]	6.5[1] / 7.4[2]		6.6[1] / 7.5[2]

1. Cooling only unit or cooling unit with electric heat
2. Cooling unit with gas heat
3. 2 in. throwaway, standard, MERV (Minimum Efficiency Reporting Value) 3
4. Optional 2 in. pleated, MERV 8
5. Optional 4 in. pleated, MERV 13

Table 20: KV50 and KY50 - 50 ton vertical supply/vertical return or vertical supply/horizontal return airflow unit

Component	Models		
	KV50/KY50		
Nominal tonnage	50		
ARI cooling performance	Two stage	Four stage	
Gross capacity at ARI A point (Btu)	560,000	560,000	
ARI net capacity (Btu)	530,000	530,000	
EER	10.7[1] / 10.4[2]	10.9[1]/ 10.5[2]	
IEER with Intellispeed	15.3[1] / 15.1[2]	16.9[1]/16.0[2]	
IEER with VAV	n/a	16.6[1] / 16.0[2]	
CFM	16,200	15,900	
System power (kW)	42.7	41.3	
Refrigerant type	R-454B	R-454B	
Refrigerant charge (lb-oz)			
System 1	31-00	32-08	
System 2	30-02	29-10	
ARI heating performance			
Heating model	N(S)1	N(S)3	T3
Heating type	Stg. Low	Stg. High	Mod. High
1st stage heat input (kBtu)	320	400	140
2nd stage heat input (kBtu)	400	800	800
1st stage heat output (kBtu)	259	324	113
2nd stage heat output (kBtu)	324	648	648
Steady state efficiency (%)	81	81	81
Number of burners	9	9/9	9/9
Number of stages / turn down	2/1.25	2/2	2/5.71
Temperature rise range (°F)	15-20	30-40	30-40
Gas limit setting (°F) (top/bottom)	150	150/150	170/170
Gas piping connection (in.)	3/4	1-1/4	1-1/14
Dimensions (in.)			
Length	232		
Width	90		
Height	77		
Operating weight (lb)	5,984		
Compressors	Two stage	Four stage	
Type	Scroll	Scroll	
Quantity	2	3	
Unit capacity steps (%)	50 / 100	25 / 50/ 75 / 100	
Condenser coil data			
Face area (sq. ft)	112.4		
Type	MCHX		
Thickness (mm)	25		
FPI	23		
Circuitry type	2-Pass		

Table 21: KV50 and KY50 - 50 ton vertical supply/vertical return or vertical supply/horizontal return airflow unit (continued)

Component	Models		
	KV50/KY50		
Nominal tonnage	**50**		
Evaporator coil data			
Face area (sq. ft)	38.9		
Rows	5		
Fins per in.	15		
Tube diameter	3/8		
Circuitry type	Intertwined		
Refrigerant control	TXV		
Condenser fan data			
Quantity	4		
Fan diameter (in.)	30		
Type	Prop		
Drive type	Direct		
Number of motors	4		
Motor HP each	2		
RPM	1,200		
Nominal total CFM	41676		
Belt drive evaporator fan data			
Quantity	2		
Fan size (in.)	20x18		
Type	Centrifugal		
Static range	Std	Med	High
Motor sheave	1VP60	1VP75	2VP60
Blower sheave	1B5V124	1B5V136	2B5V94
Belt	5VX830	5VX880	5VX780
Motor HP each	10.0	15.0	20.0
Motor RPM	1,800	1,800	1,800
Frame size	215T	254T	256T
Filters			
Quantity - size	4 - (20 x 20 x 2)[3, 4]		
	4 - (20 x 20 x 4)[5]		
	8 - (20 x 25 x 2)[3,4]		
	8 - (20 x 25 x 4)[5]		
ID Blower power (kW)	7.2[1] / 8.2[2]		7.8[1] / 8.9[2]

1. Cooling only unit or cooling unit with electric heat
2. Cooling unit with gas heat
3. 2 in. throwaway, standard, MERV (Minimum Efficiency Reporting Value) 3
4. Optional 2 in. pleated, MERV 8
5. Optional 4 in. pleated, MERV 13

Horizontal supply unit physical data

Table 22: KH27, KX27, KH30, and KX30 - 27.5 ton to 30 ton horizontal supply/horizontal return or horizontal supply/ vertical return airflow unit

Component	Models					
	KH27/KX27			KH30/KX30		
Nominal tonnage	27.5			30		
ARI cooling performance	Two stage	Four stage		Two stage	Four stage	
Gross Capacity at ARI A point (Btu)	312,000	316,000		340,000	336,000	
ARI net capacity (Btu)	298,000	302,000		328,000	326,000	
EER	10.9[1] / 10.5[2]	11.3[1] / 10.9[2]		10.5[1] / 10.4[2]	10.7[1] / 10.4[2]	
IEER with Intellispeed	15.2[1] / 14.7[2]	16.1[1] / 15.8[2]		13.8[1] / 13.5[2]	15.3[1] / 15.1[2]	
IEER with VAV	n/a	16.2[1] / 15.9[2]		n/a	14.9[1] / 14.7[2]	
CFM	10,700	10,300		9,400	9,100	
System power (kW)	31	24.1		32	27.9	
Refrigerant type	R-454B	R-454B		R-454B	R-454B	
Refrigerants charge (lb-oz)						
System 1	12-04	12-12		14-04	13-08	
System 2	12-04	11-08		13-04	13-00	
ARI heating performance						
Heating model	N(S)1	N(S)3	T3	N(S)1	N(S)3	T3
Heating type	Stg. Low	Stg. High	Mod. High	Stg. Low	Stg. High	Mod. High
1st stage heat input (kBtu)	320	400	140	320	400	140
2nd stage heat input (kBtu)	400	620	620	400	620	620
1st stage heat output (kBtu)	259	324	113	259	324	113
2nd stage heat output (kBtu)	324	502	502	324	502	502
Steady state efficiency (%)	81	81	81	81	81	81
Number of burners	9	9/5	9/5	9	9/5	9/5
Number of stages / Turn down	2/1.25	2/1.55	2/4.42	2/1.25	2/1.55	2/4.42
Temperature rise range (°F)	25-35	35-60	35-60	20-35	35-55	35-55
Gas limit setting (°F) (top/bottom)	120	160/230	230/300	120	150/210	230/300
Gas piping connection (in.)	3/4	1 1/4	1 1/4	3/4	1 1/4	1 1/14
Dimensions (in.)						
Length	180					
Width	90					
Height	70					
Operating weight (lb)	4078			4105		
Compressors	Two stage	Four stage		Two stage	Four stage	
Type	Scroll	Scroll		Scroll	Scroll	
Quantity	2	3		2	3	
Unit capacity steps (%)	50 / 100	24 / 51 / 76 /100		50 / 100	24 / 52 / 76 /100	
Condenser coil data						
Face area (sq. ft)	51.2			61.6		
Type	MCHX			MCHX		
Thickness (mm)	20			20		
FPI	23			23		
Circuitry type	2-Pass			2-Pass		

Table 23: KH27, KX27, KH30, and KX30 - 27.5 ton to 30 ton horizontal supply/horizontal return or horizontal supply/ vertical return airflow unit (continued)

Component	Models					
	KH27/KX27			KH30/KX30		
Nominal tonnage	**27.5**			**30**		
Evaporator coil data						
Face area (sq. ft)	34.4			34.4		
Rows	3			3		
Fins per inch	15			15		
Tube diameter	3/8			3/8		
Circuitry type	Intertwined			Intertwined		
Refrigerant control	TXV			TXV		
Condenser fan data						
Quantity	4			4		
Fan diameter (in.)	30			30		
Type	Prop			Prop		
Drive type	Direct			Direct		
Number of motors	4			4		
Motor HP each	1			1		
RPM	1140			1140		
Nominal total CFM	28530			29800		
Belt drive evap fan data						
Quantity	2			2		
Fan size (in.)	18x18			18x18		
Type	Centrifugal			Centrifugal		
Static range	Std	Med	High	Std	Med	High
Motor sheave	1VP65	2VP60	2VP60	1VP65	2VP60	2VP60
Blower sheave	1B5V124	2B5V94	2B5V86	1B5V124	2B5V94	2B5V86
Belt	BX82	BX75	BX74	BX82	BX75	BX74
Motor HP each	7.5	10.0	15.0	7.5	10.0	15.0
Motor RPM	1800	1800	1800	1800	1800	1800
Frame size	213T	215T	254T	213T	215T	254T
Filters						
Quantity - size	9 - (20 x 20 x 2) [3,4]			9 - (20 x 20 x 2)[3,4]		
	9 - (20 x 20 x 4) [5]			9 - (20 x 20 x 4)[5]		
	3 - (20 x 25 x 2)[3,4]			3 - (20 x 25 x 2)[3,4]		
	3 - (20 x 25 x 4)[5]			3 - (20 x 25 x 4)[5]		
ID Blower power (kW)	3.2[1] / 3.9[2]		3.0[1]/ 3.7[2]	3.7[1] / 3.9[2]		2.6[1] / 3.2[2]

1. Cooling only unit or cooling unit with electric heat
2. Cooling unit with gas heat
3. Standard 2 in. throwaway, MERV 3 (Minimum Efficiency Reporting Value)
4. Optional 2 in. pleated, MERV 8
5. Optional 4 in. pleated, MERV 13

Table 24: KH35, KX35, KH40, and KX40 - 35 ton to 40 ton horizontal supply/horizontal return or horizontal supply/vertical return airflow unit

Component	Models					
	KH35/KX35			KH40/KX40		
Nominal tonnage	35			40		
ARI cooling performance	Two stage	Four stage		Two stage	Four stage	
Gross Capacity at ARI A point (Btu)	400,000	405,000		435,000	435,000	
ARI net capacity (Btu)	388,000	386,000		410,000	410,000	
EER	11.6[1] / 11.4[2]	10.8[1]/ 10.6[2]		10.7[1] / 10.4[2]	10.5[1] / 10.2[2]	
IEER with Intellispeed	15.5[1] / 15.1[2]	16.5[1] / 16.1[2]		15.3[1]/ 15.0[2]	17.2[1] / 17.0[2]	
IEER with VAV	n/a	16.5[1] / 16.1[2]		n/a	16.7[1]/ 16.4[2]	
CFM	10,500	10,800		15,100	15,000	
System power (kW)	29.6	31.1		39	32	
Refrigerant type	R-454B	R-454B		R-454B	R-454B	
Refrigerants charge (lb-oz)						
System 1	17-00	17-00		24-08	25-00	
System 2	16-08	15-08		23-04	23-12	
ARI heating performance						
Heating model	N(S)1	N(S)3	T3	N(S)1	N(S)3	T3
Heating type	Stg. Low	Stg. High	Mod. High	Stg. Low	Stg. High	Mod. High
1st stage heat input (kBtu)	320	400	140	320	400	800
2nd stage heat input (kBtu)	400	800	800	400	800	800
1st stage heat output (kBtu)	259	324	113	259	324	113
2nd stage heat output (kBtu)	324	648	648	324	648	648
Steady state efficiency (%)	81	81	81	81	81	81
Number of burners	9	9/9	9/9	9	9/9	9/9
Number of stages / turn down	2/1.25	2/2	2/5.71	2/1.25	2/2	2/5.71
Temperature rise range (°F)	20-30	35-60	35-60	15-25	35-50	35-50
Gas limit setting (°F) (top/bottom)	170	240/190	180/270	130	260/230	200/270
Gas piping connection (in.)	3/4	1 1/4	1 1/4	3/4	1 1/4	1 1/14
Dimensions (in.)						
Length	180			232		
Width	90			90		
Height	70			77		
Operating weight (lb)	4191			5742		
Compressors	Two stage	Four stage		Two stage	Four stage	
Type	Scroll	Scroll		Scroll	Scroll	
Quantity	2	3		2	3	
Unit capacity steps (%)	50 / 100	25 / 50/ 75 / 100		50 / 100	25 / 50/ 75 / 100	
Condenser coil data						
Face area (sq. ft)	61.6			112.4		
Type	MCHX			MCHX		
Thickness (mm)	20			20		
FPI	23			23		
Circuitry type	2-Pass			2-Pass		

Table 25: KH35, KX35, KH40, and KX40 - 35 ton to 40 ton horizontal supply/horizontal return or horizontal supply/vertical return airflow unit (continued)

Component	Models					
	KH35/KX35			KH40/KX40		
Nominal tonnage	**35**			**40**		
Evaporator coil data						
Face area (sq. ft)	34.4			38.9		
Rows	4			4		
Fins per inch	15			15		
Tube diameter	3/8			3/8		
Circuitry type	Intertwined			Intertwined		
Refrigerant control	TXV			TXV		
Condenser fan data						
Quantity	4			4		
Fan diameter (in.)	30			30		
Type	Prop			Prop		
Drive type	Direct			Direct		
Number of motors	4			4		
Motor HP each	1			1		
RPM	1140			1140		
Nominal total CFM	29800			34109		
Belt drive evap fan data						
Quantity	2			2		
Fan size (in.)	18 x 18			20 x 18		
Type	Centrifugal			Centrifugal		
Static range	Std	Med	High	Std	Med	High
Motor sheave	1VP65	2VP60	2VP60	1VP60	1VP75	2VP60
Blower sheave	1B5V124	2B5V94	2B5V86	1B5V124	1B5V136	2B5V94
Belt	BX82	BX75	BX74	5VX830	5VX880	5VX780
Motor HP each	7.5	10.0	15.0	10.0	15.0	20.0
Motor RPM	1800	1800	1800	1800	1800	1800
Frame size	213T	215T	254T	215T	254T	256T
Filters						
Quantity - size	9 - (20 x 20 x 2)[3,4]			4 - (20 x 20 x 2)[3,4]		
	9 - (20 x 20 x 4)[5]			4 - (20 x 20 x 4)[5]		
	3 - (20 x 25 x 2)[3,4]			8 - (20 x 25 x 2)[3,4]		
	3 - (20 x 25 x 4)[5]			8 - (20 x 25 x 4)[5]		
ID Blower power (kW)	3.7[1]/ 4.3[2]		4.7[1] / 5.2[2]	7.0[1] / 7.7[2]		6.9[1] / 7.8[2]

1. Cooling only unit or cooling unit with electric heat
2. Cooling unit with gas heat
3. Standard 2 in. throwaway, MERV 3 (Minimum Efficiency Reporting Value)
4. Optional 2 in. pleated, MERV 8
5. Optional 4 in. pleated, MERV 13

Table 26: KH50 and KX50 - 50 ton horizontal supply/horizontal return or horizontal supply/vertical return airflow unit

Component	Models		
	KH50/KX50		
Nominal tonnage	50		
ARI cooling performance	Two stage	Four stage	
Gross Capacity at ARI A point (Btu)	560,000	560,000	
ARI net capacity (Btu)	530,000	530,000	
EER	10.6[1] / 10.3[2]	10.7[1] / 10.5[2]	
IEER with Intellispeed	15.2[1] / 15.0[2]	16.9[1] / 16.7[2]	
IEER with VAV	n/a	16.5[1] / 16.3[2]	
CFM	16,200	15,900	
System power (kW)	42.7	41.3	
Refrigerant type	R-454B	R-454B	
Refrigerants charge (lb-oz)			
System 1	31-00	32-08	
System 2	30-02	29-10	
ARI heating performance			
Heating model	N(S)1	N(S)3	TS3
Heating type	Stg. Low	Stg. High	Mod. High
1st stage heat input (kBtu)	320	400	140
2nd stage heat input (kBtu)	400	800	800
1st stage heat output (kBtu)	259	324	113
2nd stage heat output (kBtu)	324	648	648
Steady state efficiency (%)	81	81	81
Number of burners	9	9/9	9/9
Number of stages / Turn down	2/1.25	2/2	2/5.71
Temperature rise range (°F)	15-20	30-40	30-40
Gas limit setting (°F) (top/bottom)	130	170/180	200/270
Gas piping connection (in.)	3/4	1 1/4	1 1/14
Dimensions (in.)			
Length	232		
Width	90		
Height	77		
Operating weight (lb)	5984		
Compressors	Two stage	Four stage	
Type	Scroll	Scroll	
Quantity	2	3	
Unit capacity steps (%)	50 / 100	25 / 50/ 75 / 100	
Condenser coil data			
Face area (sq. ft)	112.4		
Type	MCHX		
Thickness (mm)	25		
FPI	23		
Circuitry type	2-Pass		

Table 27: KH50 and KX50 - 50 ton horizontal supply/horizontal return or horizontal supply/vertical return airflow unit (continued)

Component	Models		
	KH50/KX50		
Nominal tonnage	**50**		
Evaporator coil data			
Face area (sq. ft)	38.9		
Rows	5		
Fins per inch	15		
Tube diameter	3/8		
Circuitry type	Intertwined		
Refrigerant control	TXV		
Condenser fan data			
Quantity	4		
Fan diameter (in.)	30		
Type	Prop		
Drive type	Direct		
Number of motors	4		
Motor HP each	2		
RPM	1200		
Nominal total CFM	41676		
Belt drive evap fan data			
Quantity	2		
Fan size (in.)	20 x 18		
Type	Centrifugal		
Static range	Std	Med	High
Motor sheave	1VP60	1VP75	2VP60
Blower sheave	1B5V124	1B5V136	2B5V94
Belt	5VX830	5VX880	5VX780
Motor HP each	10.0	15.0	20.0
Motor RPM	1800	1800	1800
Frame size	215T	254T	256T
Filters			
Quantity - size	4 - (20 x 20 x 2)[3, 4]		
	4 - (20 x 20 x 4)[5]		
	8 - (20 x 25 x 2)[3, 4]		
	8 - (20 x 25 x 4)[5]		
ID Blower power (kW)	7.6[1] / 8.7[2]	8.2[1]/ 9.3[2]	

1. Cooling only unit or cooling unit with electric heat
2. Cooling unit with gas heat
3. Standard 2 in. throwaway, MERV 3 (Minimum Efficiency Reporting Value)
4. Optional 2 in. pleated, MERV 8
5. Optional 4 in. pleated, MERV 13

Optional electric heat

Note: Electric heat is only available if the nomenclature's second digit (efficiency) is standard vertical or standard horizontal.

The factory-installed heaters are wired for single point power supply. You only need to bring the power supply into the single point terminal block.

These CSA approved heaters are located within the central compartment of the unit with the heater elements extending in to the supply air chamber.

Fuses are supplied, where required, by the factory. See Optional electric heat for minimum CFM limitations. See the electrical data tables for electrical data.

Table 28: Electric heat minimum airflow requirements

Size (tons)	Heat size (kW)				
	36	54	72	90	108
27.5	8250	8250	8250	8250	-
30	9000	9000	9000	9000	-
35	10,500	10,500	10,500	10,500	-
40	-	12,000	12,000	12,000	12,000
50	-	15,000	15,000	15,000	15,000

Optional gas heat

The optional gas-fired heaters have aluminized-steel or optional stainless steel, tubular heat exchangers with spark ignition with proven pilot.

This unit is shipped from the factory for use with natural gas at elevations up to 2,000 ft (610 m) above sea level. The unit may be field-converted for use with propane gas and at elevations above 2,000 ft with a listed conversion kit. Modulating furnaces, gas model T3, are **not** certified for use with propane and cannot be converted.

Note: Install this furnace at altitudes above 2,000 ft (610 m) in accordance with local codes, or in the absence of local codes, the National Fuel Gas Code, ANSI Z223.1/ NFPA 54 or National Standard of Canada, Natural Gas and Propane Installation Code, CSA B149.1.

Table 29: Gas application data

Unit		Input (MBH)	Output (MBH)	Temp. rise (°F) [1]
Size (ton)	Heat size			
27.5	(N,S)1	400	324	25-35
	(N,S)3	620	506	35-60
	T3	620	506	35-60
30	(N,S)1	400	324	20-35
	(N,S)3	620	506	35-55
	T3	620	506	35-55
35	(N,S)1	400	324	20-30
	(N,S)3	800	648	35-60
	T3	800	648	35-60

Table 29: Gas application data

Unit		Input (MBH)	Output (MBH)	Temp. rise (°F) [1]
Size (ton)	Heat size			
40	(N,S)1	400	324	15-25
	(N,S)3	800	648	35-50
	T3	800	648	35-50
50	(N,S)1	400	324	15-20
	(N,S)3	800	648	30-40
	T3	800	648	30-40

1 On VAV units with a non-modulating furnace, individual VAV boxes must be fully open in heating mode to ensure airflow falls within the temperature rise range.

Table 30: Gas heat allowable air flow

Size (ton)	Heat size	Supply air (CFM) heating	
		Min	Max
27.5	(N,S)1	8250	12375
	(N,S)3	8250	12375
	T3	6875	12375
30	(N,S)1	9000	13500
	(N,S)3	9000	13500
	T3	7500	13500
35	(N,S)1	10500	15750
	(N,S)3	10500	15750
	T3	8750	15750
40	(N,S)1	12000	18000
	(N,S)3	12000	18000
	T3	10000	18000
50	(N,S)1	15000	20000
	(N,S)3	15000	20000
	T3	12500	20000

Gas piping

The correct sizing of gas piping depends on the cubic feet per hour of gas flow required, specific gravity of the gas, and the length of run.

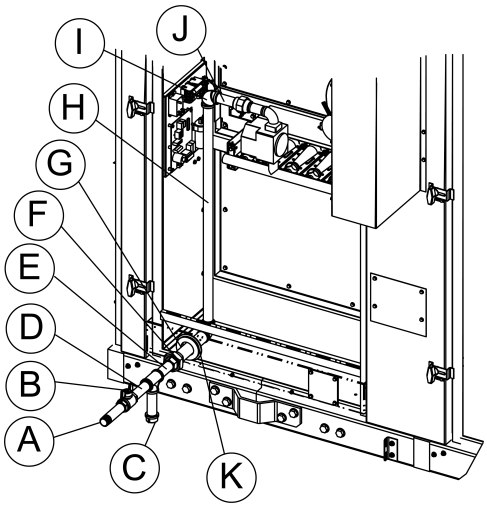
Follow the *National Fuel Gas Code Z223.1* (in U.S.A.) or the current *Gas Installation Codes CSA-B149.1* (in Canada) in all cases unless they are superseded by local codes or gas utility requirements.

See Table 31. The heating value of the gas may vary by locality. Check the value with the local gas utility.

Note: There may be a local gas utility requirement specifying a minimum diameter for gas piping. All units require a 1 1/4 in. pipe connection at the entrance fitting. Do not size the supply line smaller than the entrance fitting size.

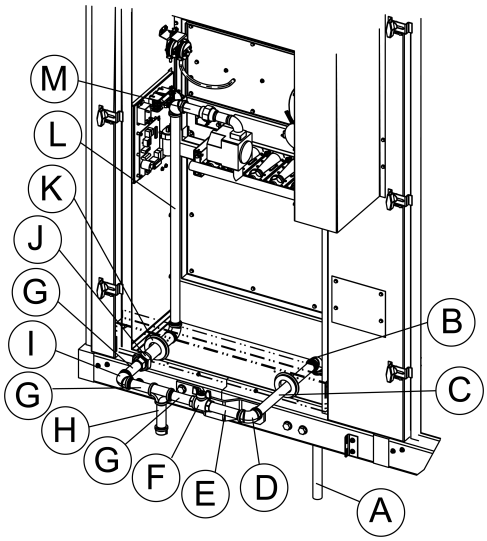
The following figures show the gas piping.

Figure 89: Low heat gas unit with side gas connection arrangement



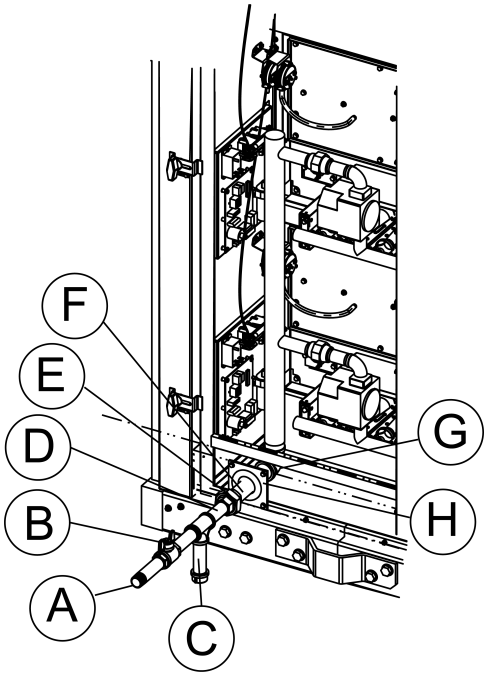
Item	Description
A	Extended pipe
B	Manual shut-off valve
C	Sediment trap
D	4 1/2 in. long nipple
E	4 in. long nipple
F	Union
G	7 in. long nipple
H	28 in. pipe
I	90° elbow
J	3.7 in. long nipple
K	Caulk between pipe and base rail grommet to provide watertight seal

Figure 90: Low heat gas unit with bottom gas connection arrangement



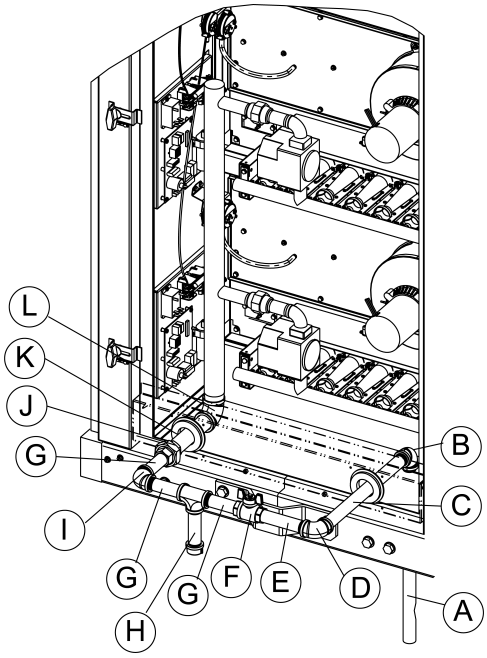
Item	Description
A	Extended pipe
B	90° elbow
C	13.5 in. pipe
D	90° elbow
E	5 in. long nipple
F	Manual shut-off valve
G	4 in. long nipple
H	Sediment trap
I	90° elbow
J	Union
K	7 in. long nipple
L	28 in. pipe
M	3.7 in. long nipple

Figure 91: High heat gas unit with side gas connection arrangement



Item	Description
A	Extended pipe
B	Manual shut-off valve
C	Sediment trap
D	4 in. long nipple
E	Reducer
F	7 in. long nipple
G	90° elbow
H	Caulk between pipe and base rail grommet to provide watertight seal

Figure 92: High heat gas unit with bottom gas connection arrangement



Item	Description
A	Extended pipe
B	90° elbow
C	13.5 in. pipe
D	90° elbow
E	5 in. long nipple
F	Manual shut-off valve
G	4 in. long nipple
H	Sediment trap
I	90° elbow
J	Reducer
K	7 in. long nipple
L	90° elbow

Table 31: Gas pipe sizing - capacity of pipe

Length of pipe (ft)	Nominal iron pipe size		
	3/4 in.	1 in.	1 1/4 in.
10	278	520	1050
20	190	350	730
30	152	285	590
40	130	245	500
50	115	215	440
60	105	195	400
70	96	180	370
80	90	170	350
90	84	160	320
100	79	150	305

ⓘ **Note:** Maximum capacity of pipe in cubic feet of gas per hour based upon a pressure drop of 0.3 in. W.C. and 0.6 specific gravity gas.

Gas connection

The gas supply line can be routed within the space and roof curb with the exit through the unit's basepan. See for the gas piping inlet location. Typical supply piping arrangements are shown in the Gas piping section. All pipe nipples, fittings, and the gas cock are field supplied.

Apply the following gas piping specifications:

- Install a drip leg or sediment trap and a ground joint union in the gas piping.
- When required by local codes, install a manual shut-off valve outside of the unit.
- Use wrought iron or steel pipe for all gas lines. Apply pipe dope sparingly to male threads only.
- If local codes allow the use of a flexible gas appliance connector, always use a new listed connector. Do not use a connector which has previously serviced another gas appliance.

⚠ WARNING

Natural gas may contain some propane. Propane is an excellent solvent and will quickly dissolve white lead and most standard commercial compounds. A special pipe dope must be used when assembling wrought iron or steel pipe. Shellac based compounds such as Gaskolac or Stalastic, and compounds such as Rectorseal #5, Clydes's or John Crane may be used.

- Clean all piping of dirt and scale. Hammer on the outside of the pipe and blow out loose particles. Before initial start-up, make sure that all gas lines external to the unit are purged of air.
- The gas supply must be a separate line and installed in accordance with all safety codes as prescribed under Limitations.
- Install a 1/8 in. NPT plugged tapping, accessible for test gage connection, immediately upstream of the gas supply connection to the unit.
- After the gas connections are complete, open the main shut-off valve admitting normal gas pressure to the mains. Check all joints for leaks with soap solution or other material suitable for the purpose. Never use a flame.

⚠ WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow the safety warning exactly could result in serious injury, death, or property damage. Never test for gas leaks with an open flame. Use a commercially available soap solution made specifically for the detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury, or loss of life.

⚠ CAUTION

The furnace and its individual shut-off valve must be disconnected from the gas supply piping system during any pressure testing at pressures greater than 1/2 psig (3.5 kPa). Pressures greater than 1/2 psig (3.5 kPa) cause gas valve damage resulting in a hazardous condition. If the gas valve is subjected to a pressure greater than 1/2 psig (3.5 kPa), it must be replaced. The furnace must be isolated from the gas supply piping system by closing its individual manual shut-off valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 psig (3.5 kPa).

⚠ WARNING

Threaded joints must be coated with a sealing compound that is resistant to the action of liquefied petroleum gases. Do not use Teflon® tape.

Propane units, tanks, and piping

All gas heat units are shipped from the factory equipped for natural gas use only. The unit may be converted in the field for use with propane gas with an accessory kit.

All propane gas equipment must conform to the safety standards of the National Fire Protection Association.

For satisfactory operation, propane gas pressure must be at the correct inlet pressure at the unit under full load. See conversion kit instructions for minimum and maximum

supply inlet pressure. Maintaining correct gas pressure depends on three main factors:

- The vaporization rate which depends on the temperature of the liquid and the wetted surface area of the containers.
- The correct pressure regulation. Two-stage regulation is recommended.
- The pressure drop in the lines between regulators and between the second stage regulator and the appliance. The pipe size required depends on the length of the pipe run and the total load of all appliances.

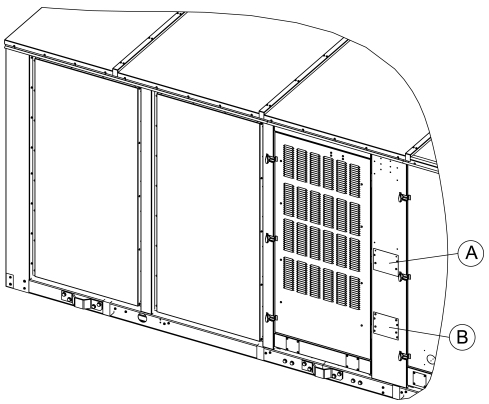
Complete information regarding tank sizing for vaporization, correct regulator settings, and pipe sizing is available from most regulator manufacturers and propane gas suppliers.

Installing the flue exhaust hood

Combustion air intake louvers are incorporated into the heating compartment right outside wall and access panel. The flue exhaust is discharged out from the side of the unit in the locations shown in Figure 93.

Note: A low gas heat unit only uses the upper exhaust port while a high gas heat unit uses both exhaust ports. If necessary, you can install a flue exhaust extension accessory in place of a hood.

Figure 93: Gas heat exhaust locations

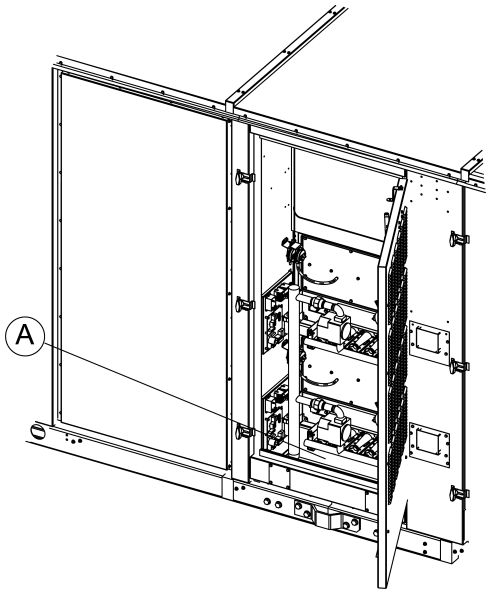


Item	Description
A	Exhaust shipping cover for low and high gas heat
B	Exhaust shipping cover for high gas heat only

1. Remove the factory shipping label and four screws that cover the exhaust opening. Retain the screws for use in a later step. The flue exhaust hood is shipped in the gas heat compartment in the location shown in Figure 94.

   Note: Only remove the covers that need to be replaced with an exhaust hood. For low gas heat units leave the lower shipping cover in place.

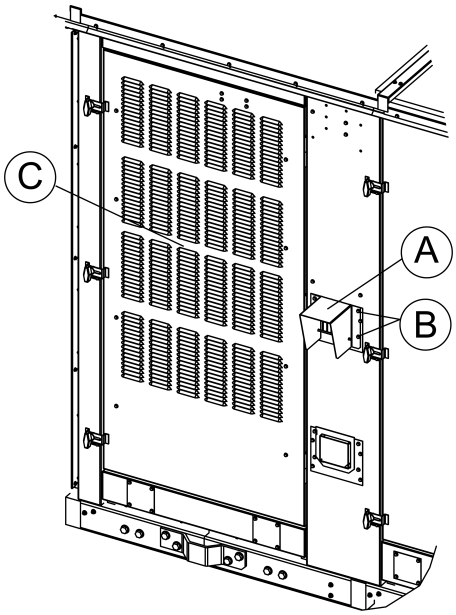
Figure 94: Flue exhaust shipping location



Item	Description
A	Flue exhaust hood shipping location

2. Using the screws removed in Step 1, attach the upper flue exhaust hood as shown in Figure 95. For units with low gas heat, the installation is now complete.

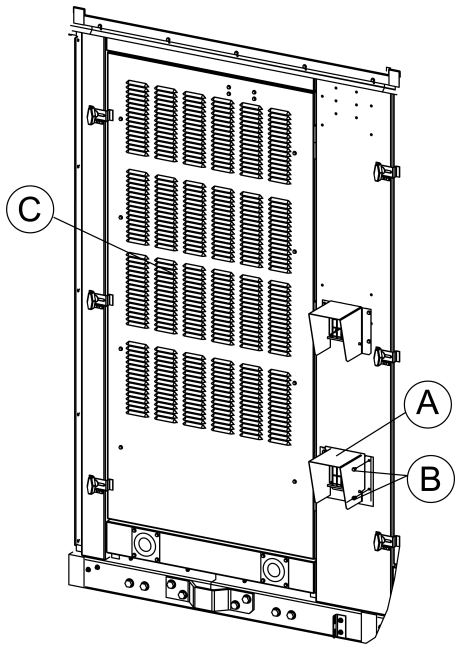
Figure 95: Low gas heat flue exhaust hood installations



Item	Description
A	Flue exhaust
B	Four mounting screws
C	Combustion air intake louvers

3. For units with high gas heat, using the screws removed in Step 1, attach the lower flue exhaust hood as shown in Figure 96.

Figure 96: High gas heat flue exhaust hood installation



Item	Description
A	Flue exhaust
B	Four mounting screws
C	Combustion air intake louvers

Economizer sequences

Several functions can drive the economizer, including: minimum position, free cooling, economizer loading, and minimum outdoor air supply.

Economizer minimum position

The economizer minimum position is set during occupied mode when outside air is not suitable for free cooling. The position of the damper is set proportionally between the economizer minimum position and the economizer minimum position low speed fan setpoints, in relationship to the VFD output percentage.

Free cooling operation

When the control determines that the outside air is suitable, the first stage of cooling is always free cooling.

Thermostat

In free cooling, with a thermostat input to Y1, the dampers modulate to control the supply air temperature to the economizer setpoint +/- 1°F (default 55°F).

If the thermostat provides an input to Y2 and the parameter COMPRESSORS OFF IN FREE COOLING is turned OFF, a compressor output energizes. The economizer dampers continue to modulate to control the supply air temperature to the economizer setpoint.

If the supply air temperature cannot be maintained within 5°F of the economizer setpoint, the first stage compressor (C1) is turned on. The second stage compressor (C2) is added as needed to keep the supply air temperature within the 5°F of the economizer setpoint.

Sensor

In free cooling, with a demand from the zone/return sensor for the first stage of cooling, the dampers modulate to control the supply air temperature to the economizer setpoint +/- 1°F.

If the economizer output is at 100% and the SAT is greater than the economizer setpoint + 1°F, the control starts a 12-minute timer to energize a compressor output.

If at any time the economizer output drops below 100%, the timer stops and resets when the economizer output returns to 100%.

When a compressor output is turned ON, the economizer dampers continue to modulate to control the supply air temperature to the economizer setpoint.

At no time is a compressor output turned ON if the economizer output is less than 100%, even if the differential between zone (or return) temperature and the current cooling setpoint is great enough to demand more than one stage of cooling.

If the economizer output goes to minimum position and the SAT is less than economizer setpoint -1°F, the control starts a 12-minute timer to de-energize a compressor output.

If at any time the economizer output goes above the minimum position, the timer stops and resets when the economizer output returns to minimum position.

If the demand for cooling from the space/return is satisfied, the economizer output modulates to minimum position and the compressor outputs are de-energized as long as their minimum run timers have expired.

Dry bulb changeover

For dry bulb economizer operation, the outside air is suitable for free cooling if the outside air temperature is 1°F below the economizer OAT enable setpoint and 1°F below the return air temperature (RAT).

Free cooling is no longer available if the outside air temperature rises above either the economizer OAT enable setpoint or the return air temperature.

Single enthalpy changeover

For single enthalpy economizer operation, the outside air is suitable for free cooling if the outside air enthalpy is at least 1 Btu/lb below the economizer outside air enthalpy setpoint and the outside air temperature is no greater than the RAT plus 9°F.

If the outside air temperature rises above the RAT plus 10°F, free cooling is no longer available. The outside air

temperature must drop to no greater than RAT plus 9°F to enter free cooling again.

Free cooling is no longer available if the outside air enthalpy rises above the economizer outside air enthalpy setpoint.

Dual enthalpy changeover

For dual enthalpy economizer operation, the outside air enthalpy must be lower than the return air enthalpy by 1 Btu/lb and the outside air temperature is no greater than the RAT plus 9°F.

Auto

The control determines the type of free cooling changeover based on which sensors are present and reliable. Conditions include the following:

- Return and outside air dry bulb = dry bulb changeover
- Return and outside air dry bulb and outside air humidity = single enthalpy
- Return and outside air dry bulb and return and outside air humidity = dual enthalpy
- If either the return or outside air dry bulb sensors are unreliable, free cooling is not available

Free cooling operation

When the control determines that the outside air is suitable, the first stage of cooling is always free cooling.

Thermostat

In free cooling, with a thermostat input to Y1, the dampers modulate to control the supply air temperature to the economizer setpoint +/- 1°F (default 55°F).

If the thermostat provides an input to Y2 and the parameter COMPRESSORS OFF IN FREE COOLING is turned OFF, a compressor output energizes. The economizer dampers continue to modulate to control the supply air temperature to the economizer setpoint.

If the supply air temperature cannot be maintained within 5°F of the economizer setpoint, the first stage compressor (C1) is turned on. The second stage compressor (C2) is added as needed to keep the supply air temperature within the 5°F of the economizer setpoint.

Sensor

In free cooling, with a demand from the zone/return sensor for the first stage of cooling, the dampers modulate to control the supply air temperature to the economizer setpoint +/- 1°F.

If the economizer output is at 100% and the SAT is greater than the economizer setpoint + 1°F, the control starts a 12-minute timer to energize a compressor output.

If at any time the economizer output drops below 100%, the timer stops and resets when the economizer output returns to 100%.

When a compressor output is turned ON, the economizer dampers continue to modulate to control the supply air temperature to the economizer setpoint.

At no time is a compressor output turned ON if the economizer output is less than 100%, even if the differential between zone (or return) temperature and the current cooling setpoint is great enough to demand more than one stage of cooling.

If the economizer output goes to minimum position and the SAT is less than economizer setpoint -1°F, the control starts a 12-minute timer to de-energize a compressor output.

If at any time the economizer output goes above the minimum position, the timer stops and resets when the economizer output returns to minimum position.

If the demand for cooling from the space/return is satisfied, the economizer output modulates to minimum position and the compressor outputs are de-energized as long as their minimum run timers have expired.

Power exhaust

Setpoints

- Economizer enable: ON
- Power exhaust enable: ON
- Modulating power exhaust: OFF
- Exhaust VFD installed: OFF
- Building pressure sensor enabled: OFF
- Economizer damper position for exhaust fan: ON Percent
- Economizer damper position for exhaust fan: OFF Percent

Inputs

No inputs are present for non-modulating power exhaust.

Outputs

- 2 VDC to 10 VDC from ECON on the economizer expansion module
- 24 VAC from EX-FAN to energize the exhaust fan on the economizer expansion module

Operation

Operation details include the following items:

- Compares the economizer output to the economizer damper position for exhaust fan on and off
- Energizes the exhaust fan when the economizer output is above the economizer damper position for exhaust fan on
- De-energizes the exhaust fan when the economizer output is below the economizer damper position for exhaust fan off

Modulating power exhaust with VFD

Setpoints and related data

The setpoints and related data include the following items:

- Power exhaust fan type (ExFType) variable frequency fan
- Building pressure setpoint (Bldg-Sp)
- Building pressure reading (Bldg-Pres)

Inputs

The input for modulating power exhaust with VFD is 0 VDC to 5 VDC from building pressure sensor to terminal BLDG PRES.

Outputs

The outputs include the following items:

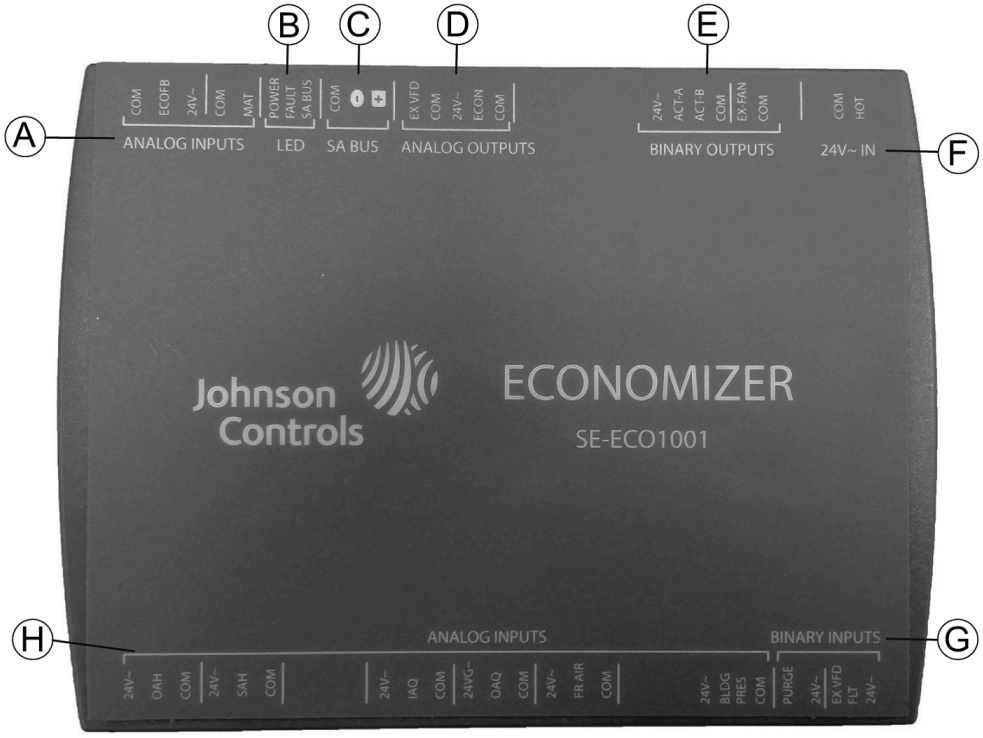
- 2 VDC to 10 VDC from EX VFD
- 24 VAC from EX-FAN

Operation

If the building pressure is above the building pressure setpoint, the exhaust output (EX VFD) increases. If the building pressure is below the building pressure setpoint, the exhaust output (EX VFD) decreases. The EX-FAN binary output is energized any time the EX VFD analog output is greater than 2.16 VDC. The EX-FAN binary output is de-energized any time the EX VFD analog output is less than or equal to 2.16 VDC. The rate of change of the analog output is determined by the deviation from setpoint and length of time away from setpoint.

Smart Equipment economizer board

Figure 97: SE-ECO1001 economizer controller



The following tables describe the details of the economizer board. See the previous figure for connection locations.

Table 32: Smart Equipment economizer board - analog inputs

Location	Board label	Cover label	Description	Function and comments
A	C	COM	24 VAC common/0-10 VDC negative for economizer actuator position feedback	Connects through circuit trace to 24V~ IN pin COM
	IN2	ECOFB	0-10 VDC positive input from economizer actuator position feedback	The EconDampPos parameter reports input status (0-100%). Used to meet California Title 24 requirements for economizer actuator position feedback.
	R	24V~	24 VAC hot supplied for economizer actuator position feedback	Connects through circuit trace to 24V~ IN pin HOT
	C	COM	Mixed air temperature sensor input from 10KΩ @ 77°F, Type III negative temperature coefficient thermistor	The MAT parameter reports input status (°F/°C), 3.65 VDC reading MAT (+) to COM (–) with open circuit. Read-only use in current control revision.
	IN1	MAT		

Table 32: Smart Equipment economizer board - analog inputs

Location	Board label	Cover label	Description	Function and comments
H	R	24V~	24 VAC hot supplied for the outdoor air humidity sensor	Connects through circuit trace to 24V~ IN pin HOT
	IN3	OAH	0-10 VDC positive input from the Outdoor Air Humidity sensor	OAH parameter reports input status (0-100%H). Used in outdoor air enthalpy calculation for dual enthalpy economizer free cooling changeover.
	C	COM	24 VAC common/0-10 VDC negative for the outdoor air humidity sensor	Connects through circuit trace to 24V~ IN pin COM
	R	24V~	24 VAC hot supplied for the supply air humidity sensor	Connects through circuit trace to 24V~ IN pin HOT
	IN4	SAH	0-10 VDC positive input from the Supply Air Humidity sensor	SAH parameter reports input status (0-100%H). Unused in current control revision.
	C	COM	24 VAC common/0-10 VDC negative for the supply air humidity sensor	Connects through circuit trace to 24V~ IN pin COM
	R	24V~	24 VAC hot supplied for the indoor air quality sensor	Connects through circuit trace to 24V~ IN pin HOT
	IN5	IAQ	0-10 VDC positive input from the Indoor Air Quality sensor	IAQRange parameter sets the CO2 parts per million measured by the indoor air quality sensor when it outputs 10 VDC; IAQ parameter reports input status (0-5000ppm). Used for demand ventilation functions if the NetIAQ parameter indicates ?Unrel.
	C	COM	24 VAC common/0-10 VDC negative for the indoor air quality sensor	Connects through circuit trace to 24V~ IN pin COM
	R	24V~	24 VAC hot supplied for the outdoor air quality sensor	Connects through circuit trace to 24V~ IN pin HOT
	IN6	OAQ	0-10 VDC positive input from the Outdoor Air Quality sensor	OAQRange parameter sets the CO2 parts per million measured by the outdoor air quality sensor when it outputs 10 VDC; OAQ parameter reports input status (0-5000ppm). Used for demand ventilation function when DVent-Mode selection is Diff between IAQ and OAQ and the NetOAQ parameter indicates ?Unrel.
	C	COM	24 VAC common/0-10 VDC negative for the outdoor air quality sensor	Connects through circuit trace to 24V~ IN pin COM
	R	24V~	24 VAC hot supplied for the air monitoring station sensor	Connects through circuit trace to 24V~ IN pin HOT
	IN7	FR AIR	0-10 VDC positive input from the air monitoring station sensor	MOA-Range parameter sets the cubic feet per minute/liters per second measured by the air monitoring station sensor when it outputs 10 VDC; Fr Air parameter reports input status (0-50000CFM/23595lps). Used for economizer minimum position reset in speed-controlled indoor blower applications.
	C	COM	24 VAC common/0-10 VDC negative for the air monitoring station sensor	Connects through circuit trace to 24V~ IN pin COM
	R	24V~	24 VAC hot supplied for the building pressure sensor	Connects through circuit trace to 24V~ IN pin HOT
	IN8	BLDG PRES	0-5 VDC positive input from the Building Pressure sensor	BldgPres parameter reports input status (-.250-.250”/ w/-.062-.062kPa). Used for modulating power exhaust functions when ExFType selection is Modulating Damper or Variable Frequency Fan.
	C	COM	24 VAC common/0-5 VDC negative for the building pressure sensor	Connects through circuit trace to 24V~ IN pin COM

Table 33: Smart Equipment economizer board - LED details

Location	Board label	Cover label	Description	Function and comments
B	POWER	POWER	Green UCB power indicator	Lit indicates 24 VAC is present at 24V~ IN COM and HOT pins
	FAULT	FAULT	Red networking error and firmware error indicator	1/10th second on/off flashing indicates a networking error (polarity, addressing) or a firmware error (likely correctable with re-loading from USB flash drive)
	SA BUS	SA BUS	Green UCB SA bus communication transmission indicator	Lit/flickering indicates UCB-to-economizer board SA bus communication is currently active, off indicates the economizer board is awaiting SA bus communication

Table 34: Smart Equipment economizer board - SA bus details

Location	Board label	Cover label	Description	Function and comments
[1]C[1]	C	COM	Common for SA BUS power and communication circuits	EconCtrlr parameter reports UCB-to-economizer board SA bus communication status. Negative of the SA BUS communication circuit to the UCB. Through the unit wiring harness, may continue on to the 4-stage board and/or fault detection and diagnostics board
	–	–	Communication for SA BUS devices	EconCtrlr parameter reports UCB-to-economizer board SA BUS communication status. Positive of the VDC (typically, a fluctuating 1.5 V to 3.5 V reading to C; at least 0.25 V lower than +) SA BUS communication circuit to the UCB. Through the unit wiring harness, may continue on to the 4-stage board and/or fault detection and diagnostics board
	+	+	Communication for SA BUS devices	EconCtrlr parameter reports UCB-to-economizer board SA BUS communication status. Positive of the VDC (typically, a fluctuating 1.5 V to 3.5 V reading to C; at least 0.25 V higher than –) SA BUS communication circuit to the UCB. Through the unit wiring harness, may continue on to the 4-stage board and/or fault detection and diagnostics board

1 When wiring the unit and other devices using the SA Bus and FC Bus, see Table 91 .

Table 35: Smart Equipment economizer board - analog outputs

Location	Board label	Cover label	Description	Function and comments
D	J4	EX VFD	2-10 VDC positive output for the modulating power Exhaust fan Variable Frequency Drive/ discharge damper modulating power exhaust actuator	ExFanVFD parameter reports output status (0-100%) when ExFType selection is Variable Frequency Fan; EAD-O parameter reports output status (0-100%) when ExFType selection is Modulating Damper. Used to ramp the power exhaust fan VFD/ position the discharge damper actuator.
		COM	24 VAC common/0-10 VDC negative for the power exhaust variable frequency drive/ discharge damper modulating power exhaust actuator	Connects through circuit trace to 24V~ IN pin COM
		24V~	24 VAC hot supplied for the discharge damper modulating power exhaust actuator and economizer actuator	Connects through circuit trace to 24V~ IN pin HOT
		ECON	2-10 VDC output for the Economizer actuator	Econ parameter reports output status (0-100%). Used to position the economizer actuator for minimum position, free cooling, demand ventilation, cooling economizer loading and purge functions
		COM	24 VAC common/0-10 VDC negative for economizer actuator	Connects through circuit trace to 24V~ IN pin COM

Table 36: Smart Equipment economizer board - binary outputs

Location	Board label	Cover label	Description	Function and comments
E	J3	24V~	24 VAC hot supplied for an incremental (floating control) economizer actuator	Connects through circuit trace to 24V~ IN pin HOT
		ACT-A	24 VAC hot outputs to position an incremental (floating control) economizer actuator	Unused in current control revision
		ACT-B	24 VAC return	Unused in current control revision
		COM	24 VAC common for an incremental (floating control) economizer actuator	Connects through circuit trace to 24V~ IN pin COM
		EX-FAN	24 VAC hot output to energize power exhaust fan contactor coil/VFD enable relay coil	ExFan parameter reports output status (Off-On) when ExFType selection is Non-Modulating, Modulating Damper or Variable Frequency Fan. Used to turn on/enable the power exhaust fan motor.
		COM	24 VAC common/0-10 VDC negative for economizer actuator	Connects through circuit trace to 24V~ IN pin COM

Table 37: Smart Equipment economizer board - 24 V~ IN connections

Location	Board label	Cover label	Description	Function and comments
F	C	COM	24 VAC transformer Common referenced to cabinet ground	24 VAC common connection to power the economizer board. Connects through circuit traces to C/COM terminals and pins distributed on the economizer board.
	R	HOT	24 VAC transformer HOT	24 VAC hot connection to power the economizer board. Connects through circuit traces to R/24V~ terminals and pins distributed on the economizer board.

Table 38: Smart Equipment economizer board - binary inputs

Location	Board label	Cover label	Description	Function and comments
G	IN9	PURGE	24 VAC hot input from the PURGE dry contact	Purge parameter reports input status (False with 0 VAC input-True with 24 VAC input). When Purge status is True, heating and cooling operation is prevented, the indoor blower and power exhaust fan operate, the economizer actuator is positioned to 100%.
		24 V~	24 VAC hot supplied for the purge dry contact	Connects through circuit trace to 24V~ IN pin HOT
	IN10	EX VFD FLT	24 VAC hot input from the power Exhaust Variable Frequency Drive Fault contact	ExFanVFDFlt parameter reports input status (Normal with 0 VAC input-Alarm with 24 VAC input) when ExFType selection is Variable Frequency Fan. When ExFanVFDFlt status is Alarm, EX-FAN fan output is prevented.
		24 V~	24 VAC hot supplied for the power exhaust variable frequency drive fault contact	Connects through circuit trace to 24V~ IN pin HOT

Indoor air quality

Indoor air quality (IAQ) is regulated by an indoor sensor input. The IAQ sensor is connected to the economizer board through the IAQ analog input terminal and the associated COM and 24V~ inputs on the economizer board. Terminal IAQ accepts a 0 VDC to +10 VDC signal with respect to the IAQ terminal.

When the signal is below its setpoint, the actuator can modulate normally in accordance with the enthalpy and mixed air sensor inputs. When the IAQ signal exceeds its setpoint setting and there is no call for free cooling, the actuator is proportionately modulated from the 0 VDC to 10 VDC signal, with 0 VDC corresponding to full closed and 10 VDC corresponding to full open. When there is no call for free cooling, the damper position is limited by the IAQ maximum damper position setting.

When the signal exceeds its setpoint (demand control ventilation setpoint) setting and there is a call for free cooling, the actuator modulates from the minimum position

to the full open position based on the highest call from either the mixed air sensor input or the IAQ voltage input.

- Optional CO^2 space sensor kit (wall mount) - part no. 2AQ04700724
- Optional CO^2 sensor kit (unit mount) - part no. 2AQ04700624

Phasing

All units are correctly phased at the factory. Check for correct compressor rotation. If the blower or compressors rotate in the wrong direction at start-up, the electrical connection to the unit is misphased. Change the phasing of the field line connection at the factory or field supplied disconnect to obtain the correct rotation. Scroll compressors operate in only one direction. The scroll is misphased if it is drawing low amperage, has similar suction and discharge pressures, or it produces a high noise level.

⚠ CAUTION

Scroll compressors require proper rotation to operate correctly. Units are properly phased at the factory. Do not change the internal wiring to make the blower condenser fans or compressor rotate correctly.

Blower rotation

Check for the correct supply air blower rotation. If the blower is rotating backwards, the line voltage at the unit point of power connection is misphased. See Phasing.

Adjusting the belt tension

To adjust the belt tension complete the following steps:

1. Loosen the two top nuts (B) on each L-bolt. See Figure 98 and Figure 99.
2. Loosen the two lower nuts (C) on each L-bolt. See Figure 98 and Figure 99.

Figure 98: Top view

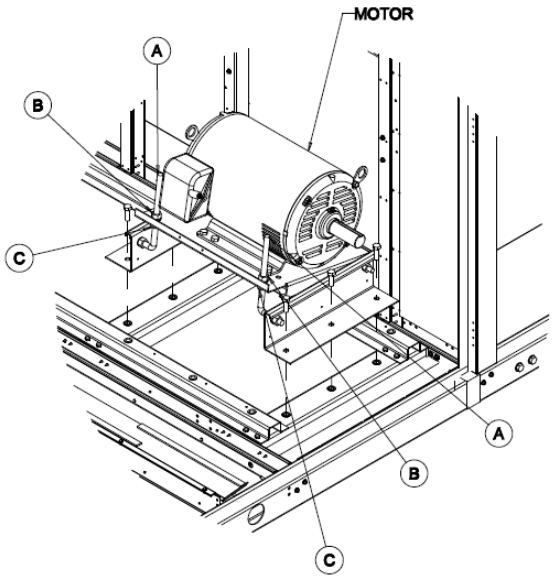
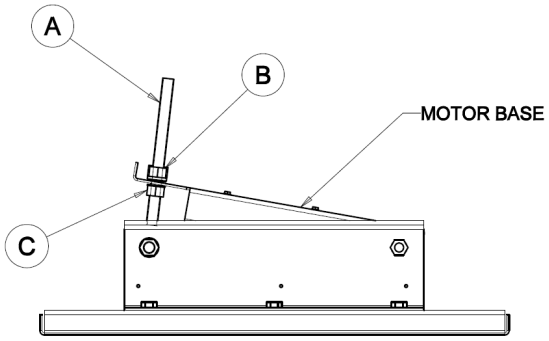


Figure 99: Side view



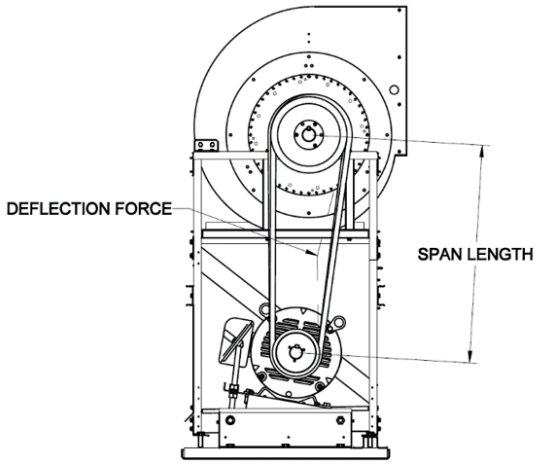
Item	Description
A	L-bolt
B	Adjustable top nut
C	Adjustable lower nut

3. To adjust the belt tension using the adjustment of nuts complete the following steps:
   a. To increase belt tension, clear the lower nuts (C) away from bracket and turn the top nuts (B) against the bracket.
   b. To decrease belt tension, clear the top nuts (B) away from bracket and turn the lower nuts (C) against the bracket.

   ⓘ **Note:** For two-belt applications, adjust the two nut and bolt assemblies so that equal tension is obtained for both belts

   ⓘ **Note:** New belts are to be tensioned to the maximum deflection force specifications for the belt section. Table 39 contains the values to be used after break-in of new belts.

Figure 100: Measuring belt tension



4. Measure belt tension:
   a. Use a belt tension checker to apply a perpendicular force to one belt at the midpoint of the span as shown in Figure 100. To determine the deflection adjacent belt (if applicable), use a straight edge from sheave to sheave as a reference line.
   b. Increase applied force until a deflection distance of 0.4 in. is obtained and compare the measured deflection force in Table 39.
   c. Adjust the belt tension until specified deflection force is measured.
   d. After the belts have been tensioned correctly, move all nuts (B or C) against the bracket.
5. After belts have been tensioned correctly, move all nuts (B or C) against the bracket

Table 39: Belt tension

Size	Motor-static	Belt tension		Max RPM
		Deflection force (lb)	Deflection distance (in.)	
27.5	7.5HP - STD	5.78	0.4	1100
	10HP - MED	4.48	0.4	
	15HP - HIGH	5.72	0.4	
30	7.5HP - STD	5.9	0.4	
	10HP - MED	6.91	0.4	
	15HP - HIGH	5.93	0.4	
35	7.5HP - STD	5.78	0.4	
	10HP - MED	4.48	0.4	
	15HP - HIGH	5.72	0.4	

Table 39: Belt tension

Size	Motor-static	Belt tension		Max RPM
		Deflection force (lb)	Deflection distance (in.)	
40	10HP - STD	7.42	0.4	1050
	15HP - MED	8.85	0.4	
	20HP - HIGH	7.23	0.4	
50	10HP - STD	7.42	0.4	
	15HP - MED	8.85	0.4	
	20HP - HIGH	7.23	0.4	

Drive selection

1. Determine the required airflow.
2. Calculate or measure the amount of external static pressure.
3. With the operating point determined from the previous steps, locate this point on the appropriate supply air blower performance table. Linear interpolation may be necessary.
4. Note the RPM and BHP from the previous step and locate the appropriate motor or drive.
5. Review the BHP compared to the motor options available. Select the appropriate motor or drive.
6. Review the RPM range for the motor options available. Select the appropriate drive if multiple drives are available for the chosen motor.
7. Determine the turns open to obtain the required operation point.

Example:

1. 9000 CFM
2. 1.2 IWG
3. Using the supply air blower performance table below, the following data point was located: 810 RPM and 4.82 BHP.
4. Using the following RPM selection table, Size X and Model Y is found.
5. 4.82 BHP does not exceed the maximum continuous BHP rating of any of the three motor options, so all three motors are still eligible for selection.
6. 810 RPM falls within the range of the 7.5 HP drive.
7. Using the 7.5-HP motor, 2.5 turns open achieves 810 RPM.

Table 40: Example supply air blower performance

Air flow (CFM)	Available external static pressure - IWG																							
	0.3		0.4		0.6		0.8		1		1.2		1.4		1.6		1.8		2		2.2		2.4		2.5	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 7.5 HP and field drive						Standard 7.5 HP and drive								Medium 10 HP and drive								High 20 HP and drive			
8000	573	2.29	599	2.53	649	2.98	696	3.39	742	3.78	786	4.16	828	4.55	869	4.95	910	5.36	949	5.79	988	6.25	1026	6.75	1045	7.00
9000	606	2.92	631	3.15	678	3.59	724	4.01	768	4.41	810	4.82	851	5.24	892	5.67	931	6.13	970	6.60	1007	7.12	1045	7.66	1063	7.95
10000	642	3.62	665	3.85	711	4.29	754	4.72	796	5.15	837	5.58	877	6.04	916	6.51	955	7.00	992	7.53	1029	8.09	1066	8.69	1084	9.01
11000	680	4.41	702	4.64	745	5.09	787	5.54	827	6.00	867	6.47	906	6.96	943	7.47	981	8.01	1017	8.59	1054	9.21	1089	9.87	1107	10.21
12000	721	5.31	741	5.55	782	6.02	822	6.50	861	6.99	899	7.49	936	8.02	973	8.58	1009	9.18	1045	9.81	1080	10.49	1115	11.21	1132	11.58
13000	763	6.36	783	6.60	822	7.10	860	7.61	897	8.14	933	8.69	969	9.26	1005	9.88	1040	10.52	1075	11.22	1109	11.95	1143	12.74	-	-

Note: Blower performance includes gas heat exchangers and 2 in. filters. See the *Static resistance tables* for additional applications. See the *RPM selection tables* to determine the required motor sheave setting and to determine the maximum continuous BHP. kW = BHP x 0.93.

Table 41: Example RPM selection

Model	HP	Max BHP	Motor sheave	Blower sheave	6 turns open	5 turns open	4 turns open	3 turns open	2 turns open	1 turn open	Fully closed
KV27	7.5	8.24	1VP65 - 1 3/8	1B5V124	717	745	772	800	827	855	882
	10	10.90	2VP60- 1 3/8	2B5V94	848	884	920	956	992	1028	1064
	15	16.13	2VP60- 1 5/8	2B5V86	945	985	1026	1066	1106	1147	n/a

Airflow performance

Vertical supply units

Table 42: KV27/KY27 bottom duct application

Air flow (cfm)	Available external static pressure - IWG																							
	0.3		0.4		0.6		0.8		1		1.2		1.4		1.6		1.8		2		2.2		2.4		2.5	
	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp
	Standard 7.5hp and field drive						Standard 7.5hp and drive								Medium 10hp and drive								High 15 hp and drive			
8,000	573	2.29	599	2.53	649	2.98	696	3.39	742	3.78	786	4.16	828	4.55	869	4.95	910	5.36	949	5.79	988	6.25	1,026	6.75	1,045	7.00
9,000	606	2.92	631	3.15	678	3.59	724	4.01	768	4.41	810	4.82	851	5.24	892	5.67	931	6.13	970	6.60	1,007	7.12	1,045	7.66	1,063	7.95
10,000	642	3.62	665	3.85	711	4.29	754	4.72	796	5.15	837	5.58	877	6.04	916	6.51	955	7.00	992	7.53	1,029	8.09	1,066	8.69	1,084	9.01
11,000	680	4.41	702	4.64	745	5.09	787	5.54	827	6.00	867	6.47	906	6.96	943	7.47	981	8.01	1,017	8.59	1,054	9.21	1,089	9.87	1,107	10.21
12,000	721	5.31	741	5.55	782	6.02	822	6.50	861	6.99	899	7.49	936	8.02	973	8.58	1,009	9.18	1,045	9.81	1,080	10.49	1,115	11.21	1,132	11.58
13,000	763	6.36	783	6.60	822	7.10	860	7.61	897	8.14	933	8.69	969	9.26	1,005	9.88	1,040	10.52	1,075	11.22	1,109	11.95	1,143	12.74	-	-

Note: Blower performance includes gas heat exchangers and 2 in. filters. See static resistance for additional applications. See rpm selection to determine the required motor sheave setting and to determine the maximum continuous bhp. kW = bhp x 0.93.

Table 43: KV30/KY30 bottom duct application

Air flow (cfm)	Available external static pressure - IWG																							
	0.3		0.4		0.6		0.8		1		1.2		1.4		1.6		1.8		2		2.2		2.4		2.5	
	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp
	Standard 7.5hp and field drive						Standard 7.5hp and drive								Medium 10hp and drive								High 15 hp and drive			
8,000	540	1.98	567	2.24	618	2.71	667	3.13	713	3.53	757	3.91	800	4.29	842	4.68	882	5.076	922	5.49	961	5.93	999	6.39	1,018	6.64
9,000	565	2.52	591	2.77	640	3.24	687	3.67	732	4.08	775	4.49	817	4.89	858	5.31	898	5.742	937	6.20	975	6.68	1,012	7.19	1,031	7.45
10,000	594	3.14	619	3.39	666	3.85	711	4.29	754	4.72	796	5.15	837	5.59	877	6.03	916	6.50	954	7.00	992	7.52	1,029	8.08	1,047	8.38
11,000	626	3.85	650	4.09	695	4.56	738	5.02	780	5.47	821	5.92	860	6.39	899	6.87	937	7.383	975	7.92	1,011	8.49	1,048	9.10	1,066	9.42
12,000	662	4.65	684	4.9	727	5.38	768	5.86	809	6.34	848	6.82	887	7.32	924	7.85	961	8.40	998	8.99	1,034	9.61	1,069	10.27	1,087	10.62
13,000	700	5.59	721	5.84	762	6.34	802	6.84	841	7.35	879	7.87	916	8.42	952	8.99	988	9.585	1,024	10.22	1,059	10.89	1,094	11.61	1,111	11.99
14,000	742	6.68	761	6.94	800	7.47	838	8.00	875	8.54	912	9.10	948	9.69	983	10.3	1,018	10.96	1,053	11.64	1,087	12.38	-	-	-	-

Note: Blower performance includes gas heat exchangers and 2 in. filters. See static resistance tables for additional applications. See rpm selection to determine the required motor sheave setting and to determine the maximum continuous bhp. kW = bhp x 0.93.

Table 44: KV35/KY35 bottom duct application

Air flow (cfm)	Available external static pressure - IWG																							
	0.3		0.4		0.6		0.8		1		1.2		1.4		1.6		1.8		2		2.2		2.4		2.5	
	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp
	Standard 7.5hp and field drive						Standard 7.5hp and drive								Medium 10hp and drive								High 15 hp and drive			
9,000	611	2.96	636	3.2	683	3.63	729	4.05	772	4.46	815	4.87	856	5.29	896	5.72	935	6.18	974	6.66	1,012	7.17	1,049	7.72	1,067	8.01
10,000	648	3.68	671	3.91	716	4.34	760	4.77	802	5.2	843	5.64	882	6.1	921	6.57	960	7.07	997	7.6	1,034	8.17	1,071	8.78	1,089	9.1
11,000	687	4.48	709	4.71	752	5.16	793	5.61	834	6.07	873	6.54	912	7.04	949	7.55	987	8.1	1,023	8.69	1,059	9.31	1,095	9.98	1,113	10.3
12,000	729	5.41	749	5.64	790	6.11	830	6.59	868	7.08	906	7.59	943	8.13	980	8.69	1,016	9.3	1,052	9.93	1,087	10.6	1,121	11.3	1,139	11.7
13,000	772	6.47	792	6.72	831	7.22	868	7.73	905	8.26	942	8.82	977	9.4	1,013	10	1,048	10.7	1,082	11.4	1,116	12.1	1,150	12.9	-	-
14,000	818	7.72	837	7.98	873	8.51	909	9.06	944	9.64	979	10.2	1,014	10.9	1,048	11.6	1,082	12.3	1,115	13	1,149	13.9	-	-	-	-
15,000	865	9.17	883	9.45	918	10	952	10.6	986	11.2	1,019	11.9	1,052	12.6	1,085	13.3	1,118	14.1	-	-	-	-	-	-	-	-
16,000	914	10.9	931	11.2	964	11.8	996	12.4	1,029	13.1	1,061	13.8	1,093	14.6	1,125	15.4	-	-	-	-	-	-	-	-	-	-

Note: Blower performance includes gas heat exchangers and 2 in. filters. See static resistance for additional applications. See rpm selection to determine the required motor sheave setting and to determine the maximum continuous bhp. kW = bhp x 0.93.

Table 45: KV40/KY40 bottom duct application

Air flow (cfm)	Available external static pressure - IWG																					
	0.4		0.6		0.8		1		1.2		1.4		1.6		1.8		2		2.2		2.4		2.5	
	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp
	Standard 10hp and field drive				Std 10hp and drive										Medium 15hp and drive						High 20 hp and drive			
12,000	600	4.41	633	4.818	666	5.255	699	5.72	731	6.227	764	6.765	796	7.34	828	7.95	860	8.59	892	9.28	924	10	940	10.4
13,000	621	5.08	654	5.536	687	6.023	720	6.54	753	7.10	785	7.692	817	8.32	850	8.99	882	9.7	914	10.4	945	11.2	961	11.6
14,000	645	5.89	678	6.391	711	6.928	743	7.50	776	8.11	809	8.763	841	9.45	873	10.2	905	11	937	11.8	969	12.6	985	13.1
15,000	670	6.84	703	7.393	736	7.982	769	8.61	802	9.28	834	10.00	866	10.8	899	11.6	931	12.4	963	13.3	994	14.3	1,010	14.8
16,000	698	7.95	731	8.554	764	9.20	797	9.89	829	10.63	862	11.42	894	12.3	926	13.1	958	14.1	990	15.1	1,022	16.2	1,038	16.7
17,000	727	9.23	760	9.885	793	10.60	826	11.36	859	12.18	891	13.05	923	14	956	15	988	16	1,020	17.2	1,051	18.4	-	-
18,000	759	10.7	792	11.41	825	12.20	857	13.05	890	13.96	922	14.95	955	16	987	17.1	1,019	18.3	1,051	19.6	-	-	-	-
19,000	792	12.3	825	13.15	858	14.04	890	15.00	923	16.04	956	17.16	988	18.4	1,020	19.7	1,052	21	-	-	-	-	-	-
20,000	827	14.2	860	15.16	892	16.17	925	17.28	958	18.48	990	19.78	1,023	21.2	1,055	22.7	-	-	-	-	-	-	-	-

Note: Blower performance includes gas heat exchangers and 2 in. filters. See static resistance for additional applications. See rpm selection to determine the required motor sheave setting and to determine the maximum continuous bhp. kW = bhp x 0.93.

Table 46: KV50/KY50 bottom duct application

Air flow (cfm)	Available external static pressure - IWG																					
	0.4		0.6		0.8		1		1.2		1.4		1.6		1.8		2		2.2		2.4		2.5	
	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp
	Standard 10hp and field drive				Standard 10hp and drive										Medium 15hp and drive						High 20 hp and drive			
12,000	616	4.61	649	5.02	681	5.47	714	5.95	746	6.47	778	7.02	811	7.61	843	8.24	875	8.9	907	9.6	939	10.3	954	10.7
13,000	639	5.33	672	5.8	705	6.3	737	6.84	770	7.41	802	8.02	834	8.67	866	9.35	898	10.1	930	10.9	962	11.7	978	12.1
14,000	665	6.2	698	6.72	731	7.27	763	7.87	796	8.5	828	9.17	860	9.89	892	10.6	924	11.4	956	12.3	988	13.2	1004	13.7
15,000	693	7.22	726	7.79	759	8.41	791	9.06	824	9.76	856	10.5	888	11.3	920	12.1	952	13	984	14	1,016	14.9	1,032	15.5
16,000	723	8.41	756	9.04	789	9.72	821	10.4	854	11.2	886	12	918	12.9	950	13.9	982	14.8	1,014	15.9	1,046	17	1,062	17.6
17000	756	9.79	788	10.5	821	11.2	853	12	886	12.9	918	13.8	950	14.8	983	15.9	1,015	17	1,046	18.2	-	-	-	-
18,000	790	11.4	822	12.1	855	13	888	13.9	920	14.9	952	15.9	985	17	1,017	18.2	1,049	19.5	-	-	-	-	-	-
19,000	826	13.2	858	14.1	891	15	924	16.1	956	17.2	988	18.4	1,020	19.7	1,053	21	-	-	-	-	-	-	-	-
20,000	863	15.3	896	16.3	929	17.4	961	18.6	994	19.9	1,026	21.3	-	-	-	-	-	-	-	-	-	-	-	-

Note: Blower performance includes gas heat exchangers and 2 in. filters. See static resistance for additional applications. See rpm selection to determine the required motor sheave setting and to determine the maximum continuous bhp. kW = bhp x 0.93.

Horizontal supply units

Table 47: KH27/KX27 side duct application

Air Flow (cfm)	Available external static pressure - IWG																							
	0.3		0.4		0.6		0.8		1		1.2		1.4		1.6		1.8		2		2.2		2.4		2.5	
	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp
	Std 7.5 hp and field drive						Std 7.5 hp and drive								Medium 10hp and drive								High 15 hp and drive			
8000	609	2.62	636	2.86	687	3.30	734	3.71	780	4.11	823	4.50	865	4.90	905	5.31	944	5.73	981	6.17	1018	6.64	1053	7.13	1071	7.39
9000	658	3.40	683	3.63	730	4.07	775	4.49	819	4.91	860	5.33	900	5.76	938	6.21	976	6.69	1012	7.18	1048	7.70	1082	8.26	1099	8.55
10000	707	4.25	730	4.48	775	4.93	817	5.37	858	5.82	898	6.28	936	6.76	973	7.26	1009	7.78	1045	8.34	1079	8.92	1113	9.54	1129	9.86
11000	756	5.20	778	5.44	820	5.91	860	6.39	899	6.87	937	7.38	974	7.91	1010	8.46	1044	9.05	1078	9.66	1112	10.31	1144	11.00	1161	11.35
12000	805	6.29	825	6.54	865	7.04	904	7.56	941	8.09	977	8.65	1012	9.23	1047	9.84	1080	10.49	1113	11.17	1146	11.89	-	-	-	-
13000	854	7.53	873	7.80	911	8.34	947	8.91	983	9.49	1018	10.11	1052	10.75	1085	11.43	1117	12.14	1149	12.89	-	-	-	-	-	-

Note: Blower performance includes gas heat exchangers and 2 in. filters. See the static resistance table for additional applications. See the rpm selection table to determine the required motor sheave setting and to determine the maximum continuous bhp. kW = bhp x 0.93

Table 48: KH30/KX30 side duct application

Air Flow (cfm)	Available external static pressure - IWG																							
	0.3		0.4		0.6		0.8		1		1.2		1.4		1.6		1.8		2		2.2		2.4		2.5	
	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp
	Std 7.5hp and field drive						Std 7.5hp and drive								Medium 10 hp and drive								High 15 hp and drive			
8000	608	2.61	635	2.85	686	3.3	735	3.72	780	4.12	824	4.51	866	4.91	906	5.32	945	5.744	982	6.19	1019	6.65	1054	7.15	1072	7.4
9000	656	3.38	681	3.62	729	4.06	775	4.48	819	4.91	860	5.33	900	5.77	939	6.22	977	6.695	1013	7.19	1048	7.72	1083	8.27	1100	8.56
10000	705	4.23	728	4.46	774	4.92	817	5.36	858	5.82	898	6.28	936	6.76	974	7.26	1010	7.79	1045	8.35	1080	8.93	1113	9.55	1130	9.87
11000	753	5.18	776	5.42	818	5.89	859	6.37	899	6.86	937	7.37	974	7.91	1010	8.46	1044	9.05	1079	9.66	1112	10.3	1145	11	-	-
12000	802	6.26	823	6.51	863	7.02	902	7.54	940	8.08	976	8.64	1012	9.22	1046	9.84	1080	10.49	1113	11.2	1146	11.9	-	-	-	-
13000	851	7.49	871	7.77	909	8.32	946	8.88	982	9.47	1017	10.1	1051	10.7	1084	11.4	1117	12.13	1149	12.9	-	-	-	-	-	-
14000	900	8.92	918	9.21	955	9.81	990	10.4	1024	11.1	1058	11.8	1091	12.5	1123	13.2	-	-	-	-	-	-	-	-	-	-

Note: Blower performance includes gas heat exchangers and 2 in. filters. See the static resistance table for additional applications. See the rpm selection table to determine the required motor sheave setting and to determine the maximum continuous bhp. kW = bhp x 0.93

Table 49: KH35/KX35 side duct application

Air Flow (cfm)	Available external static pressure - IWG																							
	0.3		0.4		0.6		0.8		1		1.2		1.4		1.6		1.8		2		2.2		2.4		2.5	
	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp
	Std 7.5 hp and field drive				Std 7.5 hp and drive										Medium 10 hp and drive								High 15 hp and drive			
9000	684	3.64	708	3.86	754	4.28	798	4.70	840	5.12	880	5.55	920	5.99	958	6.45	995	6.94	1031	7.45	1066	8.00	1101	8.57	1118	8.88
10000	735	4.53	758	4.76	801	5.20	842	5.64	882	6.10	921	6.57	959	7.06	995	7.57	1031	8.12	1066	8.69	1100	9.30	1134	9.95	1150	10.29
11000	788	5.55	809	5.78	849	6.25	888	6.74	926	7.23	963	7.75	999	8.30	1035	8.88	1069	9.48	1103	10.13	1136	10.81	-	-	-	-
12000	840	6.72	860	6.97	898	7.48	935	8.01	972	8.56	1007	9.14	1041	9.75	1075	10.39	1108	11.07	1141	11.78	-	-	-	-	-	-
13000	893	8.09	912	8.36	948	8.92	983	9.50	1018	10.11	1052	10.75	1085	11.43	1117	12.14	1149	12.89	-	-	-	-	-	-	-	-
14000	947	9.67	964	9.97	998	10.59	1032	11.23	1065	11.91	1097	12.62	1129	13.37	-	-	-	-	-	-	-	-	-	-	-	-
15000	1000	11.51	1017	11.84	1049	12.52	1081	13.23	1113	13.99	1144	14.78	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16000	1054	13.64	1069	14.01	1100	14.77	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: Blower performance includes gas heat exchangers and 2 in. filters. See the static resistance table for additional applications. See the rpm selection table to determine the required motor sheave setting and to determine the maximum continuous bhp. kW = bhp x 0.93

Table 50: KH40/KX40 side duct application

Air Flow (cfm)	Available external static pressure - IWG																					
	0.4		0.6		0.8		1		1.2		1.4		1.6		1.8		2		2.2		2.4		2.5	
	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp
	Std 10 hp and field drive				Std 10 hp and drive										Medium 15 hp and drive						High 20 hp and drive			
12000	602	4.43	642	4.94	682	5.48	720	6.06	758	6.67	795	7.32	831	8.00	866	8.71	900	9.45	934	10.22	966	11.02	982	11.42
13000	627	5.16	667	5.73	707	6.33	746	6.98	783	7.66	820	8.38	856	9.13	891	9.92	926	10.74	959	11.58	991	12.45	1007	12.90
14000	654	6.03	694	6.66	734	7.33	773	8.05	810	8.80	847	9.59	883	10.43	918	11.29	952	12.19	986	13.12	1018	14.09	1034	14.58
15000	682	7.04	723	7.74	762	8.48	801	9.27	839	10.10	876	10.98	912	11.90	947	12.86	981	13.86	1014	14.89	1047	15.96	1063	16.50
16000	712	8.21	753	8.97	792	9.79	831	10.67	869	11.59	905	12.57	941	13.59	977	14.66	1011	15.77	1044	16.92	-	-	-	-
17000	743	9.54	784	10.39	823	11.29	862	12.26	900	13.30	937	14.39	973	15.53	1008	16.73	1042	17.99	-	-	-	-	-	-
18000	776	11.05	816	11.99	856	13.01	894	14.09	932	15.26	969	16.49	1005	17.79	1040	19.16	-	-	-	-	-	-	-	-
19000	810	12.76	850	13.82	890	14.97	928	16.21	966	17.54	1003	18.95	1039	20.44	-	-	-	-	-	-	-	-	-	-
20000	844	14.72	885	15.93	924	17.25	963	18.68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: Blower performance includes gas heat exchangers and 2 in. filters. See the static resistance table for additional applications. See the rpm selection table to determine the required motor sheave setting and to determine the maximum continuous bhp. kW = bhp x 0.93

Table 51: KH50/KX50 side duct application

Air Flow (cfm)	Available external static pressure - IWG																					
	0.4		0.6		0.8		1		1.2		1.4		1.6		1.8		2		2.2		2.4		2.5	
	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp	rpm	bhp
	Std 10 hp and field drive				Std 10 hp and drive										Medium 15 hp and drive						High 20 hp and drive			
12000	622	4.68	661	5.19	700	5.74	737	6.33	775	6.95	811	7.62	847	8.31	882	9.04	916	9.81	949	10.60	982	11.43	998	11.85
13000	650	5.47	689	6.05	727	6.67	765	7.33	802	8.02	839	8.76	874	9.53	909	10.34	944	11.19	977	12.06	1010	12.97	1026	13.44
14000	679	6.41	718	7.06	757	7.75	795	8.49	832	9.26	868	10.08	904	10.94	939	11.83	973	12.77	1007	13.74	1039	14.74	1056	15.26
15000	710	7.52	750	8.24	788	9.00	826	9.82	863	10.68	900	11.59	935	12.54	970	13.54	1005	14.58	1038	15.67	-	-	-	-
16000	743	8.79	783	9.59	821	10.45	859	11.35	896	12.32	933	13.33	968	14.40	1003	15.52	1037	16.69	-	-	-	-	-	-
17000	778	10.25	817	11.14	856	12.10	894	13.12	931	14.20	967	15.35	1003	16.56	1038	17.83	-	-	-	-	-	-	-	-
18000	814	11.92	853	12.93	892	14.01	929	15.16	966	16.40	1003	17.71	1039	19.09	-	-	-	-	-	-	-	-	-	-
19000	851	13.84	890	14.99	929	16.23	967	17.56	1004	18.98	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20000	889	16.07	929	17.40	967	18.84	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: Blower performance includes gas heat exchangers and 2 in. filters. See the static resistance table for additional applications. See the rpm selection table to determine the required motor sheave setting and to determine the maximum continuous bhp. kW = bhp x 0.93

Air balance

CAUTION

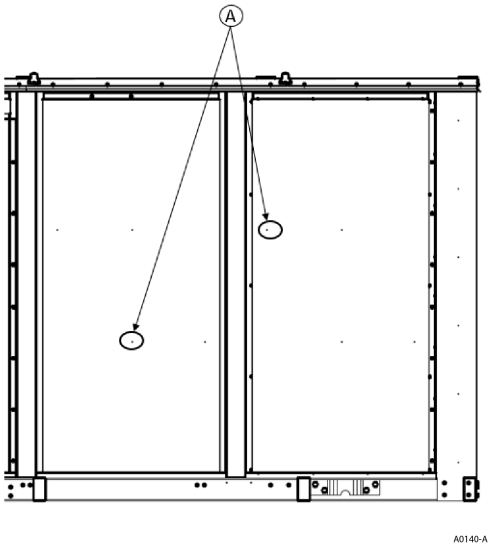
On VAV units verify that the VFD drive is set to maximum output, exhaust dampers are closed, and individual space damper boxes are full open. VFD units with bypass must not be in bypass mode (LINE position) unless all individual space dampers are full open.

Start the supply air blower motor. Adjust the resistances in both the supply and the return air duct systems to balance the air distribution throughout the conditioned space. The job specifications may require that this balancing be done by someone other than the equipment installer.

Checking the air quantity

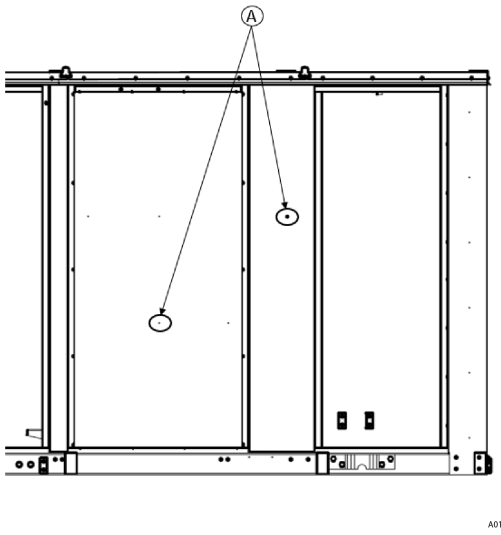
1. Drill the appropriate sized holes on the dimples on the blower and on the return air access panels on the back side of the unit. See Figure 101.

Figure 101: Dot plug location for vertical return unit



Item	Description
A	Dot plug location

Figure 102: Dot plug location for horizontal return unit



Item	Description
A	Dot plug location

2. Insert at least 8 in. of 1/4 in. tubing into each of these holes for sufficient penetration into the air flow on both sides of the indoor coil.

   Note: Insert the tubes and hold them in a position perpendicular to the air flow so that velocity pressure does not affect the static pressure readings.

3. Use an inclined manometer to determine the pressure drop across the dry evaporator coil and filters. The moisture on an evaporator coil may vary greatly, measuring the pressure drop across a wet coil under field conditions could be inaccurate. To ensure that the coil is dry, deactivate the compressors while the test is being run.

   Note: De-energize the compressors before taking any test measurements to ensure that the indoor coil is dry.

4. Use the pressure drop across a dry coil, to determine the actual CFM through the unit from the curve in the following figure.
5. After the testing is complete, collect the plugs from the polythene bag in the control box and put them in the drilled holes.

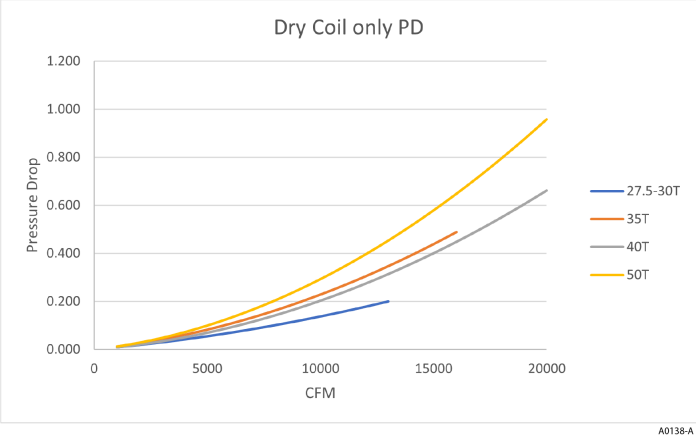
WARNING

Failure to properly adjust the total system air quantity can result in extensive blower damage.

Table 52: Dry coil pressure drop

Nominal cfm	Dry coil and filter pressure drop (IWG)			
	27.5 ton to 30 ton	35 ton	40 ton	50 ton
1000	0.009	0.011	0.009	0.013
2000	0.019	0.025	0.020	0.029
3000	0.030	0.042	0.034	0.049
4000	0.042	0.061	0.051	0.073
5000	0.055	0.082	0.070	0.100
6000	0.069	0.106	0.091	0.131
7000	0.084	0.133	0.115	0.166
8000	0.101	0.162	0.142	0.205
9000	0.118	0.194	0.171	0.247
10000	0.137	0.229	0.203	0.293
11000	0.157	0.266	0.238	0.343
12000	0.178	0.305	0.275	0.396
13000	0.200	0.348	0.314	0.454
14000	0.223	0.392	0.356	0.514
15000	-	0.439	0.401	0.579
16000	-	0.489	0.448	0.647
17000	-	-	0.498	0.719
18000	-	-	0.550	0.795
19000	-	-	0.605	0.874
20000	-	-	0.662	0.957

Figure 103: Indoor coil (dry coil) pressure drop versus supply air cfm



Item	Description
A	Large cabinet, 50 ton
B	Small cabinet, 35 ton
C	Large cabinet, 40 ton
D	Small cabinet, 27.5 ton and 30 ton

Supply air drive adjustment

The rpm of the supply air blower depends on the required cfm, the unit accessories or options, and the static resistances of both the supply and the return air duct systems. With this information, the rpm for the supply air blower and the motor pulley adjustment (turns open) can be determined from the blower performance data tables.

CAUTION

You must adjust the belt drive blower systems to the specific static and cfm requirements for the application. The belt drive blowers are not set at the factory for any specific static or cfm. You must adjust the blower speed and belt tension.Verify proper sheave alignment. Tighten the blower pulley and motor sheave set screws after these adjustments. Re-check the set screws after 10 to 12 hours of run time.

See the blower motor and drive data table.

Note the following:

- The supply air cfm must be within the limitations shown in the blower performance tables.
- You can adjust pulleys in half turn increments.
- Adjust the belt tension.
- Tighten the blower pulley and motor sheave set screws after any adjustments. Re-check the set screws after 10 to 12 hours runtime.

Table 53: Additional static resistance - vertical supply airflow

Size (ton)	cfm	Cooling only	Economizer	Reheat coil	Electric heat kW*				
					36	54	72	90	108
27.5 30 35	6,000	0.18	0.09	0.04	0.14	0.12	0.10	0.10	---
	7,000	0.21	0.12	0.06	0.15	0.13	0.10	0.10	---
	8,000	0.23	0.15	0.07	0.17	0.14	0.11	0.11	---
	9,000	0.26	0.19	0.09	0.18	0.15	0.11	0.11	---
	10,000	0.28	0.23	0.11	0.19	0.15	0.11	0.11	---
	11,000	0.30	0.28	0.13	0.20	0.16	0.11	0.11	---
	12,000	0.32	0.33	0.15	0.21	0.16	0.11	0.11	---
	13,000	0.33	0.38	0.18	0.22	0.16	0.10	0.10	---
	14,000	0.35	0.44	0.20	0.22	0.16	0.10	0.10	---
	15,000	0.36	0.50	0.23	0.23	0.16	0.09	0.09	---
	16,000	0.37	0.57	0.26	0.23	0.16	0.09	0.09	---

Table 53: Additional static resistance - vertical supply airflow

Size (ton)	cfm	Cooling only	Economizer	Reheat coil	Electric heat kW*				
					36	54	72	90	108
40 50	10,000	0.18	0.08	0.07	---	0.05	0.01	0.01	0.01
	11,000	0.21	0.10	0.07	---	0.06	0.02	0.02	0.02
	12,000	0.23	0.11	0.08	---	0.08	0.02	0.02	0.02
	13,000	0.26	0.13	0.09	---	0.09	0.03	0.03	0.03
	14,000	0.29	0.15	0.10	---	0.11	0.04	0.04	0.04
	15,000	0.32	0.17	0.11	---	0.12	0.06	0.06	0.06
	16,000	0.35	0.20	0.12	---	0.14	0.07	0.07	0.07
	17000	0.39	0.22	0.14	---	0.16	0.09	0.09	0.09
	18,000	0.42	0.25	0.15	---	0.19	0.11	0.11	0.11
	19,000	0.46	0.27	0.16	---	0.21	0.13	0.13	0.13
	20,000	0.50	0.30	0.17	---	0.24	0.15	0.15	0.15

ⓘ **Note:** *Electric heat is only available if the second nomenclature digit (efficiency) is standard vertical or standard horizontal.

Table 54: Additional static resistance - horizontal supply airflow

Size (ton)	CFM	Cooling only	Economizer	Reheat coil	Electric heat KW				
					36	54	72	90	108
27.5 30 35	6000	0.21	0.02	0.04	0.17	0.15	0.13	0.13	---
	7000	0.27	0.02	0.06	0.22	0.19	0.17	0.17	---
	8000	0.34	0.04	0.07	0.28	0.25	0.22	0.22	---
	9000	0.42	0.05	0.09	0.34	0.31	0.27	0.27	---
	10,000	0.50	0.06	0.11	0.42	0.37	0.33	0.33	---
	11,000	0.59	0.08	0.13	0.50	0.45	0.40	0.40	---
	12,000	0.69	0.10	0.15	0.58	0.53	0.48	0.48	---
	13,000	0.79	0.12	0.18	0.67	0.62	0.56	0.56	---
	14,000	0.90	0.14	0.20	0.77	0.71	0.65	0.65	---
	15,000	1.01	0.17	0.23	0.88	0.81	0.75	0.75	---
	16,000	1.13	0.20	0.26	0.99	0.92	0.85	0.85	---
40 50	10,000	0.27	0.02	0.07	---	0.14	0.10	0.10	0.10
	11,000	0.32	0.03	0.07	---	0.17	0.13	0.13	0.13
	12,000	0.36	0.04	0.08	---	0.21	0.15	0.15	0.15
	13,000	0.41	0.04	0.09	---	0.24	0.18	0.18	0.18
	14,000	0.46	0.05	0.10	---	0.27	0.21	0.21	0.21
	15,000	0.51	0.06	0.11	---	0.31	0.24	0.24	0.24
	16,000	0.56	0.07	0.12	---	0.35	0.28	0.28	0.28
	17,000	0.61	0.08	0.14	---	0.38	0.31	0.31	0.31
	18,000	0.66	0.09	0.15	---	0.42	0.35	0.35	0.35
	19,000	0.71	0.10	0.16	---	0.47	0.38	0.38	0.38
	20,000	0.76	0.11	0.17	---	0.51	0.42	0.42	0.42

ⓘ **Note:** *Electric heat is only available if the second nomenclature digit (efficiency) is standard vertical or standard horizontal.

ⓘ **Note:**

- For cooling only models, add the cooling only value to the available static resistance in the respective blower performance tables.
- For models with electric heat, add the electric heat value for your heater size to the available static resistance in the respective blower performance tables.

- If the unit contains a reheat coil or economizer, deduct the corresponding value from the available external static pressure shown in the respective blower performance tables.
- The pressure drop through the economizer is greater for 100% outdoor air than for 100% return air. If the resistance of the return air duct is less than 0.25 IWG, the unit delivers less cfm during full economizer operation.

Operation

The following sections describe the sequences of operation for the units.

Cooling sequence of operation

Compressor operation

The following sections describe the compressor operation.

Two stage cooling

- Compressors are controlled by the Y1 through Y2 thermostat inputs. If the Lead/Lag function is turned OFF, a Y1 input energizes the C1 output. The thermostat input into the Y2 energizes the C2 output.
- The FAN output for indoor fan operation energizes with any cooling output after the fan on delay for cool expires.
- A 30 second interstage delay occurs when multiple stages are requested. When the thermostat cooling inputs are lost and the minimum runtime expires, the compressor outputs stage off.

  ⓘ **Note:** A Y2 input without a Y1 input energizes C1 first and then C2 30 seconds later.

Four stage cooling

- Compressors are controlled by the Y1 through Y4 thermostat inputs. Y1 input energizes the C1 output. A Y2 input energizes the C3 output. A Y3 input de-energizes the C3 output and energizes the C2 output. A Y4 input energizes the C3 output.

  ⓘ **Note:** For all models, the C1 output energizes the first of the tandem compressors and the C3 output energizes the second of the tandem compressors.
- The FAN output for indoor fan operation energizes with any cooling output after the fan on delay for cool expires.
- A 30 second interstage delay occurs when multiple stages are requested. Compressor minimum off times are enforced while staging up and down. When the thermostat cooling inputs are lost and the minimum runtime expires, the compressor outputs stage off.
- Staging down sequence:
  - Y1, Y2, Y3, Y4 – C1, C2, C3
  - Y1, Y2, Y3 (Y4 off) – C1, C2 (C3 off)
  - Y1, Y2 (Y3 off) – C2 (C1 off)
  - Y1 (Y2 off) – C1 on (C2 off)
  - All thermostat signals off – all stages off

Continuous blower

When the room thermostat fan switch is set to ON, the supply air blower operates continuously.

Intermittent blower

With the room thermostat fan switch set to AUTO and the system switch set to either the AUTO or HEAT settings, the blower is energized whenever a cooling or heating operation is requested. The blower is energized after any specified delay associated with the operation.

When energized, the indoor blower has a minimum run time of 30 seconds. Additionally, the indoor blower has a delay of 10 seconds minimum off.

Optional VAV startup and control

⚠ CAUTION

If the unit is operated with the manual bypass switch in the LINE (BYPASS) position and there are VAV boxes present in the duct system, then boxes must be driven to the full-open position using a customer-supplied power source to prevent over-pressurizing and possible damage to the ductwork.

For units with VFD and VAV control, you must put the unit into the occupied mode to start operation. The default setting for all VAV units is unoccupied, therefore the installer must either keep the jumper wire between terminals R - OCC or use network communication of a BAS control system to switch between the unoccupied and occupied modes.

When placed into the occupied mode, the speed of the indoor blower motor is controlled by duct static pressure. The duct static setpoint (default = 1.5 in.) is the pressure that the VFD drive maintains when operating the unit in VAV mode. If the duct static pressure reaches or exceeds the high-limit setpoint (default = 4.5 in.), then the supply fan motor is shutdown.

The supply air temperature (SAT) is controlled by staging compressors on and off to satisfy the operating cooling supply air temperature setpoint. There are three setpoints that determine the resulting operating cooling supply air temperature setpoint.

- VAV cooling supply air temperature upper setpoint (default 60°F)
- VAV cooling supply air temperature lower setpoint (default 55°F)
- VAV supply air temperature reset setpoint (default 72°F)

When the return air temperature (RAT) is above the VAV supply air temperature reset setpoint the SAT is maintained at +/- 5 degrees of the VAV cooling supply air temperature lower setpoint.

When the return air temperature (RAT) is below the VAV supply air temperature reset setpoint the SAT is maintained at +/- 5 degrees of the VAV cooling supply air temperature upper setpoint.

When the outdoor air condition is sufficient for free cooling, the economizer modulates to control the SAT to +/- 1 degrees of the operational setpoint.

Cooling operation errors

Each cooling system is monitored for operation outside of the intended parameters. Errors are handled as described below. All system errors override minimum run times for compressors.

ⓘ **Note:** The following components are needed to access the control points in the Smart Equipment control.

- Local LCD on the unit control board.

OR

- GoTemp Pro mobile application

OR

- Mobile access portal (MAP) Gateway (Portable) - no longer available to purchase.
  - Source 1 P/N S1-JC-MAP1810-OP
  - MAP Gateway Quick Start Guide P/N 24-10737-16
  - MAP Gateway Instruction P/N 24-10737-8

High-pressure limit switch

During cooling operation, if a high-pressure limit switch opens, the UCB de-energizes the associated compressor, initiates the anti-short cycle delay (ASCD), and, if the other compressor is idle, stops the condenser fans. If the call for cooling is still present at the conclusion of the ASCD, the UCB re-energizes the halted compressor.

If a high-pressure switch opens three times within two hours of operation, the UCB locks out the associated compressor. If the other compressor is inactive, the condenser fans are deenergized.

Low-pressure limit switch

The low-pressure limit switch is not monitored during the initial 30 seconds of a cooling system's operation. For the following 30 seconds, the UCB monitors the low-pressure switch to ensure it closes. If the low-pressure switch fails to close after the 30-second monitoring phase, the UCB de-energizes the associated compressor, initiates the ASCD, and, if the other compressor is idle, stops the condenser fans. If the LPS is still open after the ASCD, the compressor is not be energized for 30 seconds. The second and third times that the UCB sees an open LPS counts towards the three occurrences that cause a UCB lock-out.

When the low-pressure switch is proven (closed during the 30 second monitor period described above), the UCB monitors the low-pressure limit switch for any openings. If the low-pressure switch opens for greater than 5 seconds, the UCB de-energizes the associated compressor, initiates the ASCD, and, if the other compressor is idle, stops the condenser fans. If the call for cooling is still present at the conclusion of the ASCD, the UCB re-energizes the halted compressor.

If a low-pressure switch opens three times within one hour of operation, the UCB locks out the associated compressor. If the other compressor is inactive, the condenser fans are deenergized.

Evaporator low limit

The evaporator low limit sensor is located on the suction line at the evaporator coil.

During cooling operation, if the evaporator low limit sensor (EC1, 2) detects a temperature below 26°F (default), the UCB de-energizes the associated compressor, initiates the ASCD, and, if the other compressor is idle, stops the condenser fans. If the call for cooling is still present at the conclusion of the ASCD, the UCB re-energizes the halted compressor.

If the UCB detects the evaporator low limit sensor (EC1, 2) falling below 26°F (default) three times within two hours of operation, the UCB locks out the associated compressor. If the other compressor is inactive, the condenser fans are de-energized.

Low ambient cooling

To determine when to operate in low ambient mode, the UCB has an outdoor air temperature sensor (OAT) with a low ambient setpoint at 45ºF (default). When the OAT sensor senses a temperature below the low ambient setpoint and the thermostat is calling for cooling, the UCB operates in the low ambient mode.

Low ambient mode operates the compressors in the following manner: 10 minutes on, 5 minutes off. The indoor blower is operated throughout the cycle. The 5 minute off period is necessary to defrost the indoor coil.

Low ambient mode always begins with compressor operation. Compressor minimum run time may extend the minutes of compressor operation. The off cycle begins immediately following the elapse of the minimum run time.

When operating in low ambient mode, an evaporator low limit sensor (EC1, 2) temperature below 26ºF, the UCB de-energizes the associated compressor. If the call for cooling is still present at the end of the ASCD and the evaporator temperature sensor (EC1, 2) temperature is above 26°F, the unit resumes operation.

Safety controls

The unit control board monitors the following inputs for each cooling system:

- An evaporator low limit sensor (EC1, 2) to protect against low evaporator temperatures due to a low airflow or a low return air temperature, set at 26°F. The sensor is located on the suction line at the evaporator coil.
- A high-pressure switch to protect against excessive discharge pressures due to a blocked condenser coil or a condenser motor failure. The switch opens at 650 ± 10 psig and resets 450 ± 15 psig.
- A low-pressure switch to protect against loss of refrigerant charge. The switch opens at 50 ± 5 psig and resets at 71 ± 5 psig.

The pressure switches are hard-soldered to the unit. The refrigeration systems are independently monitored and controlled. On any fault, only the associated system is

affected by any safety or preventive action. The other refrigerant system continues in operation unless it is affected by the fault as well.

The unit control board monitors the temperature limit switch of electric heat units and the temperature limit switch and the gas valve of gas furnace units.

Compressor protection

In addition to the external pressure switches, the compressors also have inherent (internal) protection. If there is an abnormal temperature rise in a compressor, the protector opens to shut down the compressor. The UCB incorporates features to minimize compressor wear and damage. An anti-short cycle delay (ASCD) is used to prevent operation of a compressor too soon after its previous run. Additionally, a minimum run time is imposed any time a compressor is energized.

The ASCD is initiated on unit start-up and on any compressor reset or lock-out.

Reset

Remove the call for cooling by raising thermostat setting higher than the conditioned space temperature.

Reheat sequence of operation

Dehumidification - hot gas reheat

The rooftop unit can have an optional hot gas reheat (HGRH) system factory installed. HGRH is used to dehumidify the interior space.

- This is accomplished by controlling the compressors to the evaporator leaving air setpoint, which is typically set lower than the active DAT cooling setpoint
- The colder air allows for more moisture removal from the discharge air
- The discharge air then passes through the HGRH coil, which adds heat to the discharge air
- Reheating the air allows dehumidification of the space while preventing over-cooling, which keeps building personnel comfortable

For two stage, the HGRH system is always on refrigeration circuit number 2. For four stage, the HGRH system is always on refrigeration circuit number 1.

The HGRH system uses a 3-way modulating valve controlled by a stepper motor.

The HGRH coil is located after the evaporator coil in the airstream.

There is a solenoid installed on the outlet of the HGRH coil. This HGRH bleed solenoid valve allows excess refrigerant and oil to bleed back into the suction line when HGRH operation is not needed.

Dehumidification sequence

The unit controller continuously monitors a %RH value. This value can be either from the space or return air.

When the current humidity level rises above the dehumidification setpoint, the unit enables the HGRH system.

Setpoints for the dehumidification sequence can be found under the **Details > Humidity Control > Setup** menu.

There are two different operating sequences for HGRH.

Unit in active cooling mode

When the unit is in an active cooling mode and there is a demand for dehumidification, the HGRH valve is controlled to the active DAT cooling setpoint.

The compressors are controlled to the active evaporator air temperature (EAT) setpoint.

Typically the active EAT setpoint is lower than the active DAT cooling setpoint. This allows for additional humidity to be removed while still providing sensible cooling.

Unit in idle mode

When the unit is not in an active cooling mode and there is a demand for dehumidification, the HGRH valve is controlled to an active DAT setpoint based on a reset schedule utilizing the effective cooling DAT setpoint and the current RAT. See Figure 104.

The compressors are controlled to the active EAT setpoint. This allows for humidity to be removed from the air while not over-cooling the space.

The unit controller uses the current humidity level as the basis for the active EAT setpoint.

- When the humidity level first increases above the active humidity setpoint, the active EAT setpoint is equal to the low cooling DAT setpoint
- When the humidity level continues to increase, the active EAT setpoint resets lower to allow for moisture removal

If at any time during an active dehumidification sequence the changeover sensor sees a demand for heat, HGRH operation is terminated regardless of the current humidity level.

Figure 104: Active DAT setpoint when unit is in idle mode

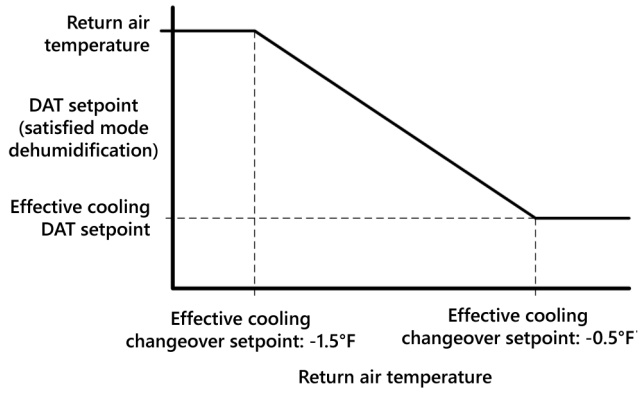
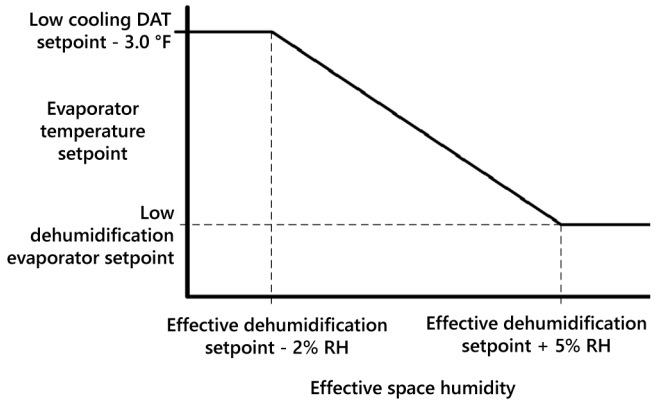


Figure 105: Active EAT setpoint based on humidity level



Hot gas reheat valve

The HGRH bleed valve is a normally open valve. For two stage, it is piped between the HGRH coil and the compressor system 2 suction line. For four stage, it is piped between the HGRH coil and the compressor system 1 suction line. The HGRH bleed valve prevents refrigerant and oil from being trapped in the HGRH coils when HGRH is inactive.

The HGRH valve is open when there is no demand for HGRH. Once a demand for HGRH exists, the HGRH bleed valve closes.

After the demand for HGRH is satisfied, the unit controller starts a 5-minute timer. When the 5-minute timer expires, the HGRH bleed valve opens.

Electric heating sequence of operations

The following sequence describes the operation of the electric heat section.

CAUTION

For units with VFD and electric heat, the speed of the indoor blower motor continues to be controlled by duct static pressure via the VAV control board.If there are VAV boxes present in the duct system, the boxes must be driven to the full-open position using a customer-supplied power source to ensure adequate airflow across the heating elements.

Two stage heating

- When there is a call for heat by the thermostat, the blower motor and the heater contactors energize engaging the first stage of heat. This is the HC1 contactor for all heaters and also the HC3 contactor only for 208/230 V units with a 54 kW heater, 460 V units with a 90 kW heater, and 460 V/575 V units with a 108 kW heater. If the second stage of heat is required the HC2 contactor is energized.
- The thermostat cycles the electric heat to satisfy the heating requirements of the conditioned space.
- When the thermostat heat inputs are lost and the 120 second minimum heat run timers have expired, heating outputs stage off. The fan off heat delay timer starts when all heating outputs are off. When the timer expires, the FAN output for the indoor fan operation de-energizes.

Note: Ensure the blower is always turned ON during heating operations.

Note: If there is a W2 call for the second stage of heat without a previous W1 call, HC1 (and HC3 when present) energizes immediately and HC2 energizes after a 30 second inter-stage delay.

Note: All electric heaters are provided with single use backup protection limits. These de-energize the heaters if the primary limit fails to open or the contactors fail to open in a failure mode. When the backup limit trips it needs to be replaced for the heater to be operational again.

Electric heat operation errors

Temperature limit

If the UCB senses zero volts from the high temperature limit, the indoor blower motor is immediately energized.

The limit is monitored at all times when the unit is in an operational mode where the electric heaters may be turned on.

If the temperature limit opens three times within one hour, it locks on the indoor blower.

Electric heat safety controls

The UCB monitors the temperature limit switch of electric heat units.
The control circuit includes the following safety controls:

Temperature limit switch

Temperature limit switch (LS1A, LS1B)

This control is located inside the heater compartment and is set to open at 130°F. It resets automatically. The limit switch operates when a high temperature condition, caused by inadequate supply air flow occurs, this shuts down the heater and continues energizing the blower.

Temperature limit switch (LS2A, LS2B)

This control is located inside the heater compartment and is set to open at at 200°F. It is a single use limit. These limit switches de-energize the heaters if the primary limit fails to open or the contactors fail to open in a failure mode. When the backup limit trips it needs to be replaced for the heater to be operational again.

Reset

Removes the call for heating by lowering the thermostat setting lower than the conditioned space temperature.

Gas heat sequence of operation

- Heating stages are controlled by the W1 through W2 thermostat inputs. A W1 or W2 input energizes a H1 or H1/H2 output.
- When the pre-ignition process is complete the ignition module energizes the gas valve and provides a 24 V input to the MV terminal on the UCB.
- The FAN ON HEAT DELAY timer starts as soon as 24 V is present on MV terminal. When the timer expires the FAN output for the indoor fan operation energizes. If 24 V is not received on the MV terminal within 6 min, an alarm appears and the fan output energizes immediately and remains On until the alarm clears.
- When the thermostat heat inputs are lost and the 120 second minimum heat run timers have expired, heating outputs stage off. The FAN OFF HEAT DELAY timer starts when 24 V is removed from the MV terminal. When the timer expires, the FAN output for the indoor fan operation de-energizes.

  ⓘ **Note:** If 24 V is lost on the MV terminal during the same heat cycle, an alarm appears and the fan output energizes and remains On until 24 V is present again on the MV terminal.

  ⓘ **Note:** If 24 V is present on the MV terminal without a call for heat, an alarm appears and the fan output energizes. If this condition occurs for 6 min an alarm appears, and remains, until the alarm condition is cleared.
- At any time, if 24 V is lost on the LIMIT terminal, the FAN output for indoor fan operation is energized. If 24 V is lost on the LIMIT input 3 times in 1 hour, an alarm appears and the FAN output is energized. The heating H1 and H2 outputs are de-energized until the alarm is cleared.

Additional heating operation for modulating furnaces

Two stage gas heat ignition control board function

Ignition Control Board on standby

The ignition control board (ICB) has all outputs de-energized and monitors the thermostat and flame sense. The ICB resets ignition trial and flame loss counters. The ICB begins a call for heat when W1 is energized at the unit control board (UCB). The ICB ignores W2 until ignition has been established.

Pressure switch proving

The ICB energizes the induced draft motor and waits for the low pressure switch to close. When the low pressure switch closes, the control begins Pre-purge period. If the call for heat is lost, the control de-energizes the inducer without post-purge and returns to standby.

If the low pressure switch does not close within 10 seconds of inducer energizing, the control flashes 2 on the LED. If the pressure switch does not close within 5 minutes of inducer energizing, the control shuts off the inducer for 30 seconds, then energizes the inducer for another 5 minutes to try to close the pressure switch. This cycle continues indefinitely until either the pressure switch is proved closed, or the call for heat ends.

Pre-purge

The ICB monitors the low pressure switch and ensures it remains closed during pre-purge. If the pressure switch opens, the control returns to pressure switch proving mode. The control waits for a 15 second pre-purge period, then begins the ignition trial.

Ignition trial period

The ICB energizes the main gas valve, second stage gas valve and spark outputs for a 10 second ignition trial. The control de-energizes the spark when flame is sensed and enters a flame stabilization period.

If flame is not established within the ignition trial period, the control de-energizes the spark and gas valve and checks for maximum number of ignition trials. The ICB has a maximum number of three ignition trials. If the control has attempted the maximum number of ignition trials within the same call for heat without flame, the control locks out flashing 4 on the LED. If the control has attempted less than maximum ignition trials, it begins an inter-purge period before attempting another ignition trial.

If the call for heat is lost during an ignition trial period, the control immediately de-energizes spark and gas. The control runs the inducer motor through a post purge period before de-energizing.

If the pressure switch is lost during an ignition trial period, the control immediately de-energizes spark and gas. The control begins pressure switch proving before an inter-purge and re-ignition attempt.

Flame stabilization period

If a flame is detected during the Ignition Trial Period, the ICB then enters the flame stabilization period. If a flame is not detected in 2 seconds, the main valve is de-energized and a retry operation begins. The flame stabilization period lasts 10 seconds. Flame detection must be lost for 2 seconds during flame stabilization for the main valve to be de-energized. When the flame stabilization period ends, a loss of flame detection for 3 seconds to 4 seconds results in the main valve being de-energized.

If flame is lost during the flame stabilization period, the control counts it as a flame loss and retries ignition or locks out as described in the Low heat section of Main burner operation.

Main burner operation

High heat warm-up

Two stage models run high heat for the first 30 seconds following flame stabilization period regardless of W2 demand. If W2 is not energized at the end of this 30 second period the control de-energizes the high gas output. If W2 is energized the control remains on high heat.

Low heat

The ICB keeps the main gas valve and induced draft motor energized while continuously monitoring the call for heat, low pressure switch, and flame status.

If the call for heat (W1) is lost, the control de-energizes the gas valve and begins post purge.

If low pressure switch opens, the control de-energizes the gas valve and begins pressure switch proving mode.

If flame is lost, the control de-energizes the gas valve within 2.0 seconds and counts the flame loss. If flame has been lost more than five times within the same call for heat, the control locks out flashing 5 on the LED. If flame has been lost less than five times, the control attempts reignition after a 30 second inter-purge period.

High heat

The ICB recognizes a call for second stage heat when W2 is energized. The control energizes the high gas output.

If the call for second stage heat goes away and the first stage call remains, the control de-energizes the high gas valve and returns to low heat operation.

Response to loss of W1, low pressure switch, and flame are identical to low heat operation.

Post purge

The ICB runs the induced draft motor for a 5 second post-purge period, then de-energizes the inducer. If a call for heat occurs during post-purge, the control finishes the post-purge, drops inducer out to re-prove open pressure switch before continuing with the heat cycle.

Lockout

While in lockout, the ICB keeps the main gas valve and induced draft motor de-energized.

Lockouts due to failed ignition or flame losses may be reset by removing the call for heat (W1) for more than 1 second, but less than 20 seconds, or by removing power from the control for over 0.25 seconds. The control automatically resets lockout after 60 minutes.

Lockouts due to detected internal control faults resets after 60 minutes or power interruption.

High temperature limit switch

If the high temperature limit switch is open the control runs the inducer, de-energizes the gas valve, and flashes 6 on the LED. When the high temperature switch closes, the control restarts the ignition sequence beginning with pre-purge.

If the high temperature limit is open for more than 6 minutes continuously during a call for heat, it is assumed that the main blower has failed and the control enters a hard lockout and flashes a 9 on the LED. During the hard lockout, the control continues to run the inducer as long as the limit switch is open. If the limit switch recloses in this hard lockout condition, the inducer runs a post purge and then shuts off. The control remains locked out until power is removed and does not reset automatically.

Roll-out switch

If the roll-out switch opens for more than 0.25 seconds, the ICB runs the inducer for a post-purge period, immediately de-energizes the gas valve, and flashes 7 on the LED.

If the roll-out switch closes, the controls remains locked out until power or W is removed. The rollout switch lockout does not reset automatically.

Power interruptions

Power interruptions less than 0.80 seconds do not cause the ICB to interrupt the heat sequence. Power interruptions over 0.25 seconds cause the control reset lockout and ignition trial counters. Power interruptions of any duration do not cause lockout or any operation requiring manual intervention.

Flame present with gas off

When the gas valve is closed, the ICB enters lockout if a flame is sensed for longer than 2.0 seconds. The control turns on the inducer blower while the flame is present.

Welded gas valve relay response

If either or both Main and Second Stage gas valve outputs are sensed to be off for more than 1 second when commanded to be **on**, the ICB shuts off all outputs and enters lockout.

If the Main valve output is sensed to be energized for more than 1 second when commanded to be off, the control de-energizes the induced draft motor (if flame is not present) to attempt to open the pressure switch to de-energize the gas valve. If the Main gas valve is still sensed as energized after the inducer has been off for 15 seconds, the control re-energizes the inducer to attempt to vent the unburned gas. In either case, the control locks out.

Modulating gas heat ignition control board function

Ignition control board on standby

The ignition control board (ICB) has all outputs de-energized and monitors the communications port and flame sense. The ICB resets ignition trial and flame loss counters. The ICB begins a call for heat when a communicated demand level is requested from the modulating furnace control (MFC) on the RS485 port.

Call for heat

The ICB checks to see if the pressure switch is open and the RPM sensor input indicates that the inducer motor is not

currently active. If the pressure switch is closed or the RPM sensor detects that the inducer is active, the ICB flashes 3 on the LED and waits indefinitely for it to become inactive. When the inducer is sensed as inactive, the ICB begins an air flow proving period. If the call for heat is lost, the ICB goes back to Standby.

Air flow proving

The ICB energizes the induced draft motor and waits for the low pressure switch to close and for the RPM sensor to provide a feedback signal of at least a level of 500 RPM. When the low pressure switch closes and the RPM sensor indicates at least 500 RPM, the control begins a pre-purge period. If the call for heat is lost, the control de-energizes the inducer without post-purge and returns to standby. If the low pressure switch does not close and the RPM sensor does not reach 500 RPM within 10 seconds of the inducer energizing, the control flashes 2 on the LED. If the pressure switch does not close and the RPM sensor does not indicate at least 500 RPM within 5 minutes of inducer energizing, the control shuts off the inducer for 30 seconds, then energizes the inducer for another 5 minutes to try to close the pressure switch and reach 500 RPM. This cycle continues indefinitely until either the airflow is proven, or the call for heat ends.

Pre-purge

The ICB monitors the low pressure switch and RPM sensor to ensure air flow remains present during pre-purge. If the pressure switch opens or the RPM sensor drops under 500 RPM, the control goes back to pressure switch proving mode. The control waits for a 30 second pre-purge period, then begins the ignition trial.

Ignition trial period

The ICB energizes the main gas valve and spark outputs for a 10 second ignition trial. The control de-energizes the spark when flame is sensed and enters a flame stabilization period. If a flame is not established within the ignition trial period, the control de-energizes the spark and gas valves and checks for maximum number of ignition trials.

The ICB has a maximum number of 3 ignition trials. If the control has attempted the maximum number of ignition trials within the same call for heat without flame, the control locks out flashing 4 on the LED. If the control has attempted less than the maximum ignition trials, it begins an inter-purge period before attempting another ignition trial.

If the call for heat is lost during an ignition trial period, the control immediately de-energizes the spark and gas. The control runs the inducer motor through a post purge period before de-energizing.

If the pressure switch is lost during an ignition trial period, the control immediately de-energizes the spark and gas. The control begins pressure switch proving before an inter-purge and re-ignition attempt.

If the rpm sensor indicates a loss of air flow during an ignition trial period, the control de-energizes the spark and gas after the 10 second ignition period. The control begins air flow proving before an inter-purge and re-ignition attempt.

Flame stabilization period

If a flame is detected during the ignition trial period, the ICB then enters the flame stabilization period. If a flame is not detected in 3 seconds (+/-1 second), the main valve is de-energized and a retry operation begins. The flame stabilization period lasts 10 seconds. Flame detection must be lost for 3 seconds (+/-1 second) during flame stabilization for the main valve to be de-energized. When the flame stabilization period has ended, a loss of flame detection within 1 seconds to 2 seconds results in the main valve being de-energized. If flame is lost during the flame stabilization period, the control counts it as a flame loss and retries ignition, or locks out as described in the Steady heat section.

Main burner operation

High heat warm-up

The ICB runs high heat for the first 30 seconds following flame stabilization period regardless of demand. If high heat is not requested at the end of this 30 second period the control reduces the high gas output and steps the inducer to a lower speed requested by the demand level. If high heat is requested the control remains on high heat.

Steady heat

The ICB keeps the main gas valve and induced draft motor energized while continuously monitoring the call for heat, low pressure switch, RPM sensor, and flame status. If the call for heat demand is lost, the control de-energizes the gas valve and begins post purge. If the low pressure switch opens or the inducer motor RPM sensor drops below 500 RPM, the control de-energizes the gas valve and begins pressure switch proving mode. If the flame is lost, the control de-energizes the gas valve within 2 seconds and counts the flame loss. If the flame is lost more than 5 times within the same call for heat, the control locks out flashing 5 on the LED. If the flame is lost less than 5 times, the control attempts re-ignition after a 30 second inter-purge period.

Post purge

The ICB runs the induced draft motor for a 5 second post-purge period, then de-energizes the inducer. If a call for heat occurs during post-purge, the control finishes the post-purge, drops inducer out to re-prove air flow before continuing with the heat cycle.

Lockout

While in lockout, the ICB keeps the main gas valve and induced draft motor de-energized. Lockouts due to failed ignition or flame losses can be reset by removing the call for heat (communicated demand) for more than 1 second, but less than 20 seconds, or by removing power from the control for over 1/4 seconds. The control automatically resets lockout after 60 minutes. Lockouts due to detected internal control faults resets after 60 minutes or power interruption.

High temperature limit switch

Any time the high temperature limit switch is open the ICB runs the inducer, de-energize the gas valve, and flash 6 on the LED. When the high temperature switch closes, the control restarts the ignition sequence beginning with pre-purge. If the high temperature limit is open for more than 6 minutes continuously during a call for heat, it is assumed that the main blower has failed and the control enters a hard lockout and flash a 9 on the LED. During the hard lockout, the control continues to run the inducer as long as the limit switch is open. If the limit switch recloses in this hard lockout condition, the inducer runs a post purge and then shutoff. The control remains locked out until power is removed and does not reset automatically.

Roll-out switch

If the roll-out switch opens for more than 1/4 seconds, the ICB runs the inducer for a post-purge period, immediately de-energizes the gas valve, and flashes 7 on the LED. If the roll-out switch closes, the control remains locked out until the power is removed or the demand is removed. The roll-out switch lockout does not reset automatically.

Power interruptions

Power interruptions less than 80mS do not cause a change in operating mode. Power interruptions more than 100 mS may cause the ICB to interrupt its current operational mode and re-start the operational sequence. Power interruptions of any duration are not to cause lockout or any operation requiring manual intervention to recover.

Flame present with gas off

If a flame is sensed for longer than 2 seconds during a period when the gas valve should be closed, the ICB enters lockout. The control turns on the inducer blower while the flame is present.

Welded gas valve relay response

If the main gas valve output is sensed to be off for more than 1 second when commanded to be on, the ICB shuts off all outputs and enters lockout. If the main valve output is sensed to be energized for more than 1 second when commanded to be off, the control de-energizes the induced draft motor (if flame is not present) to attempt to open the pressure switch to de-energize the gas valve. If the main gas valve is still sensed as energized after the inducer has been off for 10 seconds, the control re-energizes the inducer to attempt to vent the unburned gas. In either case, the control locks out.

Cooling start-up

The following sections describe the cooling start-up procedures.

Cooling pre-start checklist

The following sections describe the cooling start-up procedure.

1. Check the electrical supply voltage. Verify that it is the same as the voltage listed on the unit nameplate.
2. Set the room thermostat to the off position.
3. Turn on electrical power to the unit.
4. Set the room thermostat fan switch to on.
5. Check the indoor blower rotation.

   If the blower rotation is in the wrong direction, see Phasing section.

   a. Check the blower drive belt tension.
6. Check the unit supply air (cfm).
7. Measure the evaporator fan motor's amp draw.
8. Set the room thermostat fan switch to off.
9. Turn off electrical power to the unit.

Operating the unit

1. Turn on electrical power to the unit.
2. Set the room thermostat setting lower than the room temperature.

   First stage compressors energize after the built-in time delay of five minutes.

   Additional stages of cooling are energized by the thermostat if needed.

Post-start checklist

1. Verify the correct system pressures for both circuits.
2. Measure the temperature drop across the evaporator coil.
3. Measure the system amperage draw across all legs of 3 phase power wires.
4. Measure the condenser fan amperage draw.

Gas heat start-up

The following sections describe the gas heat start-up procedures.

Gas heat pre-start checklist

When the installation is complete, perform the following checks:

1. Check the type of gas supply. Verify that it is the same as the gas supply listed on the unit nameplate.
2. Verify that the combustion air intake and flue exhaust are free of any debris or obstruction.
3. Verify that the hood is installed over the flue exhaust discharge opening.
4. For modulating furnaces, set the System Selection bottom pin jumper to COMMISSION on the Modulating Furnace Control to correctly check the input rate and manifold pressure.

Operating instructions

CAUTION

This furnace is equipped with an automatic re-ignition system. DO NOT attempt to manually light the burners.

Gas heat post-start checklist

After the entire control circuit has been energized and the heating section is operating, perform the following checks:

1. Check for gas leaks in the unit piping and the supply piping.

WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow the safety warning exactly could result in serious injury, death, or property damage. Never test for gas leaks with an open flame. Use a commercially available soap solution made specifically for the detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury, or loss of life.

2. Check for the correct manifold gas pressures, input rates, and air temperature rise. See Checking gas heat input section.
3. Check the supply gas pressure. It must be within the limits shown on the rating nameplate.

Note: Check the supply pressure with all gas appliances in the building at full fire. The standby gas pressure must never exceed 13 in. or the operating pressure drop below the minimum as specified on the unit rating plate. If the gas pressure is outside these limits, contact the local gas utility or propane supplier for corrective action.

Table 55: Natural gas inputs and pressures

Gas model	Size (ton)	Gas input (MBH) Top module		Gas input (MBH) Bottom module		Manifold pressure (in. W.C.) Top module		Manifold pressure (in. W.C.) Bottom module		Supply pressure (in. W.C.)	
		Normal	Reduced	Normal	Reduced	Normal	Reduced	Normal	Reduced	Min	Max
(N,S)1	All	400	320	N/A	N/A	3.5	2.5	N/A	N/A	4.8	10.5
(N,S)3	27.5, 30	400	320	220	176	3.5	2.5	3.5	2.5	5.5	10.5
	35, 40 and 50	400	320	400	320	3.5	2.5	3.5	2.5	5.5	10.5
T3	27.5, 30	400	140	220	176	3.5	0.6	3.5	2.5	6.0	10.5
	35, 40 and 50	400	140	400	320	3.5	0.6	3.5	2.5	6.0	10.5

Note: Propane inputs and pressures are provided in the listed conversion kit instructions. Modulating furnaces are **not** certified for use with propane and cannot be converted.

Shutting down the unit

1. Set the thermostat to the lowest temperature setting.
2. Turn off all electrical power to unit.
3. Open the gas heat access panel.
4. Turn the gas valve switch to the OFF position.
5. For modulating furnaces, when commissioning is complete return the System Selection bottom pin jumper to NORM OPERATION on the Modulating Furnace Control.

Checking gas heat input

For two stage and modulating furnaces, check the input rate at full input and minimum input. The intended input for each furnace is shown in Vertical supply unit physical data and on the unit rating plate. The table applies to units operating on 60 Hz power only.

Important

If this is a modulating furnace, the Modulating Furnace Control board must be in COMMISSION mode on the System Selection pin jumper when checking input rate. Otherwise, the furnace input will fluctuate automatically and not maintain a steady rate. In COMMISSION mode, a second stage thermostat call will run the furnace at full input and a first stage call will run at minimum input.

To determine the rate of gas flow at second stage (full input)

To determine the rate of gas flow at second stage (full input):

1. Turn off all other gas appliances connected to the gas meter.
2. Turn on the furnace and make sure the thermostat is calling for second stage (100% input) heat.
3. Measure the time needed for one revolution of the hand on the lowest increment dial on the meter. A typical gas meter has a 1/2 or a 1 cubic foot test dial.
4. Using the number of seconds it takes for one revolution of the dial, calculate the cubic feet of gas consumed per hour. See the example in To determine the rate of gas flow at first stage (minimum input).
5. If necessary, adjust the high pressure regulator as discussed in the section Adjusting the manifold gas pressure. **Do not over-fire the furnace on the second stage.** If in doubt, it is better to leave the second stage of the furnace slightly under-fired. Repeat Step 1 to Step 5.

To determine the rate of gas flow at first stage (minimum input)

1. Turn off all other gas appliances connected to the gas meter.
2. Turn on the furnace and make sure the thermostat is calling for first stage (minimum input) heat.
3. Even when the thermostat is calling for first stage heat, the unit lights on second stage and runs on second stage for 1 minute. Allow this 1 minute time period to expire and be certain the unit is running on first stage.
4. Measure the time needed for one revolution of the hand on the lowest increment dial on the meter. A typical gas meter has a 1/2 cubic foot or a 1 cubic foot test dial.
5. Using the number of seconds it takes for one revolution of the dial, calculate the cubic feet of gas consumed per hour. See the following example for reference.
6. If necessary, adjust the low pressure regulator as discussed in the section Adjusting the manifold gas pressure. **Do not not under-fire the furnace on the first stage.** If in doubt, it is better to leave the first stage of the furnace slightly over-fired. Repeat Step 1 to Step 6.

Table 56: Gas rate cubic feet per hour

Seconds for one rev.	Size of test dial	
	1/2 cu. ft	1 cu. ft
10	180	360
12	150	300
14	129	257
16	113	225

Table 56: Gas rate cubic feet per hour

Seconds for one rev.	Size of test dial	
	1/2 cu. ft	1 cu. ft
18	100	200
20	90	180
22	82	164
24	75	150
26	69	138
28	64	129
30	60	120
32	56	113
34	53	106
36	50	100
38	47	95
40	45	90
42	43	86
44	41	82
46	39	78
48	37	75
50	36	72
52	35	69
54	34	67
56	32	64
58	31	62
60	30	60

Note: To find the Btu input, multiply the number of cubic feet of gas consumed per hour by the Btu content of the gas in your particular locality (contact your gas company for this information as it varies widely from area to area).

Example

By actual measurement, it takes 19 seconds for the hand on a 1 cubic foot dial to make a revolution with a 200,000 Btuh furnace running. To determine rotations per minute, divide 60 by 19 = 3.16. To calculate rotations per hour, multiply 3.16 • 60 = 189.6. Multiply 189.6 • 1 (0.5 if using a 1/2 cubic foot dial) = 189.6. Multiply 189.6 • (the Btu rating of the gas). For this example, assume the gas has a Btu rating of 1050 Btu/ft^3. The result of 199,000 Btuh is within 2% of the 200,000 Btuh rating of the furnace.

Adjusting the manifold gas pressure

Two stage

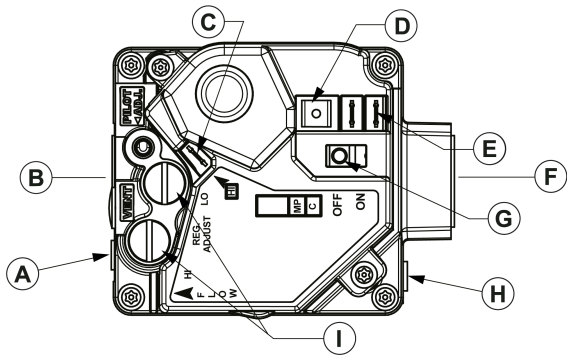
This gas furnace has two heat stages. The gas valve has two adjustment screws located under two cover screws. The second stage adjustment screw is adjacent to the HI marking on the valve and the first stage adjustment screw is located adjacent to the LO marking on the valve.

Manifold pressure adjustment procedure.

Adjust second stage first, then adjust first stage pressure. See the Vertical supply unit physical data or the unit rating plate.

1. Turn off all power to the unit.
2. Using the outlet pressure port on the gas valve, connect a manometer to monitor the manifold pressure.
3. Remove cover screws covering HI and LO pressure adjustment screws.
4. Turn on power to the unit.
5. Set thermostat to call for second stage heat and start furnace.
6. If necessary, using a screwdriver, turn the second stage adjustment screw (adjacent to the HI marking on the valve) clockwise to increase manifold pressure or counterclockwise to decrease manifold pressure.
7. After the high manifold pressure has been checked, adjust the thermostat to call for first stage heat.
8. If necessary, using a screwdriver, turn the first stage adjustment screw (adjacent to the LO marking on the valve) clockwise to increase manifold pressure or counterclockwise to decrease manifold pressure.
9. Once pressure has been checked, replace the cover screws covering the HI and LO pressure adjustment screws.

Figure 106: Two stage gas valve



Item	Description
A	Outlet pressure tap 1/8 in. - 27 NPT
B	Outlet
C	3/16 in. x .032 in. thk. male spade terminal - 2nd stage coil
D	External jumper
E	1/4 in. x .032 in. thk. male spade terminals (2) - common
F	Inlet
G	On/Off switch
H	Inlet pressure tap 1/8 in. - 27 NPT
I	Regulator cover screws (reg. adj. beneath these screws)

Modulating gas furnace

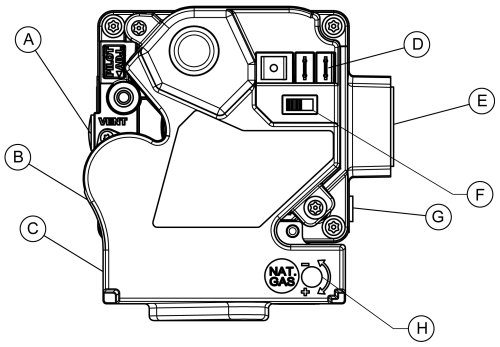
This gas furnace is a fully modulating system. The modulating furnace requires manifold pressure adjustment at both the highest setting (100%, full input) and lowest setting (35%, minimum input) of the gas valve to ensure it regulates correctly across the full range. Both settings are adjusted by a single Rotary DIP Switch on the valve. See Figure 107).

Important: The Modulating Furnace Control (MFC) board must be in COMMISSION mode on the System Selection pin jumper when checking input rate. Otherwise, the manifold pressure fluctuates automatically and does not maintain a steady rate. In COMMISSION mode, the MFC maintains a 100% (full input) heat demand with a second stage thermostat call and a 35% (minimum input) heat demand with a first stage call.

1. Turn off all power to the unit.
2. Using the outlet pressure port on the gas valve, connect a manometer to monitor the manifold pressure.
3. Remove the plastic cap covering the pressure adjustment rotary DIP switch.
4. Turn on power to the unit.
5. Set thermostat to call for second stage heat and start furnace.
6. If necessary, using a small flat-head screwdriver, turn the rotary DIP switch clockwise to increase manifold pressure or counterclockwise to decrease manifold pressure.

   Note: When adjusting the rotary DIP switch, wait 1 second between steps to allow the software to register the change. If a change is not registered, the offset returns to its original setting.
7. After you have checked the manifold pressureat its highest setting, adjust the thermostat to call for the first stage heat to set the manifold pressure at its lowest setting.
8. Wait at least one minute for the furnace to step down to its lowest setting and adjust the manifold pressure, if necessary, using the same procedure in Step 6.
9. After you have checked the pressure, replace the plastic cap covering the rotary DIP switch.

Figure 107: Gas valve



Item	Description
A	Outlet
B	Outlet pressure tap, 1/8 in. – 27 NPT
C	5 pin plug (modulator)
D	1/4 in. x 0.032 in. thk male spade terminals (2) – main and common
E	Inlet
F	On/Off switch
G	Inlet pressure tap, 1/8 in. – 27 NPT
H	Regulator cap (regulator adjustment rotary dip switch beneath)

Adjustment of temperature rise

The temperature rise (the difference of temperature between the mixed air entering the furnace and the heated air leaving the furnace) must lie within the range shown on the unit rating plate and the data in Vertical supply unit physical data when the unit is operating as full input.

Air temperature rise is determined when the furnace is firing at full input. Two stage furnaces require a second stage thermostat call. Modulating furnaces require a second stage thermostat call and the modulating furnace control must be in COMMISSION mode to maintain full input.

After the temperature rise has been determined, the CFM can be calculated as follows:

$$\text{CFM} = \text{Btu Input} \cdot \frac{0.8}{(1.08 \cdot \Delta°\text{F})}$$

After about 20 minutes of operation, determine the furnace temperature rise. Take readings of both the return air and the heated air in the ducts (about 6 ft from the furnace) where they are not affected by radiant heat. Increase the blower CFM to decrease the temperature rise; decrease the blower CFM to increase the rise (See Supply air drive adjustment).

Note: Each gas heat exchanger size has a minimum allowable CFM. Below this CFM, the limit opens.

Servicing and inspecting the burners and orifices

Before checking or changing burners or orifices, close the main manual shut-valve and shut off all power to the unit.

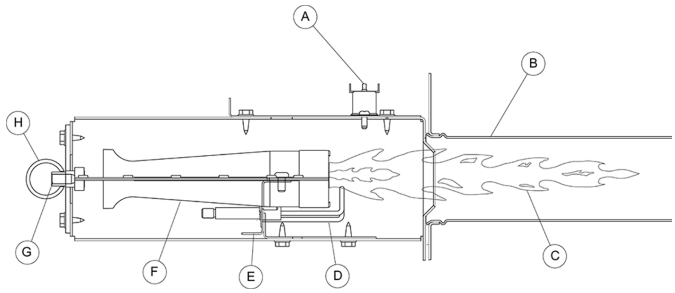
1. Open the union fitting just upstream of the unit gas valve and downstream from the main manual shut-off valve in the gas supply line.
2. Remove the screws holding each end of the manifold to the manifold supports.
3. Disconnect wiring to the gas valve. Remove the manifold and gas valve assembly. Orifices can now be inspected or replaced.

   To service burners, complete Step 4.
4. Remove the heat shield on top of the manifold supports. Burners are now accessible for inspection or replacement.

   Note: Reverse the preceding procedure to replace the assemblies.

   Make sure that burners are level and sit at the rear of the gas orifice.

Figure 108: Typical flame



Item	Description
A	Roll-out switch
B	Heat exchanger tube
C	Burner flame (blue only)
D	Ignitor
E	Burner bracket
F	Burner
G	Orifice
H	Manifold

Charging tables

Table 57: 27.5 ton charging table - system 1

Air Flow; Indoor DB/WB	Outdoor DryBulb °F	Suction Pressure psig	Suction Temp °F	Liquid Pressure psig	Liquid Temp °F	Delta T, Indoor DB, °F
300 Cfm/Ton; 80/62	75.01	109.69	53.30	280.68	78.81	32
	84.99	112.57	53.73	334.90	88.11	31
	95.07	113.33	55.53	385.02	98.63	31
300 Cfm/Ton; 80/67	75.01	120.51	57.43	278.21	80.42	27
	84.99	122.17	58.40	329.12	89.54	27
	95.07	123.98	59.43	385.11	99.23	26
300 Cfm/Ton; 80/72	75.01	131.79	61.55	275.76	82.62	23
	84.99	133.44	62.47	327.38	91.03	22
	95.07	135.21	63.42	384.32	100.20	21
300 Cfm/Ton; 75/62	75.01	109.48	52.93	281.83	78.51	27
	84.99	111.13	53.99	332.23	88.27	27
	95.07	112.86	55.07	387.57	98.34	26
400 Cfm/Ton; 80/62	75.01	116.45	55.89	277.96	80.14	28
	84.99	117.65	56.72	328.37	89.35	28
	95.07	119.52	57.81	383.94	99.09	27
400 Cfm/Ton; 80/67	75.01	126.67	59.69	278.28	80.72	24
	84.99	128.19	60.60	329.82	89.73	23
	95.07	129.57	61.43	386.46	99.31	23
400 Cfm/Ton; 80/72	75.01	138.43	63.91	275.26	83.14	19
	84.99	139.79	64.69	327.79	91.29	18
	95.07	141.50	65.60	384.60	100.55	18
400 Cfm/Ton; 75/62	75.01	115.26	55.17	281.93	78.75	24
	84.99	116.78	56.13	332.57	88.47	23
	95.07	118.49	57.17	388.15	98.51	23

Table 58: 27.5 ton charging table - system 2

Air Flow; Indoor DB/WB	Outdoor DryBulb °F	Suction Pressure psig	Suction Temp °F	Liquid Pressure psig	Liquid Temp °F	Delta T, Indoor DB, °F
300 Cfm/Ton; 80/62	75.01	109.29	53.34	245.90	86.49	32
	84.99	101.48	49.15	389.22	97.61	31
	95.07	112.78	55.40	333.67	109.31	31
300 Cfm/Ton; 80/67	75.01	119.35	57.30	245.72	86.75	27
	84.99	121.13	58.28	289.08	98.00	27
	95.07	122.89	59.25	336.61	109.43	26
300 Cfm/Ton; 80/72	75.01	130.37	61.47	244.65	87.24	23
	84.99	132.16	62.40	289.82	98.29	22
	95.07	134.04	63.36	338.15	109.66	21
300 Cfm/Ton; 75/62	75.01	108.86	52.93	247.20	86.40	27
	84.99	110.48	53.91	289.33	97.75	27
	95.07	112.16	54.92	335.57	109.23	26
400 Cfm/Ton; 80/62	75.01	115.41	55.76	244.46	86.69	28
	84.99	116.84	56.65	287.54	97.95	28
	95.07	119.27	57.89	334.58	109.40	27
400 Cfm/Ton; 80/67	75.01	125.25	59.55	246.92	86.82	24
	84.99	126.56	60.33	291.14	98.02	23
	95.07	128.41	61.30	337.90	109.49	23
400 Cfm/Ton; 80/72	75.01	136.66	63.77	245.11	87.43	19
	84.99	138.29	64.62	290.71	98.41	18
	95.07	140.04	65.50	339.33	109.77	18
400 Cfm/Ton; 75/62	75.01	114.53	55.21	247.98	86.47	24
	84.99	116.11	56.14	290.46	97.80	23
	95.07	117.73	57.09	336.71	109.29	23

Table 59: 30 ton charging table - system 1

Air Flow; Indoor DB/WB	Outdoor DryBulb °F	Suction Pressure psig	Suction Temp °F	Liquid Pressure psig	Liquid Temp °F	Delta T, Indoor DB, °F
300 Cfm/Ton; 80/62	75.01	107.18	52.19	263.82	76.33	33
	84.99	109.10	53.29	308.29	86.23	32
	95.07	111.11	54.42	356.55	96.29	31
300 Cfm/Ton; 80/67	75.01	117.66	56.39	263.21	76.86	28
	84.99	119.54	57.41	309.11	86.61	27
	95.07	121.50	58.46	358.98	96.58	26
300 Cfm/Ton; 80/72	75.01	128.47	60.55	262.96	77.62	23
	84.99	130.50	61.57	309.66	87.17	22
	95.07	132.54	62.58	360.51	97.04	22
300 Cfm/Ton; 75/62	75.01	107.05	51.90	264.66	76.24	28
	84.99	108.80	52.94	309.27	86.13	27
	95.07	110.68	54.03	358.16	96.17	26
400 Cfm/Ton; 80/62	75.01	113.68	54.81	262.79	76.67	29
	84.99	115.49	55.83	307.55	86.51	28
	95.07	117.00	56.73	357.01	96.47	27
400 Cfm/Ton; 80/67	75.01	123.86	58.80	264.02	77.08	24
	84.99	125.50	59.69	310.50	86.76	24
	95.07	127.31	60.66	360.64	96.72	23
400 Cfm/Ton; 80/72	75.01	135.07	63.01	263.39	77.97	19
	84.99	136.82	63.89	311.06	87.39	19
	95.07	138.72	64.82	362.21	97.22	18
400 Cfm/Ton; 75/62	75.01	112.81	54.25	265.68	76.35	24
	84.99	114.30	55.14	310.79	86.22	24
	95.07	116.17	56.20	359.62	96.28	23

Table 60: 30 ton charging table - system 2

Air Flow; Indoor DB/WB	Outdoor DryBulb °F	Suction Pressure psig	Suction Temp °F	Liquid Pressure psig	Liquid Temp °F	Delta T, Indoor DB, °F
300 Cfm/Ton; 80/62	75.01	107.18	52.12	262.40	89.43	33
	84.99	108.95	53.18	305.33	101.21	32
	95.07	110.89	54.29	358.07	113.11	31
300 Cfm/Ton; 80/67	75.01	117.43	56.13	263.44	89.52	28
	84.99	119.23	57.13	307.40	101.31	27
	95.07	121.10	58.16	359.29	113.19	26
300 Cfm/Ton; 80/72	75.01	128.26	60.21	264.04	89.70	23
	84.99	130.16	61.20	309.19	101.46	22
	95.07	132.14	62.20	358.47	113.37	22
300 Cfm/Ton; 75/62	75.01	106.93	51.76	262.83	89.38	28
	84.99	108.61	52.79	308.45	101.15	27
	95.07	110.40	53.86	361.58	113.05	26
400 Cfm/Ton; 80/62	75.01	113.56	54.63	262.56	89.48	29
	84.99	115.16	55.58	305.94	101.27	28
	95.07	116.67	56.50	357.24	113.15	27
400 Cfm/Ton; 80/67	75.01	123.58	58.47	264.59	89.58	24
	84.99	125.22	59.38	308.84	101.37	24
	95.07	126.67	60.21	361.63	113.24	23
400 Cfm/Ton; 80/72	75.01	134.69	62.56	264.93	89.80	19
	84.99	136.47	63.47	310.49	101.55	19
	95.07	138.26	64.38	359.85	113.45	18
400 Cfm/Ton; 75/62	75.01	112.47	53.97	264.10	89.42	24
	84.99	114.18	54.97	309.31	101.19	24
	95.07	115.88	55.97	362.88	113.08	23

Table 61: 35 ton charging table - system 1

Air Flow; Indoor DB/WB	Outdoor DryBulb °F	Suction Pressure psig	Suction Temp °F	Liquid Pressure psig	Liquid Temp °F	Delta T, Indoor DB, °F
300 Cfm/Ton; 80/62	75.01	115.22	54.79	292.51	73.81	33
	84.99	116.69	55.62	341.94	82.46	33
	95.07	118.57	56.59	395.14	91.66	32
300 Cfm/Ton; 80/67	75.01	125.67	58.96	295.47	74.96	28
	84.99	127.31	59.81	345.88	83.35	27
	95.07	129.06	60.68	400.81	92.23	27
300 Cfm/Ton; 80/72	75.01	137.54	63.50	297.89	76.75	23
	84.99	139.21	64.30	349.46	84.69	22
	95.07	141.09	65.17	405.34	93.31	22
300 Cfm/Ton; 75/62	75.01	114.53	54.35	295.18	73.06	28
	84.99	116.02	55.19	344.75	81.93	28
	95.07	117.59	56.04	398.85	91.10	27
400 Cfm/Ton; 80/62	75.01	121.80	57.44	292.74	75.00	30
	84.99	123.87	58.47	342.99	83.33	29
	95.07	126.27	59.62	397.92	92.22	29
400 Cfm/Ton; 80/67	75.01	131.91	61.38	297.30	75.56	24
	84.99	133.40	62.13	347.97	83.87	24
	95.07	135.14	62.98	402.70	92.75	23
400 Cfm/Ton; 80/72	75.01	144.00	65.87	299.67	77.46	19
	84.99	145.42	66.55	351.75	85.22	19
	95.07	146.99	67.29	408.12	93.71	18
400 Cfm/Ton; 75/62	75.01	120.65	56.84	296.32	73.70	25
	84.99	122.08	57.61	346.16	82.44	24
	95.07	123.54	58.41	400.27	91.55	24

Table 62: 35 ton charging table - system 2

Air Flow; Indoor DB/WB	Outdoor DryBulb °F	Suction Pressure psig	Suction Temp °F	Liquid Pressure psig	Liquid Temp °F	Delta T, Indoor DB, °F
300 Cfm/Ton; 80/62	75.01	111.20	54.15	243.65	76.11	33
	84.99	112.92	55.19	286.55	85.47	33
	95.07	114.44	56.12	333.90	95.05	32
300 Cfm/Ton; 80/67	75.01	121.93	58.42	242.99	77.32	28
	84.99	123.66	59.37	287.16	86.29	27
	95.07	125.45	60.36	335.47	95.69	27
300 Cfm/Ton; 80/72	75.01	133.57	62.84	242.24	78.89	23
	84.99	135.39	63.78	287.34	87.46	22
	95.07	137.32	64.75	336.43	96.60	22
300 Cfm/Ton; 75/62	75.01	111.11	53.88	245.28	75.75	28
	84.99	112.77	54.87	288.62	85.16	28
	95.07	114.57	55.94	336.01	94.85	27
400 Cfm/Ton; 80/62	75.01	117.93	56.84	242.41	77.00	30
	84.99	119.40	57.74	285.50	86.17	29
	95.07	121.21	58.75	333.14	95.62	29
400 Cfm/Ton; 80/67	75.01	128.75	61.04	243.42	77.80	24
	84.99	130.29	61.89	287.97	86.69	24
	95.07	131.86	62.76	336.31	96.05	23
400 Cfm/Ton; 80/72	75.01	140.48	65.38	242.19	79.56	19
	84.99	142.04	66.20	287.96	87.92	19
	95.07	143.78	67.06	337.54	96.97	18
400 Cfm/Ton; 75/62	75.01	117.37	56.40	245.68	76.12	25
	84.99	118.84	57.30	289.33	85.46	24
	95.07	120.38	58.21	336.87	95.09	24

Table 63: 40 ton charging table - system 1

Air Flow; Indoor DB/WB	Outdoor DryBulb °F	Suction Pressure psig	Suction Temp °F	Liquid Pressure psig	Liquid Temp °F	Delta T, Indoor DB, °F
300 Cfm/Ton; 80/62	75.01	120.14	58.14	251.12	68.32	31
	84.99	122.07	59.27	296.75	77.11	31
	95.07	124.09	60.44	348.50	86.06	30
300 Cfm/Ton; 80/67	75.01	131.90	62.66	252.42	68.69	26
	84.99	133.73	63.68	299.69	77.33	26
	95.07	135.72	64.77	353.69	86.19	25
300 Cfm/Ton; 80/72	75.01	143.93	67.09	255.17	68.99	21
	84.99	145.83	68.08	302.64	77.47	21
	95.07	148.01	69.15	356.01	86.24	20
300 Cfm/Ton; 75/62	75.01	120.49	58.02	253.14	68.22	26
	84.99	122.20	59.08	299.75	77.02	26
	95.07	124.01	60.12	354.08	85.97	25
400 Cfm/Ton; 80/62	75.01	127.46	60.98	250.01	68.62	27
	84.99	130.04	62.30	296.36	77.31	26
	95.07	132.79	63.69	349.31	86.20	25
400 Cfm/Ton; 80/67	75.01	138.43	65.09	253.79	68.89	23
	84.99	139.99	65.97	301.34	77.41	22
	95.07	141.67	66.91	354.58	86.15	22
400 Cfm/Ton; 80/72	75.01	150.56	69.46	257.01	69.04	18
	84.99	152.31	70.35	303.65	77.49	18
	95.07	154.14	71.27	358.72	86.32	17
400 Cfm/Ton; 75/62	75.01	126.66	60.43	253.80	68.36	23
	84.99	127.90	61.26	301.48	77.10	23
	95.07	129.51	62.23	355.90	86.03	22

Table 64: 40 ton charging table - system 2

Air Flow; Indoor DB/WB	Outdoor DryBulb °F	Suction Pressure psig	Suction Temp °F	Liquid Pressure psig	Liquid Temp °F	Delta T, Indoor DB, °F
300 Cfm/Ton; 80/62	75.01	120.96	58.64	239.99	84.21	31
	84.99	122.47	59.57	286.75	94.98	31
	95.07	124.11	60.56	340.24	105.95	30
300 Cfm/Ton; 80/67	75.01	131.46	62.68	241.01	84.48	26
	84.99	133.15	63.62	289.34	95.12	26
	95.07	134.85	64.57	344.77	105.92	25
300 Cfm/Ton; 80/72	75.01	143.36	67.06	240.63	84.72	21
	84.99	145.05	67.95	289.28	95.16	21
	95.07	147.17	68.98	343.64	106.11	20
300 Cfm/Ton; 75/62	75.01	119.87	57.96	244.84	83.95	26
	84.99	121.62	59.01	291.87	94.80	26
	95.07	123.55	60.10	347.12	105.83	25
400 Cfm/Ton; 80/62	75.01	128.72	61.64	239.38	84.50	27
	84.99	131.10	62.85	286.94	95.15	26
	95.07	133.79	64.17	340.36	105.94	25
400 Cfm/Ton; 80/67	75.01	137.42	64.89	240.12	84.65	23
	84.99	138.98	65.76	288.41	95.14	22
	95.07	140.73	66.70	342.21	106.02	22
400 Cfm/Ton; 80/72	75.01	149.09	69.11	240.81	84.62	18
	84.99	150.74	69.96	288.77	95.30	18
	95.07	152.48	70.84	345.07	106.18	17
400 Cfm/Ton; 75/62	75.01	125.82	60.29	243.57	84.14	23
	84.99	127.40	61.22	291.11	94.93	23
	95.07	129.00	62.17	346.01	105.91	22

Table 65: 50 ton charging table - system 1

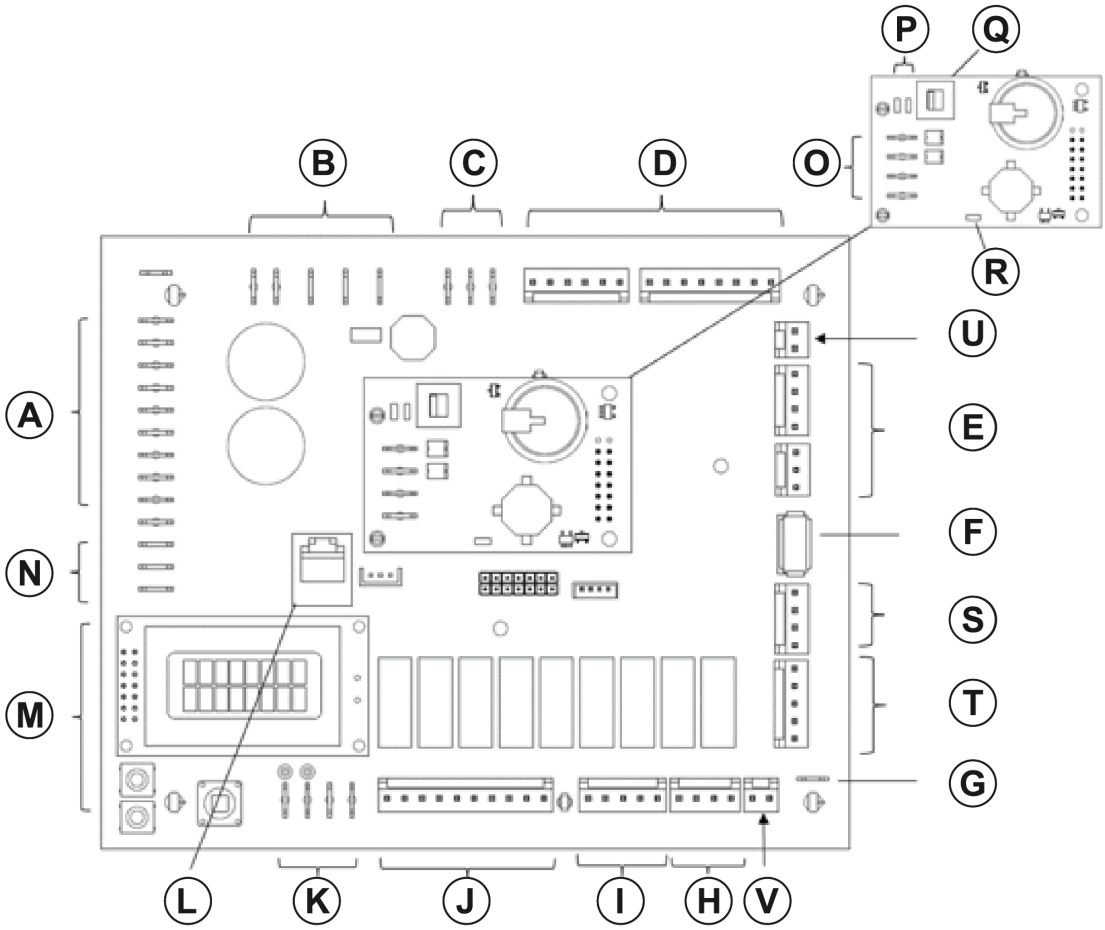
Air Flow; Indoor DB/WB	Outdoor DryBulb °F	Suction Pressure psig	Suction Temp °F	Liquid Pressure psig	Liquid Temp °F	Delta T, Indoor DB, °F
300 Cfm/Ton; 80/62	75.01	115.42	57.47	291.14	73.20	32
	84.99	120.57	59.81	338.65	82.54	29
	95.07	126.67	62.45	391.64	91.51	26
300 Cfm/Ton; 80/67	75.01	126.06	61.59	295.25	74.01	27
	84.99	131.14	63.80	343.93	82.62	25
	95.07	135.58	65.71	397.20	91.83	23
300 Cfm/Ton; 80/72	75.01	137.51	65.86	299.15	74.57	22
	84.99	142.83	68.03	348.96	83.31	20
	95.07	147.05	69.78	403.62	92.37	18
300 Cfm/Ton; 75/62	75.01	115.05	57.09	292.17	72.89	27
	84.99	119.90	59.32	340.33	82.16	25
	95.07	124.07	61.25	392.81	91.18	23
400 Cfm/Ton; 80/62	75.01	121.72	59.94	292.68	73.88	28
	95.07	114.29	57.69	386.80	91.27	33
	104.86	120.41	60.41	442.37	100.13	30
400 Cfm/Ton; 80/67	75.01	132.38	63.97	297.66	74.21	24
	95.07	125.12	61.86	392.17	91.38	28
	104.86	131.49	64.52	448.99	100.55	25
400 Cfm/Ton; 80/72	75.01	143.81	68.13	301.83	74.78	19
	95.07	136.61	66.09	397.56	92.00	23
	104.86	143.20	68.70	455.77	101.08	20
400 Cfm/Ton; 75/62	75.01	121.05	59.45	294.65	73.26	24
	95.07	113.97	57.35	388.02	91.09	28
	104.86	120.18	60.10	444.20	99.94	25

Table 66: 50 ton charging table - system 2

Air Flow; Indoor DB/WB	Outdoor DryBulb °F	Suction Pressure psig	Suction Temp °F	Liquid Pressure psig	Liquid Temp °F	Delta T, Indoor DB, °F
300 Cfm/Ton; 80/62	75.01	116.97	56.85	267.24	88.59	32
	84.99	122.04	59.16	310.74	99.92	29
	95.07	128.54	61.96	359.04	111.22	26
300 Cfm/Ton; 80/67	75.01	127.81	61.14	270.79	89.36	27
	84.99	133.00	63.38	315.06	100.18	25
	95.07	137.47	65.29	363.51	111.72	23
300 Cfm/Ton; 80/72	75.01	139.66	65.61	273.84	90.14	22
	84.99	145.03	67.80	319.23	101.29	20
	95.07	149.46	69.62	368.90	112.61	18
300 Cfm/Ton; 75/62	75.01	116.52	56.47	268.37	88.29	27
	84.99	121.56	58.77	312.17	99.63	25
	95.07	125.69	60.68	359.92	110.77	23
400 Cfm/Ton; 80/62	75.01	123.58	59.49	268.59	89.29	28
	95.07	115.82	57.04	354.88	110.79	33
	104.86	121.78	59.65	405.39	121.82	30
400 Cfm/Ton; 80/67	75.01	134.21	63.59	272.47	89.56	24
	95.07	126.85	61.31	359.46	111.05	28
	104.86	133.28	64.00	411.28	122.41	25
400 Cfm/Ton; 80/72	75.01	145.97	67.92	276.11	90.57	19
	95.07	138.80	65.79	363.98	111.97	23
	104.86	145.57	68.47	416.73	123.30	20
400 Cfm/Ton; 75/62	75.01	122.65	58.92	270.38	88.70	24
	95.07	115.56	56.68	356.12	110.61	28
	104.86	121.77	59.44	407.14	121.63	25

Smart Equipment unit control board

Figure 109: Unit control board



The following tables describe the details of the UCB, see the previous figure for the connection locations.

Table 67: Smart Equipment UCB - thermostat connection strip

Location	Label	Description	Function and comments
A	W1	1st stage heating request, 24 VAC input switched from R	Not effective for cooling-only units
	W2	2nd stage heating request, 24 VAC input switched from R	Not effective for cooling-only units or units with single-stage heat sections
	Y1	1st stage cooling request, 24 VAC input switched from R	
	Y2	2nd stage cooling request, 24 VAC input switched from R	Visible in the display menu when the #ClgStgs parameter is set for 2 or more, also effective for economizer free cooling supply air temperature reset when the #ClgStgs parameter is set for 1 or more
	G	Continuous indoor blower request, 24 VAC input switched from R	
	OCC	Occupancy request, 24 VAC input switched from R	Must have the OccMode parameter set for External to be effective
	X	Hard lockout indicator, 24 volt output to a light thermostat LED	
	R	24 VAC hot for thermostat switching and power	If field-added external accessories for unit shutdown are used, 24 VAC hot return from smoke detector and/or user shutdown relay switching in series
	SD-24	If field-added external accessories for unit shutdown are used, 24 VAC hot out for smoke detector and/or user shutdown relay switching in series	Unit wiring harness jumper plug for factory shutdown accessories must be removed if the switching of field-added external accessories for unit shutdown are wired between thermostat connection strip SD-24 and R
	C	24 VAC common for thermostat power	
	+	MOD BUS	Future
	-	MOD BUS	Future
	C	MOD BUS	Future

Table 68: Smart Equipment UCB - limit, 24 VAC power, and shutdown connections

Location	Label	Description	Function and comments
B	LIMIT	Monitored 24 VAC input through heat section limit switch(es)	If voltage is absent, indicating the heat section is over-temperature, the UCB turns on the indoor blower
	C	24 VAC, 75 VA transformer Common referenced to cabinet ground	Connects through circuit traces to thermostat connection strip C and indoor blower VFD pin C
	24V	24 VAC, 75 VA transformer hot	Powers the UCB microprocessor, connects through circuit trace to the SD 24 terminal
	SD 24	24 VAC hot out for factory accessory smoke detector and/or user shutdown relay switching in series	Connects through circuit trace to thermostat connection strip SD-24. A wiring harness jumper plug connecting SD 24 to SD R is in place if factory accessories for unit shutdown are not used - this jumper plug must be removed if the switching of field-added external accessories for unit shutdown are wired between thermostat connection strip SD-24 and R
	SD R	24 VAC hot return from factory accessory smoke detector and user shutdown relay switching in series	Connects through circuit trace to the R terminal on the upper left of the board
	R	24 VAC hot for switched inputs to the UCB	Connects through circuit trace to the thermostat connection strip R terminal, right FAN OVR pin, right HPS1 pin, right HPS2 pin, lower DFS pin and lower APS pin

Table 69: Smart Equipment UCB - space temperature sensor connections

Location	Label	Description	Function and comments
C	ST	Space Temperature sensor input from 10KΩ @ 77°F, Type III negative temperature coefficient thermistor	Positive of VDC circuit (3.625 VDC reading to COM with open circuit), effective if “Thermo- stat-only Control” parameter is set OFF, space sensor override momentary shorts ST to COM to initiate/terminate temporary occupancy
	COM	Common for ST and SSO inputs	Negative of VDC circuit for ST and SSO inputs
	SSO	Space Sensor Offset input from 0 to 20KΩ potentiometer	Positive of VDC circuit (3.625 VDC reading to COM with open circuit), 10KΩ/2.5 VDC is 0°F offset, 0Ω/0 VDC is maximum above offset and 20KΩ/3.4 VDC is maximum below offset from active space temperature setpoint

Table 70: Smart Equipment UCB - temperature sensor connections

Location	Label	Description	Function and comments
D	SAT+	Supply Air Temperature sensor input from 10KΩ @ 77°F, Type III negative temperature coefficient thermistor	Input required for operation; 3.625 VDC reading SAT+ to SAT– with open circuit. Used in heat/cool staging cutouts, free cooling operation, demand ventilation operation, comfort ventilation operation, economizer loading operation, VAV cooling operation, hydronic heat operation
	RAT+	Return Air Temperature sensor input from 10KΩ @ 77°F, Type III negative temperature coefficient thermistor	Input required for operation; 3.625 VDC reading RAT+ to RAT– with open circuit. Used in return air enthalpy calculation. Substitutes for space temperature if no other space temperature input is present.
	OAT+	Outside Air Temperature sensor input from 10KΩ @ 77°F, Type III negative temperature coefficient thermistor	Input required for operation but may be a communicated value; 3.625 VDC reading OAT+ to OAT– with open circuit. Used in heat/cool cutouts, low ambient cooling determination, dry bulb free cooling changeover, outside air enthalpy calculation, economizer loading operation, heat pump demand defrost calculation.
	CC1+	#1 refrigerant circuit Condenser Coil temperature sensor input from 10KΩ @ 77°F, Type III negative temperature coefficient thermistor	Input required for heat pump units, not required for A/C units; 3.625 VDC reading CC1+ to CC1– with open circuit. Used in heat pump demand defrost calculation.
	EC1+	#1 refrigerant circuit Evaporator Coil temperature sensor input from 10KΩ @ 77°F, Type III negative temperature coefficient thermistor	Input required for operation; 3.625 VDC reading EC1+ to EC1– with open circuit. Used in suction line temperature safety.
	CC2+	#2 refrigerant circuit Condenser Coil temperature sensor input from 10KΩ @ 77°F, Type III negative temperature coefficient thermistor	Input required for 2-compressor heat pump units, not required for 2-compressor A/C units, not active for 1-compressor units; 3.625 VDC reading CC2+ to CC2– with open circuit. Used in heat pump demand defrost calculation.
	EC2+	#2 refrigerant circuit Evaporator Coil temperature sensor input from 10KΩ @ 77°F, Type III negative temperature coefficient thermistor	Input required for operation of 2-compressor units, not active for 1-compressor units; 3.625 VDC reading EC2+ to EC2– with open circuit. Used in suction line temperature safety.

Table 71: Smart Equipment UCB - pinned connections

Location	Label	Description	Function and comments
E	RAH+	Return Air Humidity input from 0-10 VDC @ 0-100% RH sensor	Input required for reheat units, optional in all other units, may be a communicated value. Used in return air enthalpy calculation, temperature/humidity setpoint reset, reheat operation.
	DCT PRS+	Supply Duct Pressure input from 0-5 VDC @ 0-5" w.c. sensor	Input required for variable air volume units. Used in VAV indoor blower operation.
	C	Common for the VFD output	Negative of the VDC circuit for the VFD output
	VFD	2-10 VDC (0-100%) output for the indoor blower Variable Frequency Drive	Output is active with indoor blower operation. For CV units: this output provides stepped IntelliSpeed control of the indoor blower VFD based on fan-only, cooling stage and heating stage outputs. For VAV units: this output provides control of the indoor blower VFD based on supply duct static pressure input and setpoint.
	VFDFLT	24 VAC hot input from the normally open VFD alarm contact	The VFD alarm contact switches from R within the unit wiring harness. 24 VAC input results in unit shutdown and a "VFD fault" alarm

Table 72: Smart Equipment UCB - USB connector

Location	Label	Description	Function and comments
F	J10	Type A female Universal Serial Bus connector	Used for backup, restoration, and copying of board parameters as well as board software updating through a flash drive
	J15	Factory wired SA Bus connector	

Table 73: Smart Equipment UCB - 24 V terminal

Location	Label	Description	Function and comments
G	24V FOR OUTPUTS	24 VAC hot for H1, H2, CN-FAN, AUX HGR, FAN C1 and C2 output relay contact switching	Output relay circuitry is isolated from other UCB components and the 24 VAC hot source may be from a second transformer in the unit

Table 74: Smart Equipment UCB - heat section connections

Location	Label	Description	Function and comments
H	H1	24 VAC hot output for heat section stage 1	Not effective for cooling-only units. Output if demand is present and permissions allow one stage or two stages of heat section operation
	H2	24 VAC hot output for heat section stage 2	Not effective for cooling-only units or units with single-stage heat sections. Output if demand is present and permissions allow two stages of heat section operation
	MV	24 VAC hot input confirming heat section operation	Sourced from gas valve in gas heat units or first stage heat contactor in electric heat units. Input within 5 minutes from initiation of H1 output initiates the "Heat On Fan Delay" timer, loss of input following the termination of H1 output initiates the "Heat On Fan Delay" timer, no input within 5 minutes from initiation of H1 output initiates an "Ignition Failure" alarm, input for longer than 5 minutes without H1 output initiates a "Gas Valve Mis-wire" alarm

Table 75: Smart Equipment UCB - pin cooling and fan output

Location	Label	Description	Function and comments
I	CN-FAN	24 VAC hot output for the condenser fan contactor coil	Output with either C1 or C2 output; interrupted during defrost cycle for heat pump units
	AUX HGR	24 VAC hot output for hot gas reheat components	Effective only for reheat units, output with reheat operation
	FAN	24 VAC hot output for indoor blower contactor coil/indoor blower VFD enable relay coil	Output with heat/cool operation, G input or schedule demand
	C1	24 VAC hot output for compressor 1	If demand is present and permissions allow compressor 1 operation; output with compressor cooling, comfort ventilation cooling, reheat or heat pump heating demands
	C2	24 VAC hot output for compressor 2	Not effective for one stage compressor UCBs. If demand is present and permissions allow compressor 2 operation; output with compressor cooling, comfort ventilation cooling or heat pump heating demands

Table 76: Smart Equipment UCB - refrigerant circuit safety switch and indoor blower overload connections

Location	Label	Description	Function and comments
J	HPS1 (right pin)	24 VAC hot out for refrigerant circuit 1 High Pressure Switch	Connects through circuit trace to the R terminal
	HPS1 (left pin)	24 VAC hot return from refrigerant circuit 1 High Pressure Switch	Input is only considered if C1 output is needed; input must be present to allow C1 output. Three HPS1 trips in a two hour period cause a “High Pressure Switch 1 Lockout” and C1 output is then prevented until alarm reset. Connects through circuit trace to the right LPS1 pin.
	LPS1 (right pin)	24 VAC hot out for refrigerant circuit 1 Low Pressure Switch	Connects through circuit trace to the left HSP1 pin
	LPS1 (left pin)	24 VAC hot return from refrigerant circuit 1 Low Pressure Switch	Input is only considered after 30 seconds of C1 output; afterwards, input must be present to allow C1 output. Three LPS1 trips in a one hour period cause a “Low Pressure Switch 1 Lockout” and C1 output is then prevented until alarm reset.
	HPS2 (right pin)	24 VAC hot out for refrigerant circuit 2 High Pressure Switch	Not effective for one stage compressor UCBs. Connects through circuit trace to the R terminal
	HPS2 (left pin)	24 VAC hot return from refrigerant circuit 2 High Pressure Switch	Not effective for one stage compressor UCBs. Input is only considered if C2 output is needed; input must be present to allow C1 output. Three HPS2 trips in a two hour period cause a “High Pressure Switch 1 Lockout” and C2 output is then prevented until alarm reset. Connects through circuit trace to the right LPS2 pin.
	LPS2 (right pin)	24 VAC hot out for refrigerant circuit 2 Low Pressure Switch	Not effective for one stage compressor UCBs. Connects through circuit trace to the left HSP2 pin
	LPS2 (left pin)	24 VAC hot return from refrigerant circuit 2 Low Pressure Switch	Not effective for one stage compressor UCBs. Input is only considered after 30 seconds of C2 output; afterwards, input must be present to allow C2 output. Three LPS2 trips in a one hour period cause a “Low Pressure Switch 2 Lockout” and C2 output is then prevented until alarm reset.
	FAN OVR (right pin)	24 VAC hot out for indoor blower FAN Overload relay contact/ motor protector switch	Connects through circuit trace to the R terminal
	FAN OVR (left pin)	24 VAC hot return from indoor blower FAN Overload relay contact/motor protector switch	Input is only considered if FAN output is needed; input must be present to allow FAN output and unit operation. One FAN OVR trip lasting longer than 5 minutes or three FAN OVR trips in a two hour period cause a “Fan Overload Lockout” and unit operation is then prevented until alarm reset.

Table 77: Smart Equipment UCB - SA BUS connections

Location	Label	Description	[1]Function and comments[1]
K	PWR	Power for SA (“Sensor-Actuator”) BUS devices	Also incorporated in the J8 6-pin phone jack connector at the left-center of the board. Positive of the 15 VDC (reading to C) circuit for powering an optional netstat and/or Multi Touch gateway
	C	Common for SA BUS power and communication circuits	Also incorporated in the J8 6-pin phone jack connector at the left-center of the board. Negative of the SA BUS circuits
	–	Communication for SA BUS devices	Also incorporated in the J8 6-pin phone jack connector at the left-center of the board. Positive of the VDC (typically, a fluctuating 1.5 to 3.5 volts reading to C; at least 0.25 volts lower than +) SA BUS communication circuit to optional economizer board, 4-stage board, fault detection and diagnostics board, netstat and/or Multi Touch gateway
	+	Communication for SA BUS devices	Also incorporated in the J8 6-pin phone jack connector at the left-center of the board. Positive of the VDC (typically, a fluctuating 1.5 to 3.5 volts reading to C; at least 0.25 volts higher than –) SA BUS communication circuit to optional economizer board, 4-stage board, fault detection and diagnostics board, netstat and/or Multi Touch gateway
L	J8	6-pin phone jack connector	Incorporates the SA BUS terminals for convenience/alternate connection of SA BUS devices, primarily used for temporary service connection of the Multi Touch gateway

1 When wiring unit and other devices using the SA Bus and FC Bus, see Table 91.

Table 78: Smart Equipment UCB - user interface

Location	Label	Description	Function and comments
M	Display	On-board, 2-line x 8-character back-lit display	On-board display, buttons and joystick allow access to UCB, economizer, 4-stage and FDD board parameters
	ENTER	Button for display menu acknowledgment and navigation	
	CANCEL	Button for display menu navigation and zeroing of active compressor ASCD timer	
	JOY	4-way Joystick for display menu navigation	

Table 79: Smart Equipment UCB - LEDs

Location	Label	Description	Function and comments
N	POWER	Green UCB power indicator	Lit indicates 24 VAC is present at C and 24V terminals
	FAULT	Red hard lockout, networking error and firmware error indicator	1/2 second on/off flashing indicates one or more alarm is currently active, 1/10th second on/off flashing indicates a networking error (polarity, addressing) or a firmware error (likely correctable with re-loading from USB flash drive)
	SA BUS	Green UCB SA bus communication transmission indicator	Lit/flickering indicates UCB SA bus communication is currently active, off indicates the UCB is awaiting SA bus communication

Table 80: Smart Equipment UCB - optional communication sub-board

Location	Label	Description	Function and comments
O Terminal FC BUS connections	FC+	FC (“Field Connected”) BUS BACnet MSTP communication	Positive of the VDC (typically, a fluctuating 1.5 to 3.5 volts reading to COM; at least 0.25 volts higher than –) FC bus BACnet MSTP communication circuit
	FC–	FC (“Field Connected”) BUS BACnet MSTP communication	Positive of the VDC (typically, a fluctuating 1.5 to 3.5 volts reading to COM; at least 0.25 volts lower than +) FC bus BACnet MSTP communication circuit
	COM	Common for the FC (“Field Connected”) BUS BACnet MSTP communication circuit	Negative of the VDC FC bus BACnet MSTP communication circuit
	SHLD	Shield for the FC (“Field Connected”) BUS BACnet MSTP communication circuit	Earth ground reference of the cable to prevent interference on the FC bus BACnet MSTP communication circuit
Q	EOL switch	End Of Line selector switch for the FC BUS BACnet MSTP communication circuit	ON selected only for the UCB that is the terminus of the FC bus BACnet MSTP communication cable to prevent signal “bounce-back”
P	EOL	Green End Of Line indicator	Lit indicates the EOL switch is selected ON
	FC BUS	Green FC bus communication transmission indicator	Lit/flickering indicates outgoing UCB FC bus communication is currently active, off indicates the UCB is awaiting incoming FC bus communication
R	ISO PWR	Green communication board Isolated Power indicator	Lit indicates the UCB is supplying power to the communication sub-board

Table 81: Smart Equipment - pinned connections

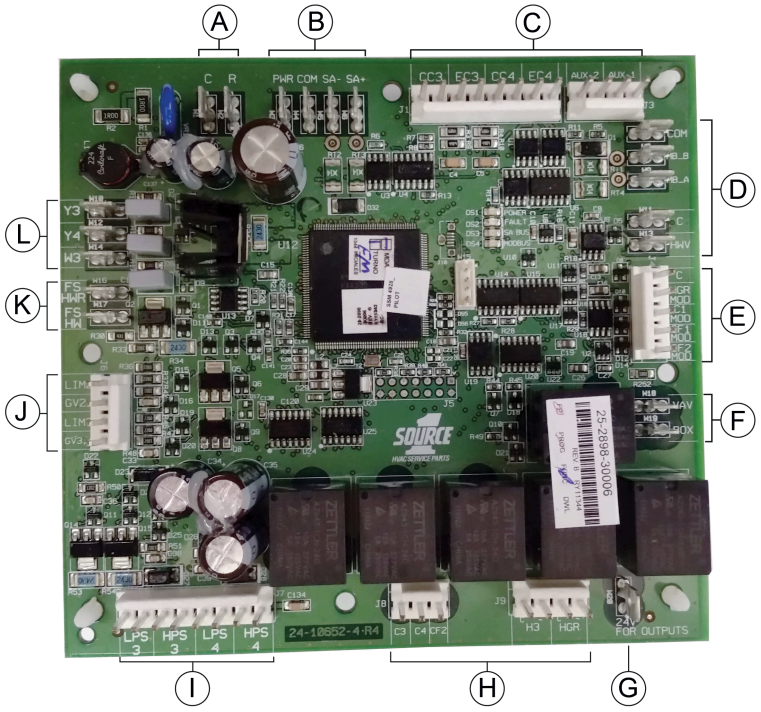
Location	Label	Description	Function and comments
S	COS	Condensate Overflow Switch	COS is 24V input that senses the switch is closed if 24V is present. Binary Input – just senses 24V on/off. If COS opens, the compressor outputs are disabled. When COS is closed, compressors run normally. COS can be enabled/disabled by a menu option on the control board.
	R	R pin is 24V supply to the switch	Connects through circuit trace to the R terminal
	RDS	Refrigerant Detection System or Switch	If the switch opens, the control shuts off all outputs, except the indoor blower. Energizes the indoor blower, if it was off at the time. If the switch recloses, there will be a five minute delay, then return to normal operation. For products without an RDS, these pins must be jumpered. There are no menu options to turn this function off.
	R	R pin is 24V supply to the Sensor	Connects through circuit trace to the R terminal

Table 81: Smart Equipment - pinned connections

Location	Label	Description	Function and comments
T	DFS (upper pin)	24 VAC hot return from Dirty Filter Switch	Optional input; switch closure for greater than 15 seconds during indoor blower operation initiates a notification alarm
	DFS (lower pin)	24 VAC hot out for Dirty Filter Switch	Connects through circuit trace to the R terminal
	APS (upper pin)	24 VAC hot return from Air Proving Switch	When this optional input is enabled: the air proving switch must close within 30 seconds of initiation of indoor blower operation and not open for greater than 10 seconds during indoor blower operation to allow heat/cool operation and prevent an “APS open” alarm; the air proving switch must open within 30 seconds of termination of indoor blower operation to prevent an “APS stuck closed” notification alarm
	APS (lower pin)	24 VAC hot out for Air Proving Switch	Connects through circuit trace to the R terminal
U	AI1 +	Not used	Not used
	AI1 -	Not used	Not used
V	BO1	Not used	Not used
	BO2	Not used	Not used

Four-stage board

Figure 110: Four-stage board



The following tables describe the details of the four-stage board, see the previous figure for the connection locations.

Table 82: Four-stage board - power and communication terminals

Location	Label	Description	Function and comments
A	C	24VAC common for 4-stage board power	
	R	24VAC hot for 4-stage board power	
B	PWR	Sensor Actuator (SA) Bus Power for SA bus devices	Not used on 4-stage board
	COM	Common for SA BUS power and communication circuits	Negative of the SA BUS circuits
	SA-	Communication for SA BUS devices	Negative of the VDC (typically, a fluctuating 1.5 to 3.5 volts reading to C; at least 0.25 volts lower than +) SA BUS communication circuit to optional economizer board, 4-stage board, fault detection and diagnostics board, netstat and/or MAP Gateway
	SA+	Communication for SA BUS devices	Positive of the VDC (typically, a fluctuating 1.5 to 3.5 volts reading to C; at least 0.25 volts higher than –) SA BUS communication circuit to optional economizer board, 4-stage board, fault detection and diagnostics board, netstat and/or MAP Gateway

Table 83: Four-stage board - temperature sensor connections

Location	Label	Description	Function and comments
C	CC3+	#3 refrigerant circuit Condenser Coil temperature sensor input from 10KΩ @ 77°F, Type III negative temperature coefficient thermistor	Input required for heat pump units, not required for A/C units; 3.625 VDC reading CC3+ to CC3– with open circuit. Used in heat pump demand defrost calculation.
	EC3+	#3 refrigerant circuit Evaporator Coil temperature sensor input from 10KΩ @ 77°F, Type III negative temperature coefficient thermistor	Input required for operation; 3.625 VDC reading EC3+ to EC3– with open circuit. Used in suction line temperature safety.
	CC4+	#4 refrigerant circuit Condenser Coil temperature sensor input from 10KΩ @ 77°F, Type III negative temperature coefficient thermistor	Input required for heat pump units, not required for A/C units; 3.625 VDC reading CC4+ to CC4– with open circuit. Used in heat pump demand defrost calculation.
C	EC4+	#4 refrigerant circuit Evaporator Coil temperature sensor input from 10KΩ @ 77°F, Type III negative temperature coefficient thermistor	Input required for operation; 3.625 VDC reading EC4+ to EC4– with open circuit. Used in suction line temperature safety.
	AUX-2+	Not used	Not used
	AUX-1+	Not used	Not used

Table 84: Four-stage board - quick connect

Location	Label	Description	Function and comments
D	COM	Common for Modbus connection to staged heat board	Future
	MB_B	Terminal B for Modbus connection to staged heat board	Future
	MB_A	Terminal A for Modbus connection to staged heat board	Future
	C	Common for HW Valve connection	0-10VDC
	HWV	Analog out for HW Valve	0-10VDC
F	VAV	VAV box Common relay contact	Used to interlock the VAV boxes with RTU morning warm-up
	BOX	VAV box normally open relay contact	Used to interlock the VAV boxes with RTU morning warm-up

Table 85: Four-stage board - harness connectors

Location	Label	Description	Function and comments
E	C	Common for analog outputs	Common for analog outputs
	HGR MOD	0-10VDC analog output for hot gas reheat	Modulating HGR Valve Output
	C1 MOD	0-10VDC analog output for C1 modulation	Future
	CF1 MOD	0-10VDC analog output for Condenser Fan 1 modulation	Future
	CF2 MOD	0-10VDC analog output for Condenser Fan 2 modulation	Future

Table 86: Four-stage board - outputs and cool and heat section connections

Location	Label	Description	Function and comments
G	24V FOR OUTPUTS	24 VAC hot for C3, C4, CF2, H3, and HGR	Output relay circuitry is isolated from other 4-stage components and the 24 VAC hot source may be from a second transformer in the unit
H	C3	24 VAC hot output for compressor 3	If demand is present and permissions allow compressor 3 operation
	C4	24 VAC hot output for compressor 4	If demand is present and permissions allow compressor 4 operation
	CF2	24 VAC hot output for the condenser fan contactor coil	Output with either C3 or C4 output.
	H3	24 VAC hot output for heat section stage 3	Not effective for cooling-only units. Output if demand is present and permissions allow heat section operation
	HGR	24 VAC hot output for hot gas reheat	Future

Table 87: Four-stage board - refrigerant circuit safety switches

Location	Label	Description	Function and comments
I	LPS3 (right pin)	24 VAC hot out for refrigerant circuit 3 Low Pressure Switch	Connects through circuit trace to the left HSP3 pin
	LPS3 (left pin)	24 VAC hot return from refrigerant circuit 3 Low Pressure Switch	Input is only considered after 30 seconds of C3 output; afterwards, input must be present to allow C3 output. Three LPS3 trips in a one hour period cause a “Low Pressure Switch 3 Lockout” and C3 output is then prevented until alarm reset.
	HPS3 (right pin)	24 VAC hot out for refrigerant circuit 3 High Pressure Switch	Connects through circuit trace to the R terminal
	HPS3 (left pin)	24 VAC hot return from refrigerant circuit 3 High Pressure Switch	Input is only considered if C3 output is needed; input must be present to allow C3 output. Three HPS3 trips in a two hour period cause a “High Pressure Switch 3 Lockout” and C3 output is then prevented until alarm reset. Connects through circuit trace to the right LPS3 pin.
	LPS4 (right pin)	24 VAC hot out for refrigerant circuit 4 Low Pressure Switch	Connects through circuit trace to the left HSP4 pin
	LPS4 (left pin)	24 VAC hot return from refrigerant circuit 4 Low Pressure Switch	Input is only considered after 30 seconds of C4 output; afterwards, input must be present to allow C4 output. Three LPS4 trips in a one hour period cause a “Low Pressure Switch 4 Lockout” and C4 output is then prevented until alarm reset.
	HPS4 (right pin)	24 VAC hot out for refrigerant circuit 4 High Pressure Switch	Connects through circuit trace to the R terminal
	HPS4 (left pin)	24 VAC hot return from refrigerant circuit 4 High Pressure Switch	Input is only considered if C4 output is needed; input must be present to allow C4 output. Three HPS4 trips in a two hour period cause a “High Pressure Switch 4 Lockout” and C4 output is then prevented until alarm reset. Connects through circuit trace to the right LPS4 pin.

Table 88: Four-stage board - heat safety circuit

Location	Label	Description	Function and comments
J	LIM2	Monitored 24 VAC input through heat section limit switches	If voltage is absent, indicating the heat section is over temperature, the UCB turns on the indoor blower
	GV2	24 VAC hot input confirming heat section operation	Sourced from gas valve 2 in gas heat units or second stage heat contactor in electric heat units. Input within 5 minutes from initiation of H2 output initiates the Heat On Fan Delay timer, loss of input following the termination of H2 output initiates the Heat On Fan Delay timer, no input within 5 minutes from initiation of H2 output initiates an Ignition Failure alarm, input for longer than 5 minutes without H2 output initiates a Gas Valve Mis-wire alarm
	LIM3	Monitored 24 VAC input through heat section limit switches	If voltage is absent, indicating the heat section is over temperature, the UCB turns on the indoor blower
	GV3,4	24 VAC hot input confirming heat section operation	

Table 89: Four-stage board - hot water safety quick connects and thermostat inputs

Location	Label	Description	Function and comments
K	FS HWR	Flow switch for Hydronic heat – 24VAC hot output	Flow switch interlock for hot water coil
	FS HW	Flow switch for Hydronic heat – 24VAC hot return	Flow switch interlock for hot water coil
L	Y3	3rd stage cooling request, 24 VAC input switched from R	Visible in the display menu when the #ClgStgs parameter is set to 4, also effective for economizer free cooling supply air temperature reset when the #ClgStgs parameter is set to 4
	Y4	4th stage cooling request, 24 VAC input switched from R	Visible in the display menu when the #ClgStgs parameter is set to 4, also effective for economizer free cooling supply air temperature reset when the #ClgStgs parameter is set to 4
	W3	3rd stage heating request, 24 VAC input switched from R	Not effective for cooling-only units

Modulating furnace control

Figure 111: Modulating furnace control board

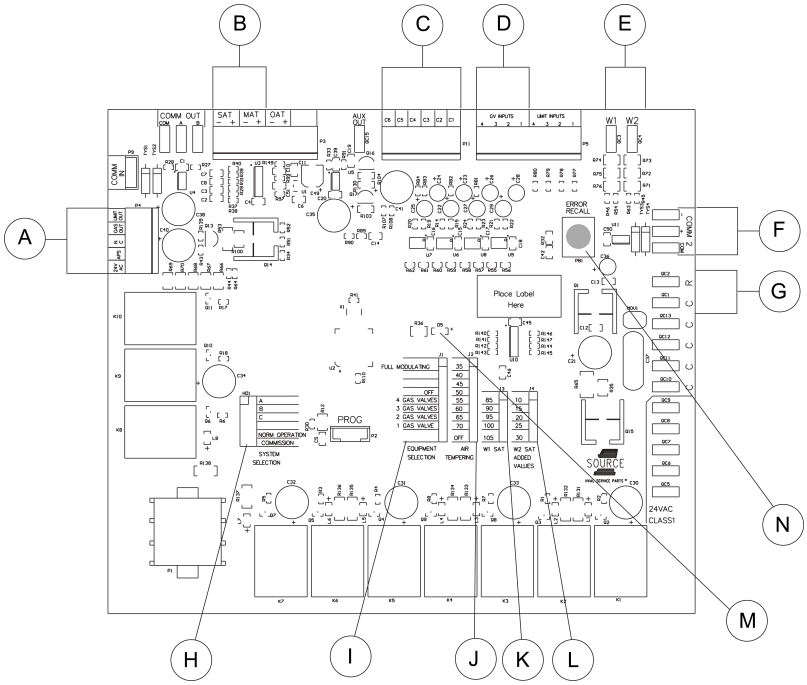


Table 90: Modulating furnace control board details

	Description		Function and comments
A	APS	24 VAC hot return from Air Proving Switch	Air Proving Switch input verifies indoor airflow operation. During Normal Heating, if APS input (closed switch) is not received within 2 min of heat call, LED alarm flashes **5** but does not interrupt heat demand output. APS input is required to operate Air Tempering.
	NC	Not used	Not used
	GAS OUT	24 VAC output confirming heat section operation	Sends gas valve operation signal to UCB. During Normal Heating, when GV INPUT is received the MFC immediately outputs gas signal to UCB. In Air Tempering, the MFC does not output gas signal to the UCB; this is to avoid UCB alarm (Air Tempering operates without thermostat heating call from UCB).
B	SAT+	Supply Air Temperature sensor input from 10KΩ @ 77°F, Type III negative temperature coefficient thermistor	Senses temperature of air leaving heat section. Input required for normal operation; 5.0 VDC reading SAT+ to SAT– with open circuit. Used in Normal Heating and Air Tempering to adjust heat demand output to maintain target supply air temperature. If MFC receives invalid SAT input (indicating bad thermistor) during Normal Heating, heat demand defaults to 35% heat output (lowest level). MFC will not operate Air Tempering with invalid SAT input. LED alarm flashes **3** with invalid SAT.
	MAT+	Mixed Air Temperature sensor input from 10KΩ @ 77°F, Type III negative temperature coefficient thermistor	Senses temperature of air entering heat section. 5.0 VDC reading SAT+ to SAT– with open circuit. Used in Normal Heating to limit air temperature rise (SAT minus MAT) to a maximum of 65°F. Used in Air Tempering to determine if MAT is below value on **AIR TEMPERING** pin selection. The MFC does not operate Air Tempering with invalid MAT input. LED alarm flashes **4** with invalid MAT.
C	C1 through C6	Compressor signals, 24 VAC inputs (not all used)	Sourced from compressor control voltage signals. Monitors all compressors in the unit. If any compressors are on, the LED flashes 6 (non-fault condition) and the MFC does not operate Air Tempering.
D	GV INPUTS, 1	24 VAC input confirming heat section operation	Sourced from main gas valve ON signal. Used in MFC logic for **GAS OUT** output. If GV INPUT is not received within 5 min of heat demand output, LED alarm flashes **2** but does not interrupt heat demand output.

Table 90: Modulating furnace control board details

	Description		Function and comments
E	W1	1st stage heating request, 24 VAC input from H1 on UCB	With W1 input only from the UCB, the MFC adjusts heat demand level to maintain supply air temperature value on **W1 SAT** pin selection.
	W2	2nd stage heating request, 24 VAC input from H2 on UCB	With W2 input (plus W1) from the UCB, the MFC adjusts heat demand level to maintain supply air temperature of the added value of **W1 SAT** plus **W2 SAT ADDED VALUE** pin selections.
F	COMM 2, -	Communication for ignition control	Heat call and demand level to ignition control. Negative of the VDC (typically, a fluctuating 1.5 V to 3.5 V reading to C; at least 0.25 V lower than +).
	COMM 2, +	Communication for ignition control	Heat call and demand level to ignition control. Positive of the VDC (typically, a fluctuating 1.5 V to 3.5 V reading to C; at least 0.25 V lower than -).
	COMM, COM	Common for ignition control communication circuit	
G	R	24 VAC hot for MFC board power	
	C	24 VAC common for MFC board power	
H	SYSTEM SELECTION (2 jumper pins)	System and operating mode pin selections	There are 2 jumpers for this pin bank. **A** and **NORM OPERATION** yields normal operation. **A** and **COMMISSION** is for rating the furnace and adjusting manifold pressure; automated modulation is bypassed, W1 input outputs a steady 35% (lowest) heat demand, W1 and W2 input outputs a steady 100% (highest) heat demand. **(BLANK)** and **COMMISSION** step through an auto-sequence routine with a W1 or W1 and W2 input.
I	EQUIPMENT SELECTION (2 jumper pins)	Equipment type pin selections	There are 2 jumpers for this pin bank. **FULL MODULATING** and **1 GAS VALVE** should always be selected for this system.
J	AIR TEMPERING (1 jumper pin)	Air Tempering pin selection.	Used to select whether the Air Tempering function is allowed to operate. If jumper is set to any value other than **OFF**, the MFC initiates furnace operation if the MAT sensor input reading is 3°F below the selected value. To operate Air Tempering, APS input must be on, W1/W2 heat call from UCB must be off, and all compressor inputs must have been off for 10 min. If MFC has been in tempering mode (heating) for 10 min and SAT reading is 5°F or more above the Air Tempering selected value, heating is ended. If all conditions for Air Tempering are still met, it is re-initiated after a 10 min minimum off delay.
K	W1 SAT (1 jumper pin)	W1 SAT setpoint pin selection.	With W1 input only from the UCB, the MFC adjusts heat demand level to maintain supply air temperature value on **W1 SAT** pin selection.
L	W2 SAT ADDED VALUE (1 jumper pin)	W2 SAT Added Value setpoint pin selection.	With W2 input (plus W1) from the UCB, the MFC adjusts heat demand level to maintain supply air temperature of the added value of **W1 SAT** plus **W2 SAT ADDED VALUE** pin selections.
M	LED Light	LED status or alarm code	Flash count corresponds to status or fault condition.
N	ERROR RECALL (Button)	Error recall button	When pushed, the last 5 alarms are flashed by the LED. The most recent is flashed first, followed by the next most recent, and continuing until all the alarms stored (5 maximum) are flashed.

Cable specifications

Table 91: Cable type for FC buses and SA buses in order of preference

Bus and cable type	Non-plenum applications		Plenum applications	
	Part number	O.D.	Part number	O.D.
[1]FC Bus: 22 AWG stranded, 3-wire twisted shielded cable[1]	Anixter: CBL-22/3-FC-PVC Belden®: B5501FE	0.138 in.	Anixter: CBL-22/3-FC-PLN Belden: B6501FE	0.140 in.
SA Bus (Terminal Block): 22 AWG stranded, 4-wire, 2 twisted-pair shielded cable	Anixter: CBL-22/2P-SA-PVC Belden: B5541FE	0.209 in.	Anixter: CBL-22/2P-SA-PLN Belden: B6541FE	0.206 in.
SA Bus (Modular Jack): [2]26 AWG solid 6-wire, 3 twisted-pair cable[2]	—	—	Anixter preassembled: CBL-NETWORK25 CBL-NETWORK50 CBL-NETWORK75 CBL-NETWORK100	0.15 in.
FC Bus: 22 AWG stranded, 3-wire twisted non-shielded cable	Belden: B5501UE	0.135 in.	Belden: B6501UE	0.131 in.
SA Bus (Terminal Block): 22 AWG stranded, 4-wire, 2 twisted-pair non-shielded cable	Belden: B5541UE	0.206 in.	Belden: B6541UE	0.199 in.

1 Use 3-wire for FC bus and 4-wire, 2 twisted-pair for SA bus, 22 AWG stranded, shielded cable. A 22 gauge cable offers the best performance for various baud rates, cable distances, and number of trunk devices primarily due to lower conductor-to-conductor capacitance. Shielded cable offers better overall electrical noise immunity than non-shielded cable. Observe the shield grounding requirements.

2 Use 26 AWG solid, 6-wire (3 twisted pairs) cable as the best fit for fabricating modular cables with the modular jack housing assembly. Be sure the cable you use fits the modular jack housing. The preassembled cables that are available from Anixter (Part No. CBL-NETWORKxxx) use 24 gauge wire.

General maintenance

In order to ensure long and trouble free service from your system, we recommend periodic inspection, cleaning, lubrication, and adjustment by your installing dealer or contractor. Be sure to ask about this service. For those who prefer to do-it-yourself, follow the instructions listed below to care for your system.

Make sure that snow or debris does not accumulate in or around the unit. Make sure that overhanging structures or shrubs do not obstruct the outdoor air discharge, combustion air inlets, or vent outlets on your unit. These provide air for combustion and ventilation. Adequate air is important to the safe and correct operation of the unit.

Heating system inspection

It is the owner's responsibility to ensure that an annual inspection of the entire heating portion of the unit is made by a qualified service technician. This must include inspection of the burner, heating element, and flue for any corrosion or soot accumulation that may require cleaning. The burner and controls are also checked for proper operation.

In addition, at least once during the heating season, the owner must make a visual inspection of the flue outlet for evidence of black soot or blockage of flue outlet by leaves or other debris. If you find any soot, contact a qualified service technician immediately. If any blockage is found, it must be cleared immediately. After removing the debris, check the manual reset rollout switch located above the burner shield and reset as needed. See Inspecting the unit.

Inspecting the unit

To inspect the unit, complete the following actions.

- Check for obvious signs of deterioration of the unit.
- Check that the return and supply ducts attached to the unit are sound and air tight.
- Check that the unit's physical support, concrete slab, or roof curb is sound and not in need of repair.
- Make sure that there are no gaps between the roof curb and the unit where rain could leak into the building.
- Start the furnace. Check that the vent motor starts, the igniter starts to spark and ignites the burner flame.

  If the main burner does not ignite, contact a qualified service technician for assistance.
- Check the appearance of the main burner flame. The flame must have a blue appearance. See Figure 112.

Example:

Figure 112: Typical flame appearance

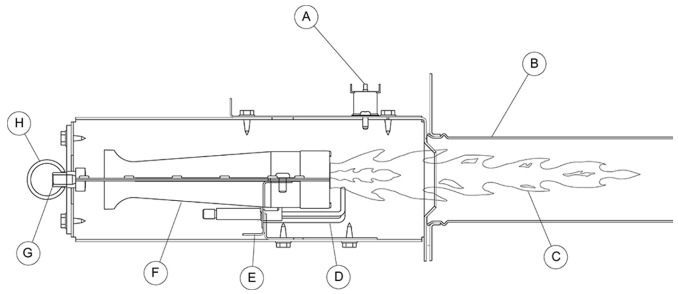


Table 92: Typical flame components

Item	Description	Item	Description
A	Roll-out switch	E	Burner bracket
B	Heat exchanger tube	F	Burner
C	Burner flame (blue only)	G	Orifice
D	Igniter	H	Manifold

Burner check

Periodically, at least annually at the beginning of each heating season, make a visual check of the main burner flame to determine if the burners need cleaning.

Cleaning the burners

Remove the burners from the furnace as explained in the burner instructions section in the unit installation manual. Clean the burners with a wire brush and vacuum as needed.

Cleaning flue passages and heating elements

With proper combustion adjustment, the heat exchanger tubes of a gas-fired furnace seldom needs cleaning. If the tubes become sooted, clean them as follows:

1. Remove the burner assembly as explained in the Burner/ Orifices Instructions section in the Unit Installation Instructions.
2. Remove the screws that hold the draft assembly and flue exhaust. Carefully remove the draft inducer assembly and flue exhaust..
3. Remove the screws on the perimeter border of the flue collector box cover plate. Carefully remove the flue collector box cover plate and the insulation.
4. Using a wire brush on a flexible wand, brush out the inside of each heat exchanger from the burner inlet and flue outlet ends.
5. Brush out the inside of the flue collector box.
6. Run the wire brush into the flue exhaust tube from the flue collector box end.
7. If soot build-up is particularly bad, remove the draft motor and clean the wheel and housing.
8. After brushing is complete, blow away all the brushed areas with air or nitrogen. Vacuum as needed.
9. Replace the parts in the reverse order that they were removed in Steps 1 through 3.
10. Make sure that all the seams behind the draft assembly and on the exhaust vent side of the combustion system are airtight. Apply a high temperature (500°F+) sealing compound where needed.

Air filters

Refer to the technical guide or installation manual for the number and sizes of filters required for each unit. Filters can be installed in the building at a suitable return air location if an economizer or outside air accessory is not used.

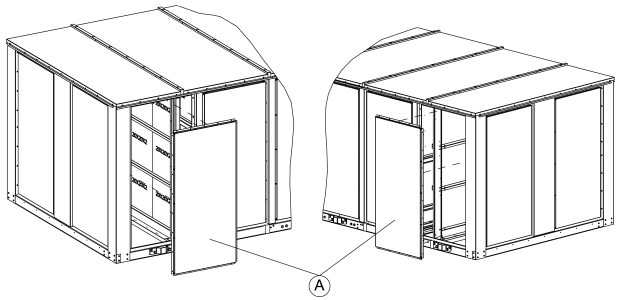
Note: Do not operate the unit without a filter.

Inspect filters once a month. Thoroughly clean the filters or replace them if it appears that they are beginning to accumulate excessive dirt.

Installing the air filters

1. Remove the return air access panels from both sides of the unit.

Figure 113: Return air access panel locations

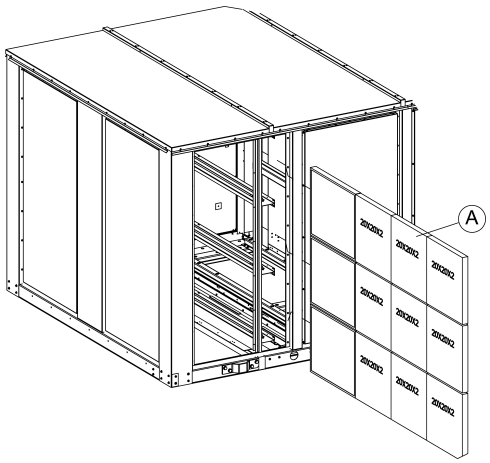


Item	Description
A	Return air access panels

Note: Install the filters with the air flow arrows pointing inward towards the indoor coil. In the event the spacers in the filter section are removed, they must be reinstalled in their original position.

2. Slide the filters all the way into the filter racks provided. When more than one filter in a filter rack is required, they must butt each other when you slide them into position.

Figure 114: Filter installation



Item	Description
A	Filters

3. Replace the return air access panel.

Economizer

Even with clean filters correctly in place, the economizer assembly can become dust laden after many months of use. Inspect the entire assembly annually. If the assembly is heavily coated with dust, you can brush and clean it with a vacuum cleaner. A common aerosol contact cleaner can help remove excess accumulation. After the dust and debris is removed, apply a silicon-based spray lubricant to each of

the gears used to connect and ensure correct alignment of the damper blades.

WARNING

Perform all maintenance operations on the damper assembly with power disconnected. Do not clean or lubricate with the unit in operation.

CAUTION

Excessive lubrication may accelerate the accumulation of dust.

Blower assembly

Even with clean filters correctly in place, blower wheels and motors can become dust laden after many months of operation. Inspect the entire blower assembly annually. If the motor and wheels are heavily coated with dust, brush and clean them with a vacuum cleaner.

Blower shaft bearing

Inspect blower shaft bearings on a monthly basis. At a minimum, re-lubricate the bearings every 6 months using a lithium-based grease (NLGI grade 2) recommended for ball bearing service.

WARNING

Perform all maintenance operations on the blower motor with electric power disconnected. Do not attempt to lubricate bearings with the unit in operation.

CAUTION

Damage can occur if the bearings are overlubricated. Use grease sparingly.

Motors

Outdoor fan motors are permanently lubricated and require no maintenance. The ventor motor is factory lubricated for an estimated 10-year life.

Indoor blower motor and drive

The indoor blower motor features ball bearings that do not require periodic lubrication. Periodic lubrication of the motor and bearings can extend the life of components but is optional. Every three years, use a low pressure grease gun to pump grease into the bearing grease fitting until grease just begins to show at the seals. Do not over lubricate. Use any lithium base grease recommended for ball bearing service.

Condenser coil

Check the outdoor coil monthly. Clean the coil as often as necessary to keep it clean. Clean any debris and dirt from the outside coil face with a brush. Be careful not to damage the fins. If the coil is extremely dirty, you can use a hose to wash the coil from the inside out. You can brush a soapy solution on the outside.

WARNING

Do not stand on any sheet metal base. A structural failure of the base could cause a fall resulting in serious injury or death.

Registers

Supply and return air registers must be open when the unit is in operation. Make sure that obstructions do not block the airflow in or out of the registers.

Start-up & Service Data Instruction

Commercial Package Units

3.0 To 50.0 tons

Start-up Checklist

Date: _____

Job Name: _____

Customer Name: _____

Address: _____

City: _____ State: _____ Zip: _____

Model Number: _____ Serial Number: _____

Qualified Start-up Technician: _____ Signature: _____

HVAC Contractor: _____ Phone: _____

Address: _____

Contractor's E-mail Address: _____

Electrical Contractor: _____ Phone: _____

Distributor Name: _____ Phone: _____

Warranty Statement

BHC Residential & Light Commercial LLC is confident that this equipment will operate to the owner's satisfaction if the proper procedures are followed and checks are made at initial start-up. This confidence is supported by the 30 day dealer protection coverage portion of our standard warranty policy which states that BHC Residential & Light Commercial LLC will cover parts and labor on new equipment start-up failures that are caused by a defect in factory workmanship or material, for a period of 30 days from installation. Refer to the current standard warranty policy and warranty manual for details.

In the event that communication with BHC Residential & Light Commercial LLC is required regarding technical and/or warranty concerns, all parties to the discussion should have a copy of the equipment start-up sheet for reference. A copy of the original start-up sheet should be filed with the Technical Services Department.

The packaged unit is available in constant or variable air volume versions with a large variety of custom options and accessories available. Therefore, some variation in the startup procedure will exist depending upon the products capacity, control system, options and accessories installed.

This start-up sheet covers all startup check points common to all package equipment. In addition it covers essential startup check points for a number of common installation options. Depending upon the particular unit being started not all sections of this startup sheet will apply. Complete those sections applicable and use the notes section to record any additional information pertinent to your particular installation.

Warranty claims are to be made through the distributor from whom the equipment was purchased.

Equipment Startup

Use the local LCD or GoTemp Pro mobile application to complete the start-up.

A copy of the completed start-up sheet should be kept on file by the distributor providing the equipment and a copy sent to:

BHC Residential & Light Commercial LLC
Technical Services Department
5005 York Drive
Norman, OK 73069

1034349-UCL-L-0426

Safety Warnings

The inspections and recording of data outlined in this procedure are required for start-up of BHC Residential & Light Commercial LLC' packaged products. Industry recognized safety standards and practices must be observed at all times. General industry knowledge and experience are required to assure technician safety. It is the responsibility of the technician to assess all potential dangers and take all steps warranted to perform the work in a safe manner. By addressing those potential dangers, prior to beginning any work, the technician can perform the work in a safe manner with minimal risk of injury.

⚠WARNING

Lethal voltages are present during some start-up checks. Extreme caution must be used at all times.

⚠WARNING

Moving parts may be exposed during some startup checks. Extreme caution must be used at all times.

NOTE: Read and review this entire document before beginning any of the startup procedures.

Design Application Information

This information will be available from the specifying engineer who selected the equipment. If the system is a VAV system the CFM will be the airflow when the remote VAV boxes are in the full open position and the frequency drive is operating at 60 HZ. **Do not proceed with the equipment start-up without the design CFM information.**

Design Supply Air CFM: _____ Design Return Air CFM:_____

Design Outdoor Air CFM At Minimum Position: _____

Total External Static Pressure: _____

Supply Static Pressure: _____

Return Static Pressure: _____

Design Building Static Pressure: _____

Outside Air Dilution: Economizer Position Percentage: _____ CFM: _____

Supply Gas Pressure After Regulator W/o Heat Active _____ Inches_____

ADDITIONAL APPLICATION NOTES FROM SPECIFYING ENGINEER:

Reference

General Inspection	Completed	See Notes
Unit inspected for shipping, storage, or rigging damage	☐	☐
Unit installed with proper clearances	☐	☐
Unit installed within slope limitations	☐	☐
Refrigeration system checked for gross leaks (presence of oil)	☐	☐
Terminal screws and wiring connections checked for tightness	☐	☐
Filters installed correctly and clean	☐	☐
Economizer hoods installed in operating position	☐	☐
Condensate drain trapped properly, refer to Installation Manual	☐	☐
Economizer damper linkage tight	☐	☐
Gas Heat vent hood installed	☐	☐
All field wiring (power and control) complete	☐	☐

Air Moving Inspection	Completed	See Notes
Alignment of drive components	☐	☐
Belt tension adjusted properly	☐	☐
Blower pulleys tight on shaft, bearing set screws tight, wheel tight to shaft	☐	☐
Pressure switch or transducer tubing installed properly	☐	☐

Exhaust Inspection Powered ☐ Barometric Relief ☐	Completed	See Notes
Check hub for tightness	☐	☐
Check fan blade for clearance	☐	☐
Check for proper rotation	☐	☐
Check for proper mounting (screen faces towards unit)	☐	☐
Prove operation by increasing minimum setting on economizer	☐	☐

Economizer Inspection Standard ☐ BAS ☐	Completed	See Notes
CO_2 sensor installed Yes ☐ No ☐	☐	☐
Check economizer setting (Reference Smart Equipment Control Board LCD menu location)	☐	☐
Prove economizer open/close through Smart Equipment Board Setting	☐	☐

Reheat Mode Normal ☐ or Alternate ☐ Not Applicable ☐
Humidity Sensor (2SH0401) _____

Operating Measurements - Air Flow

Fan operates with proper rotation (All VFD equipped units with the optional Manual Bypass must be phased for correct blower rotation with the Bypass switch set in the LINE position) ID Fans ☐ Exh. Fans ☐ Cond. Fans ☐	
Pressure drop across dry evaporator coil (At maximum design CFM) [1]	IWC
External Static Pressure	IWC
Return Static Pressure	IWC
Supply Static Pressure	IWC
Supply Air CFM Using Dry Coil Chart	CFM
Final Adjusted Supply Air CFM[2]	CFM

1. Consult the proper airflow to pressure drop table to obtain the actual airflow at the measured pressure differential.
2. Was a motor pulley adjustment or change required to obtain the correct airflow?
   Was it necessary to increase of decrease the airflow to meet the design conditions?
   If the motor pulley size was changed, measure the outside diameters of the motor and blower pulleys and record those diameters here;

Blower Motor HP _____ FLA_____ RPM_____

Pulley Pitch Diameter _____Turns Out_____ Final Turns Out_____

Blower Pulley Pitch Diameter _____ Fixed Sheave_____

Electrical Data

T1 - T2 _____ Volts T2 - T3 _____ Volts

Control Voltage _____ Volts T1 - T3 _____ Volts

Device	Nameplate	Measured List All Three Amperages
Supply Fan Motor[1, 2]	AMPS	AMPS
Exhaust Motor (Dampers 100%)	AMPS	AMPS
Condenser Fan #1	AMPS	AMPS
Condenser Fan #2 (if equipped)	AMPS	AMPS
Condenser Fan #3 (if equipped)	AMPS	AMPS
Condenser Fan #4 (if equipped)	AMPS	AMPS
Compressor #1	AMPS	AMPS
Compressor #2 (if equipped)	AMPS	AMPS
Compressor #3 (if equipped)	AMPS	AMPS
Compressor #4 (if equipped)	AMPS	AMPS

1. VAV units with heat section - simulate heat call to drive VAV boxes and VFD/IGV to maximum design airflow position.
2. VAV units without heat section - VAV boxes must be set to maximum design airflow position.

Refrigerant Safeties

Action	Completed	See Notes
Prove Compressor Rotation (3 phase only) by gauge pressure	☐	☐
Prove High Pressure Safety, All Systems	☐	☐
Prove Low Pressure Safety, All Systems	☐	☐

Refrigerant Detection System (RDS) Safety Test

Action	Completed	See Notes
Does the System have a Refrigerant Detection System (RDS) installed for R-454B?	☐	☐
Does Control Board Show any RDS alarms?	☐	☐
Are all available RDS Sensors pulsing with a green light?	☐	☐
Caution do not continue until any RDS alarms are resolved		
Prove Refrigerant Detection System Alarm Mitigation (Heating Units) – Shuts Down Active Heat Call[1]	☐	☐
Prove Refrigerant Detection System Alarm Mitigation (Cooling Mode) – Shuts Down Active Cooling Call[1]	☐	☐

1. Complete the above steps by pulling the J1 harness off the UCB during an active call for heat/cooling

Operating Measurements - Cooling

Stage	Discharge Pressure	Discharge Temp.	Liquid Line Temp.[1]	Subcooling[2]	Suction Pressure	Suction Temp.	Superheat
First	#	°	°	°	#	°	°
Second (if equipped)	#	°	°	°	#	°	°
Third (if equipped)	#	°	°	°	#	°	°
Fourth (if equipped)	#	°	°	°	#	°	°
Reheat 1st Stage	#	°	°	°	#	°	°

1. Liquid temperature should be taken before filter/drier.
2. Subtract 10 psi from discharge pressure for estimated liquid line pressure

Outside air temperature	_____	°F db	_____	°F wb	_____ %RH
Return Air Temperature	_____	°F db	_____	°F wb	_____ %RH
Mixed Air Temperature	_____	°F db	_____	°F wb	_____ %RH
Supply Air Temperature	_____	°F db	_____	°F wb	_____ %RH

Operating Measurements - Gas Heating

Fuel Type: ☐ Natural Gas ☐ LP Gas

Action		Completed	See Notes
Check for gas leaks		☐	☐
Prove Ventor Motor Operation		☐	☐
Prove Primary Safety Operation		☐	☐
Prove Auxiliary Safety Operation		☐	☐
Prove Rollout Switch Operation		☐	☐
Prove Smoke Detector Operation		☐	☐
Manifold Pressure	Stage 1	IWC	☐
	Stage 2 (If Equipped)	IWC	☐
	Stage 3 (If Equipped)	IWC	☐
Supply gas pressure at full fire		IWC	☐
Check temperature rise[1]	☐ measured at full fire	°F	☐

1. Input X Eff. (BTU output)
   1.08 X Temp. Rise

Operating Measurements Electric Heating

Heater kW _____kW Heater Voltage, Nameplate _____ Volts

Heater Model Number: _____

Serial Number: _____

Heater	Nameplate	Measured List All Three Amperages		
Stage 1	_____AMPS	_____AMPS	_____AMPS	_____AMPS
Stage 2	_____AMPS	_____AMPS	_____AMPS	_____AMPS
Stage 3	_____AMPS	_____AMPS	_____AMPS	_____AMPS
Stage 4	_____AMPS	_____AMPS	_____AMPS	_____AMPS
Checked Heater Limit		Yes ☐	No ☐	
Air Moving Switch Installed?		Yes ☐	No ☐	

Operating Measurements - Staging Controls

Verify Proper Operation of Heating/Cooling Staging Controls	
Create a cooling demand at the Thermostat, BAS System or Smart Equipment Verify that cooling/economizer stages are energized.	☐
Create a heating demand at the Thermostat, BAS System or Smart Equipment Verify that heating stages are energized.	☐
Verify Proper Operation of the Variable Frequency Drive (If Required)	
Verify that motor speed modulates with duct pressure change.	☐

Final - Inspection

Verify that all operational control set points have been set to desired value Scroll through all setpoints and change as may be necessary to suit the occupant requirements.	☐
Verify that all option parameters are correct Scroll through all option parameters and ensure that all installed options are enabled in the software and all others are disabled in the software. (Factory software settings should match the installed options)	☐
Verify that all access panels have been closed and secured	☐
Save a backup file from the unit control board onto a USB flash drive.	☐

Observed Product Deficiencies & Concerns:

1034349-UCL-L-0426
Supersedes: 1034349-UCL-K-0126

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