

INSTALLATION MANUAL

R-410A XP SERIES W/SMART EQUIPMENT™

6-1/2 - 12-1/2 Ton

60 Hertz



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General

York® XP078-150 heat pumps are single package, reverse cycle air conditioners designed for outdoor installation on a rooftop or slab and for non-residential use. The units can be equipped with factory or field-installed electric heaters for heating applications.

The units are completely assembled on rigid, permanently attached base rails. All piping, refrigerant charge, and electrical wiring is factory installed and tested. The units require electric power and duct connections. The electric heaters have nickel-chrome elements and use single-point power connection.

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.

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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

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.

CAUTION

This system uses R-410A Refrigerant which operates at higher pressures than R-22. No other refrigerant may be used in this system. Gage sets, hoses, refrigerant containers and recovery systems must be designed to handle R-410A. If you are unsure, consult the equipment manufacturer. Failure to use R-410A compatible servicing equipment may result in property damage or injury.

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 precautions in the literature, labels, and tags accompanying the equipment whenever working on air conditioning equipment. Be sure to follow all other applicable safety precautions and codes including National Electric Code, ANSI/NFPA No. 70 - latest edition U.S. A. and Canadian Electric Code, CSA C22.1 in Canada.

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

Inspection

As soon as you receive a unit, you must inspect it for possible damage during transit. If damage is evident, note the extent of the damage on the carrier's freight bill. You must make a separate request for inspection by the carrier's agent in writing.

Reference

Additional information is available in the following reference forms:

- Technical Guide - XP078-150, 5167824
- General Installation - XP078-150, 5167546
- Smart Equipment™ Control Quick Start Guide 1136326
- Economizer Accessory -
Downflow Factory Installed
Downflow Field Installed
Horizontal Field Installed
- Motorized Outdoor Air Damper
- Manual Outdoor Air Damper (0-100%)
- Manual Outdoor Air Damper (0-35%)
- Electric Heater Accessory 50 in. cabinet

Renewal parts

Contact your local York® 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.

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

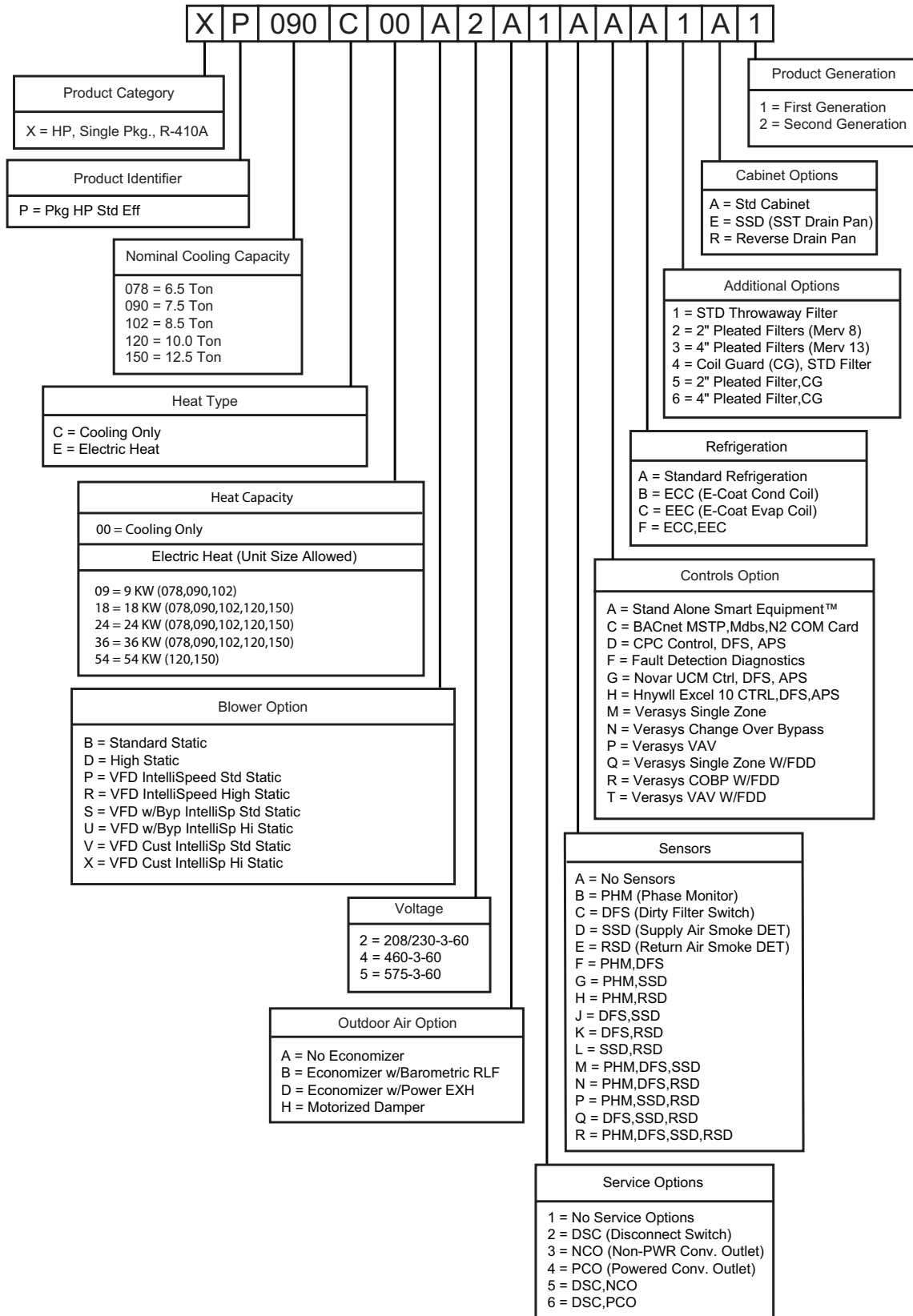
Improper installation may create a condition where the operation of the product could cause personal injury or property damage.

CAUTION

This system uses R-410A Refrigerant which operates at higher pressures than R-22. No other refrigerant may be used in this system.

Nomenclature

6.5-12.5 Ton York® Model Number 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 assure that these instructions are made available to the consumer. The installer must instruct the consumer to retain the instructions for future reference.

This equipment is not to be used for temporary heating of buildings or structures under construction.

Preceding installation

1. Remove the two screws that hold the brackets in the front, rear, and compressor side fork-lift slots. See Figure 1

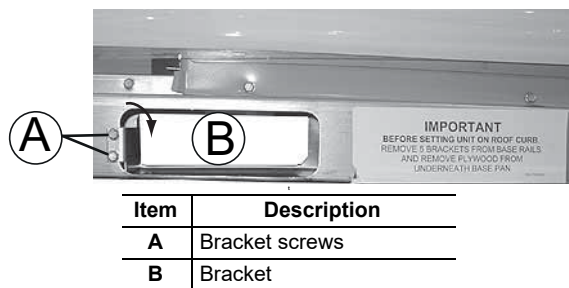


Figure 1: Unit shipping bracket

2. Turn each bracket toward the ground. The protective plywood covering drops to the ground.
3. Remove the condenser coil protective covering.
4. Remove the toolless doorknobs and instruction packet, see Figure 3.

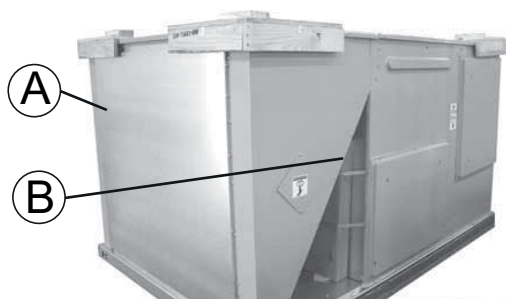


Figure 2: Condenser covering

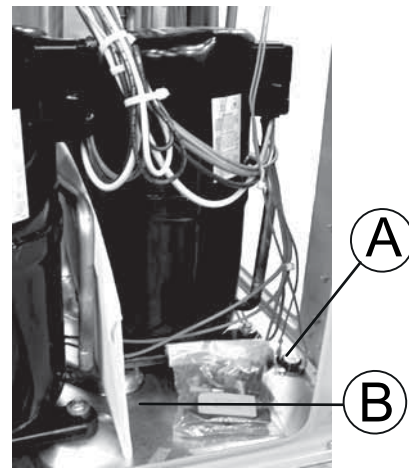


Figure 3: Compressor section

5. If a factory option convenience outlet is installed, you must install the weatherproof outlet in the field. The cover is located behind the filter access panel.
 - a. Remove the shipping label that covers the convenience outlet.
 - b. Follow the instructions on the back of the weatherproof cover box.
 - c. Attach the cover to the unit with the four screws provided.

CAUTION

208/230-3-60 and 380/415-3-50 units with a factory-installed powered convenience outlet option are wired for 230v and 415v power supply respectively. Change the tap on the transformer for 208-3-60 or 380-3-50 operation. See the unit wiring diagram.

Limitations

These units must be installed in accordance with the following:

In U.S.A.:

1. National Electrical Code, ANSI/NFPA No. 70 - Latest Edition
2. Local building codes, and
3. Local electric utility requirements

In Canada:

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

Refer to unit application data found in this document.

If components are added to a unit to meet local codes, they are installed at the dealer's and/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).

This unit is not to be used for temporary heating of buildings or structures under construction.

It is permitted to use the unit for heating and cooling of buildings or structures under construction where the application and use must comply with all manufacturer's installation instructions including the following:

- The unit must be operated under thermostatic control.
- Return and supply air ducts must be sealed to the unit.
- Air filters are in place.
- The return air temperature must be maintained between 55°F (13°C) and 80°F (27°C).

- When the construction phase is completed and before formal start up and commissioning, the unit, duct work and components must be thoroughly cleaned and inspected. This is to ensure that the operation of the unit during construction has not contaminated the unit.

Note: If the unit is used during the construction phase, the standard limited warranty provisions go into effect when the unit is placed into operation.

CAUTION

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), please call the applications department for Ducted Systems @ 1-877-874-SERV for guidance. Additional accessories may be needed for stable operation at temperatures below 30°F.

Unit components

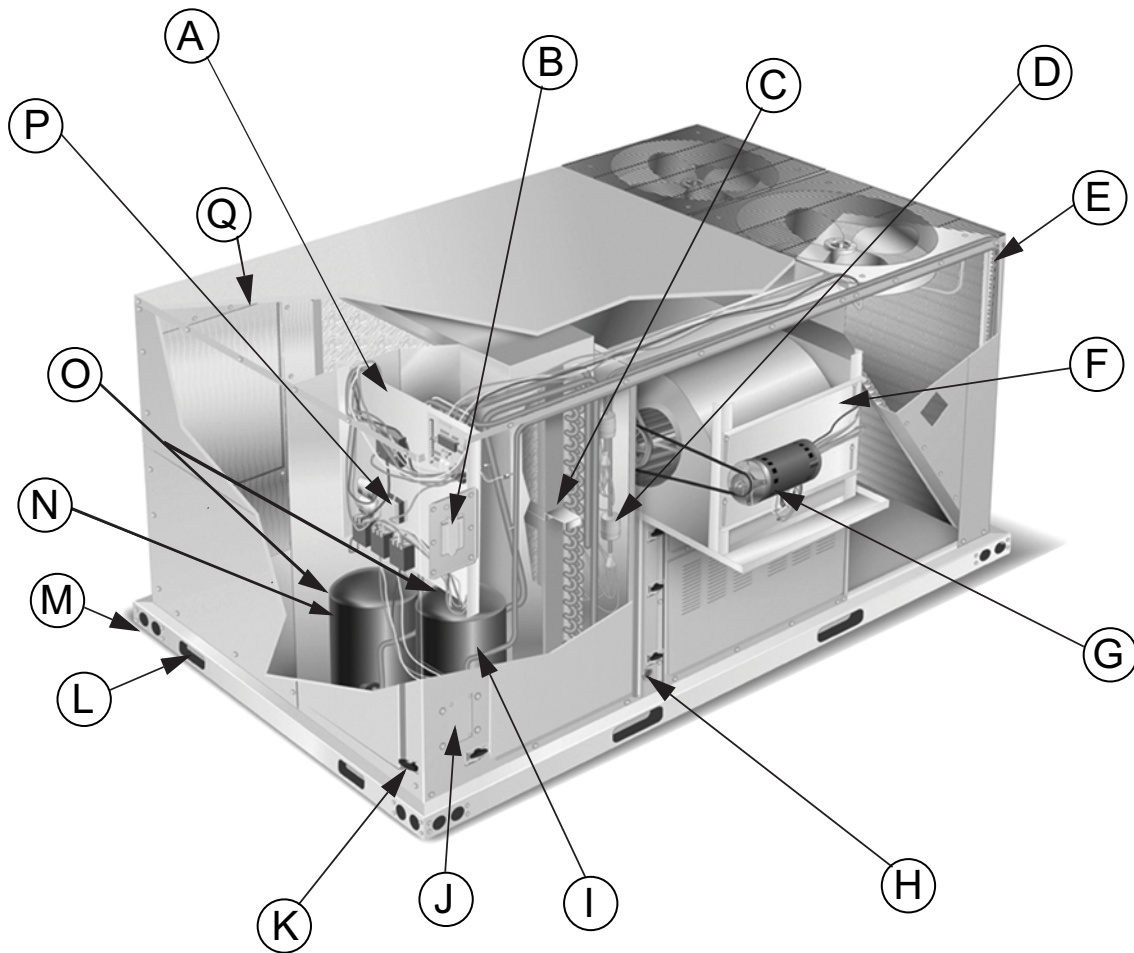


Figure 4: Component location

Figure 4 shows the XP078-150 unit. Table 1 lists the components of the unit.

Table 1: Component location table

Item	Description	Item	Description
A	Smart Equipment™ Control board with screw connectors for thermostat wiring and network connection	J	Side entry power and control wiring knockouts
B	Disconnect location (optional disconnect switch)	K	Toolless door latch
C	Filter access (2" or 4" filter options)	L	Roof curbs in eight- and fourteen-inch heights
D	Filter drier (solid core)	M	Base rails with forklift slots (3 sides) and lifting holes
E	Condenser section	N	Compressor #2 access (high-efficiency compressor)
F	Slide-out motor and blower assembly for easy adjustment and service	O	Dual stage cooling for maximum comfort (7-1/2 - 12-1/2 only)
G	Belt-drive blower motor	P	Terminal block for high-voltage connection
H	Slide-out drain pan with steel 1 in. NPT, female connection	Q	Second model nameplate inside control door
I	Compressor #1 access (high-efficiency compressor)		

Table 2: XP078-150 unit limitations

Size (tons)	Model	Unit voltage	Unit limitations		
			Applied voltage		Outdoor DB temp
			Minimum	Maximum	Maximum (°F)
078 (6.5)	XP	208/230-3-60	187	252	125
		460-3-60	432	504	125
		575-3-60	540	630	125
090 (7.5)	XP	208/230-3-60	187	252	125
		460-3-60	432	504	125
		575-3-60	540	630	125
102 (8.5)	XP	208/230-3-60	187	252	125
		460-3-60	432	504	125
		575-3-60	540	630	125
120 (10)	XP	208/230-3-60	187	252	125
		460-3-60	432	504	125
		575-3-60	540	630	125
150 (12.5)	XP	208/230-3-60	187	252	125
		460-3-60	432	504	125
		575-3-60	540	630	125

Location

Use the following guidelines to select a suitable location for these units:

- The unit is designed for *outdoor installation only*.
- 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 inches. The length and width must be at least 6 inches 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 inch across the entire width and length of the unit.

Clearances

All units require particular clearances for proper operation and service. See Table 6 for the clearances required for construction, servicing, and proper unit operation.

WARNING

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

Rigging and handling

Exercise care when you move the unit. Do not remove any packaging until the unit is near the place of installation. To rig the unit, attach chain or cable slings to the lifting holes provided in the base rails. You must 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 York® 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.

Units may be moved or lifted with a forklift. Slotted openings in the base rails are provided for this purpose.

THE LENGTH OF THE FORKS MUST BE A MINIMUM OF 60 INCHES.

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.

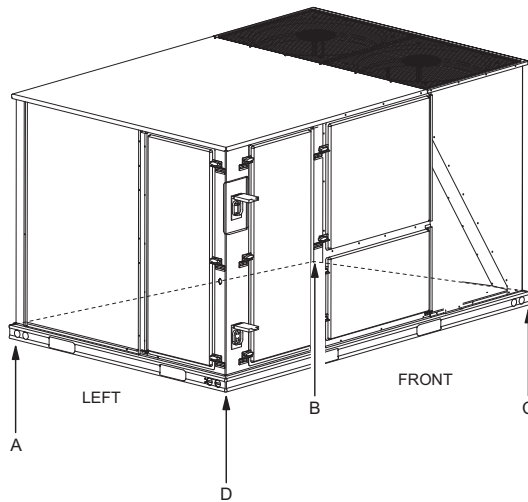


Figure 5: Unit 4 point load weight

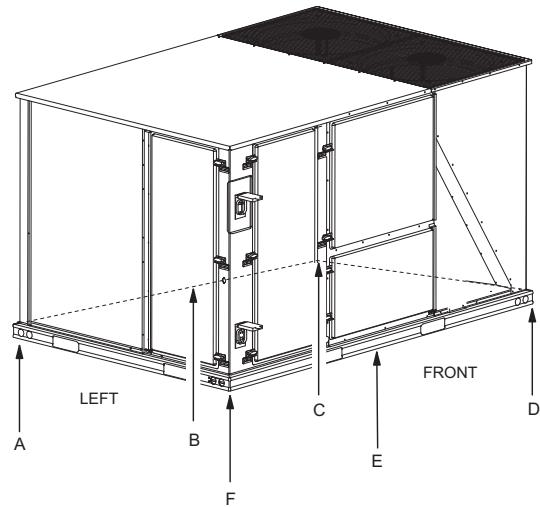


Figure 6: Unit 6 point load weight

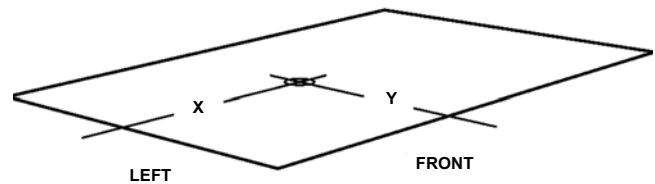


Figure 7: Center of gravity

Table 3: Weights and dimensions

Size (tons)	Model	Weight (lbs.)		Center of gravity		4 point load location (lbs.)				6 point load location (lbs.)					
		Shipping	Operating	X	Y	A	B	C	D	A	B	C	D	E	F
078 (6.5)	XP	1085	1080	38	25	262	195	266	357	184	150	124	169	204	250
090 (7.5)	XP	1095	1090	38	23	243	181	284	381	171	139	115	181	217	267
102 (8.5)	XP	1142	1137	38	25.5	282	210	276	370	197	161	133	175	211	259
120 (10)	XP	1140	1135	38	25.5	281	209	275	369	197	160	133	175	211	259
150 (12.5)	XP	1408	1403	51	25.5	259	347	456	340	165	198	244	320	260	216

Table 4: XP078-150 unit accessory weights

Unit accessory	Weight (lbs.)	
	Shipping	Operating
Economizer	90	85
Power exhaust	40	35
Electric heat ¹	49	49

1. Weight given is for the maximum heater size available (54KW).

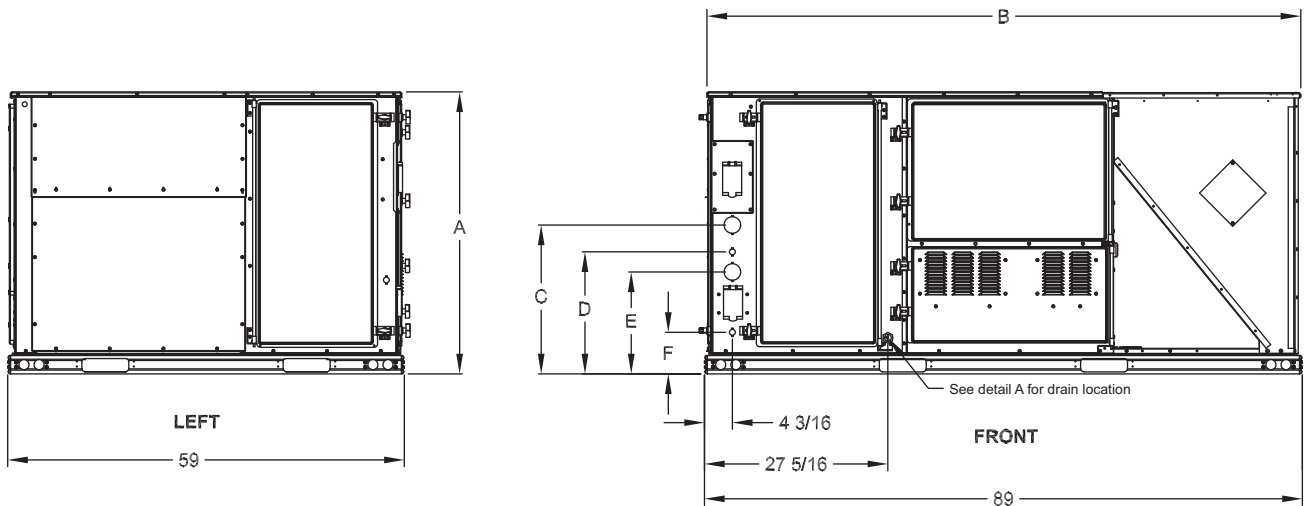


Figure 8: XP078-120 physical dimensions

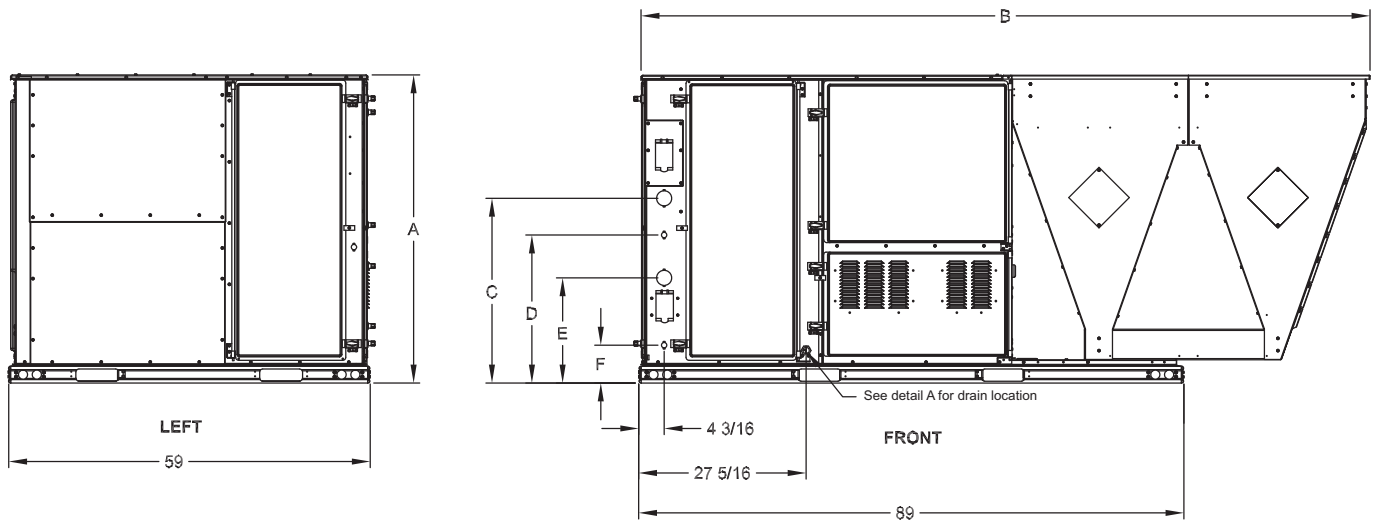


Figure 9: XP150 physical dimensions

Table 5: XP078-150 unit physical dimensions

Unit model number	Dimension (in.)					
	A	B	C	D	E	F
XP078	50 3/4	89	30 3/16	24 3/16	17 3/16	6 3/16
XP090	50 3/4	89	30 3/16	24 3/16	17 3/16	6 3/16
XP102	50 3/4	89	30 3/16	24 3/16	17 3/16	6 3/16
XP120	50 3/4	89	30 3/16	24 3/16	17 3/16	6 3/16
XP150	50 3/4	119 1/2	30 3/16	24 3/16	17 3/16	6 3/16

Detail A

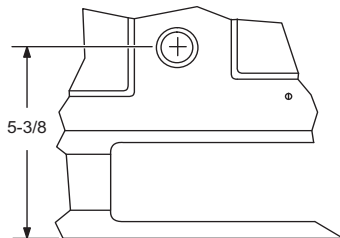


Table 6: XP078-150 unit clearances

Direction	Distance (in.)	Direction	Distance (in.)
Top ¹	72	Right	12
Front	36	Left	36
Rear	36	Bottom ²	0

- Units must be installed outdoors. Make sure that overhanging structures or shrubs do not obscure the condenser air discharge outlet.
- Units may be installed on combustible floors made from wood or class A, B or C roof covering materials.

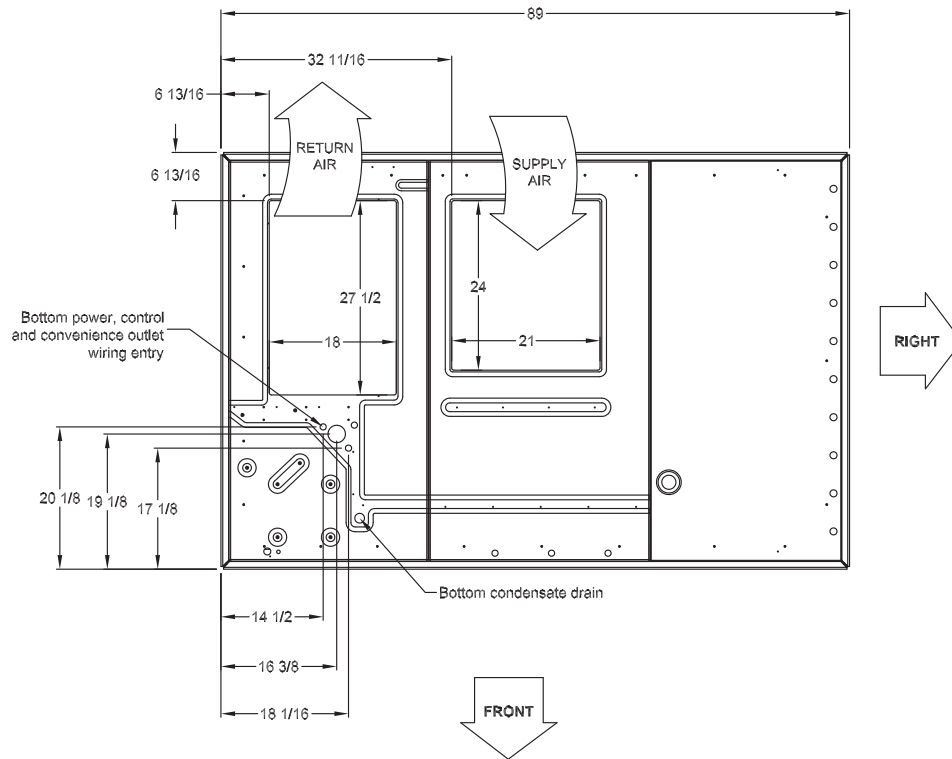


Figure 10: XP078-150 unit bottom duct openings

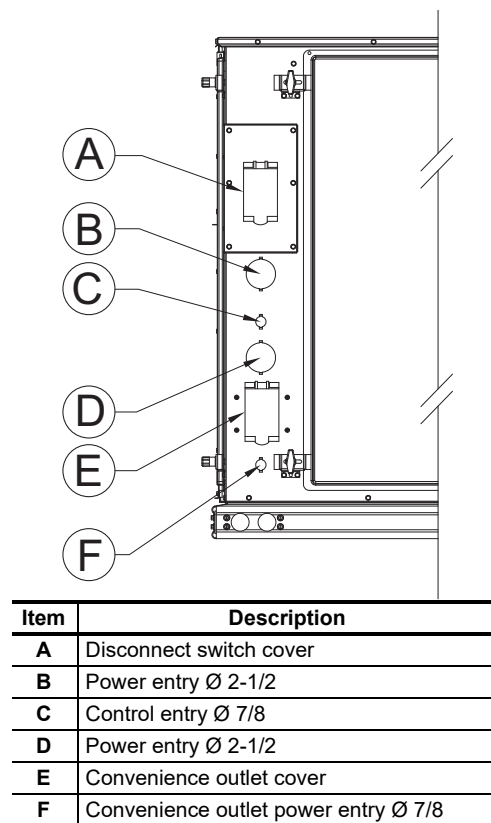


Figure 11: XP078-150 unit electrical entry

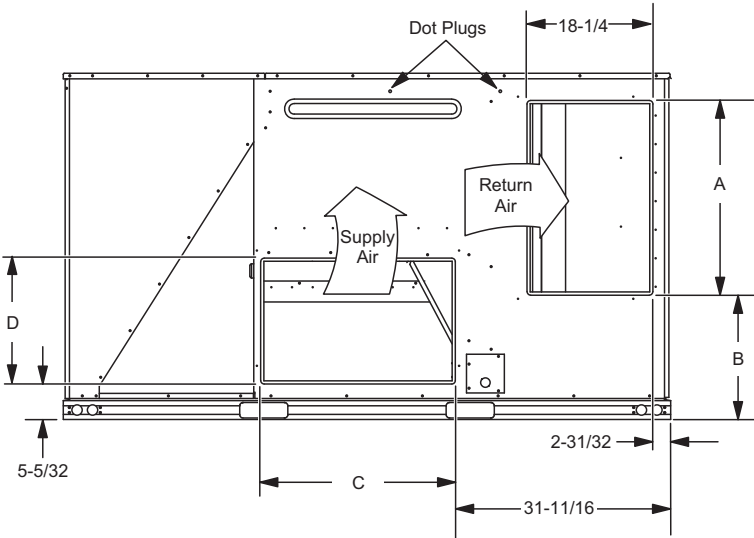


Figure 12: XP078-120 unit side duct openings

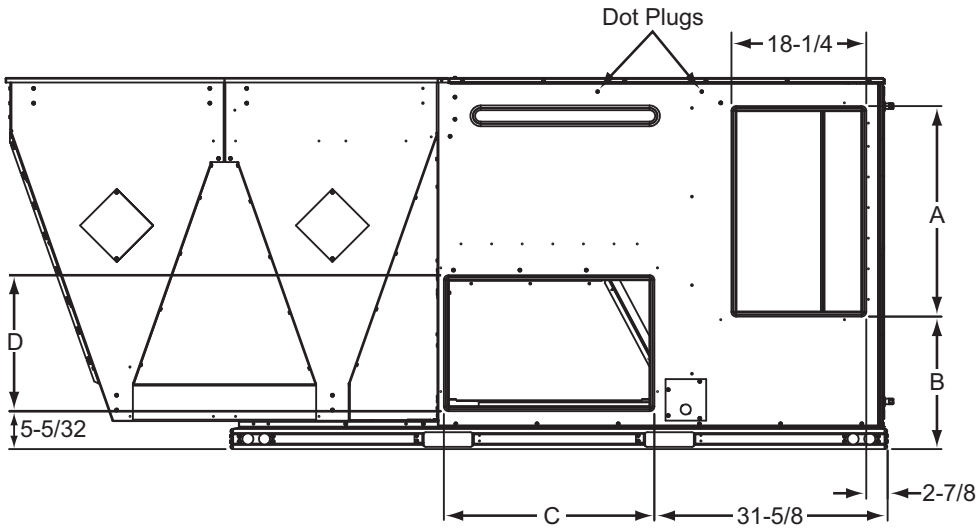


Figure 13: XP150 unit side duct openings

Table 7: Side duct dimensions

Unit model number	Dimension (in.)			
	A	B	C	D
XP078	28 1/4	18 1/16	28 1/4	18 1/4
XP090	28 1/4	18 1/16	28 1/4	18 1/4
XP102	28 1/4	18 1/16	28 1/4	18 1/4
XP120	28 1/4	18 1/16	28 1/4	18 1/4
XP150	28 1/4	18 1/16	28 1/4	18 1/4

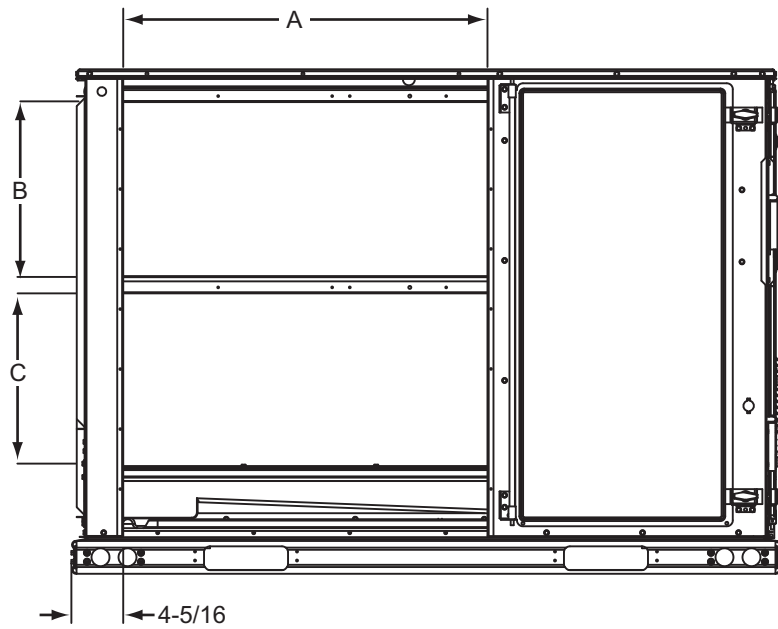


Figure 14: XP078-150 unit left/end duct opening

Table 8: Left/end duct dimensions

Unit model number	Dimension (in.)		
	A	B	C
XP078	30.358	22.580	22.330
XP090	30.358	22.580	22.330
XP102	30.358	22.580	22.330
XP120	30.358	22.580	22.330
XP150	30.358	22.580	22.330

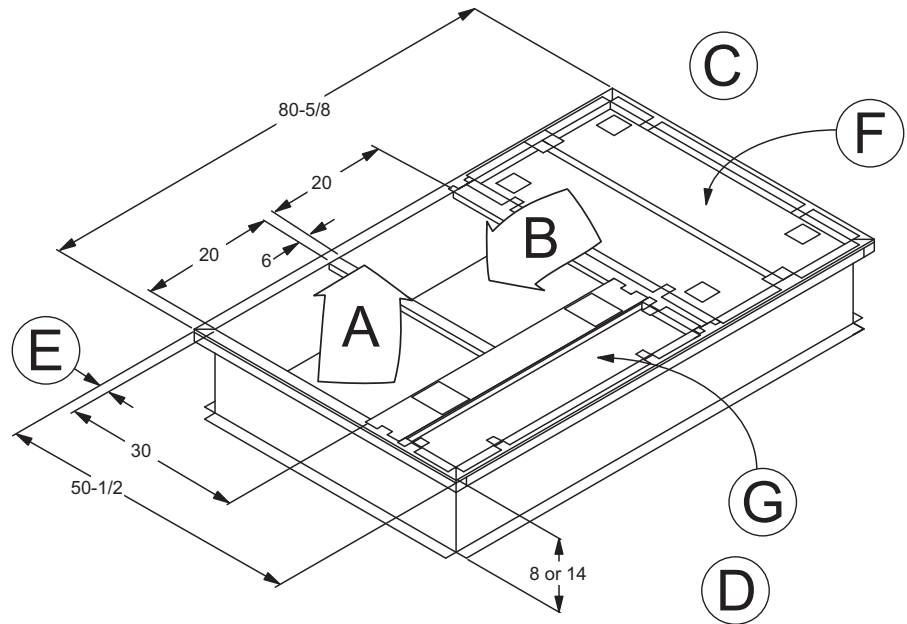


Figure 15: XP078-150 roof curb

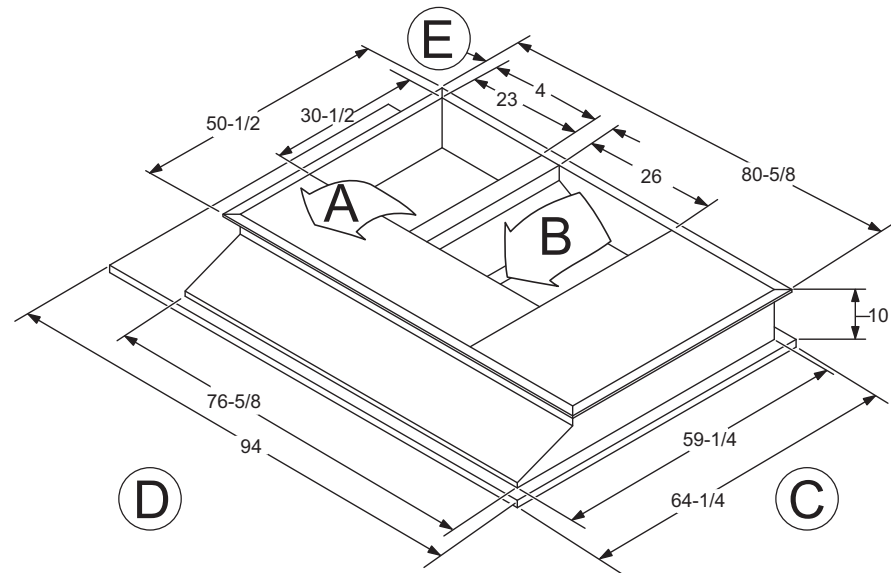


Figure 16: XP078-150 transition roof curb

Roof curb components

Item	Description
A	Return air
B	Supply air
C	Right side of the unit
D	Front side of the unit
E	2 typ.
F	Insulated deck under the condenser section
G	Insulated deck under the compressor section

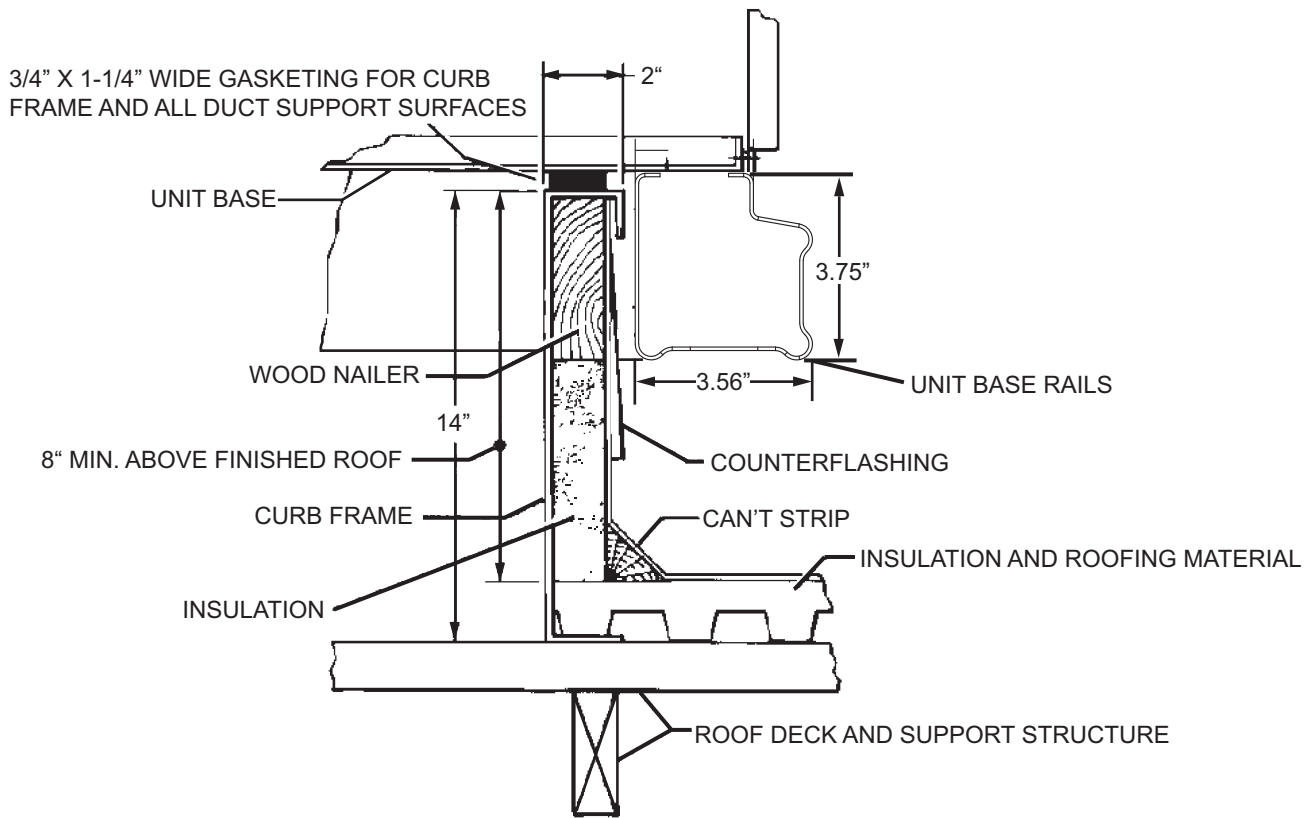


Figure 17: XP078-150 roof curb cut away

Ductwork

You must 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 Figure 10 for bottom air duct openings. See Figures 12 and 13, and Table 7 for side air duct openings.

Duct covers

Units are shipped with the side duct openings covered.

For a bottom duct application, no duct cover changes are necessary.

For a side duct application, complete the following steps.

1. Remove the side duct covers.
2. Orient the supply panel with the painted surface up.
3. Slide the supply panel between the heat exchanger and the unit bottom. The painted surface must face the heat exchanger. The space is narrow but there is adequate room to install the panel.
4. Secure the supply panel with the factory-installed bracket and two screws.
5. Orient the return panel with the painted surface down.
6. Install the return panel over the corresponding side duct. The painted surface must face the down flow duct opening.
7. Secure the return panel with four screws.

CAUTION

When you fasten ductwork to the side duct flanges on the unit, insert the screws through duct flanges only. DO NOT insert the screws through the casing. You must insulate and water-proof outdoor ductwork.



Figure 18: Side panels with hole plugs

Note: Note the orientation of the panel with the insulation side facing up.



Figure 19: Return downflow plenum with panel



Figure 20: Discharge panel in place

Side panels

Units are shipped with side panels to cover the area where an economizer or motorized damper may be installed. You must keep these panels to use them as tops for the economizer rain hoods (see Figure 21).



Figure 21: Side panels for economizer hood tops

Condensate drain

The side condensate drain is reversible and maybe re-oriented to the rear of the cabinet to facilitate condensate piping. A condensate drain connection is available through the base pan for piping inside the roof curb.

Note: Plumbing must conform to local codes.

To install the connection, complete the following steps.

1. Trap the connection according to Figure 22.

Note: You must protect the trap and drain lines from freezing.

2. Install the condensate drain line from the 1 inch NPT female connection on the unit to an open drain. Use a sealing compound on male pipe threads.

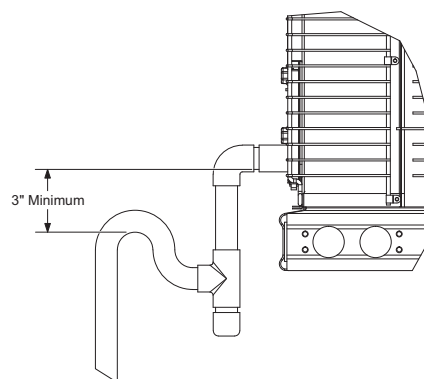


Figure 22: Condensate drain

Compressors

The scroll compressor used in this product is specifically designed to operate with R-410A refrigerant and cannot be interchanged.

⚠ CAUTION

This system uses R-410A refrigerant which operates at higher pressures than R-22. No other refrigerant may be used in this system.

The compressor also uses a polyolester (POE oil), Mobil 3MA POE. This oil is extremely hygroscopic, meaning it absorbs water readily. POE oil can absorb 15 times as much water as other oils designed for HCFC and CFC refrigerants. 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 (polyolester) 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.

Filters

Two-inch filters are supplied with each unit. One-inch filters may be used with no modification to the filter racks.

Always install filters ahead of evaporator coil. Keep the filters clean and replace them with filters of the same size and type. Dirty filters reduce the capacity of the unit and result in frosted

coils or safety shutdown. See the physical data tables for the number and size of filters needed for the unit.

Do not operate the unit without filters properly installed.

⚠ CAUTION

Make sure that panel latches are properly positioned on the unit to maintain an airtight seal.

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/or local ordinances. The unit must be electrically grounded in accordance with NEC and CEC as specified above and/or 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 Table 2.

⚠ CAUTION

208/230-3-60 and 380/415-3-50 units control transformers are factory wired for 230v and 415v power supply respectively. Change the tap on the transformer for 208-3-60 or 380-3-50 operation. See the unit wiring diagram.

The internal wiring harnesses furnished with this unit are an integral part of the design certified unit. Field alteration to comply with electrical codes is not required.

If any of the wire supplied with the unit must be replaced, 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 for these units. Factory-installed disconnects are available. If you install a disconnect (field supplied or York International® supplied accessory), see to Figure 4 for the recommended mounting location.

⚠ CAUTION

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

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 properly 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 properly fused.

See Figures 23 and 24 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 water-proof connectors so that water or moisture cannot be drawn into the unit during normal operation. These water-proofing 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 Table 10, *Electrical data*, on page 20 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.

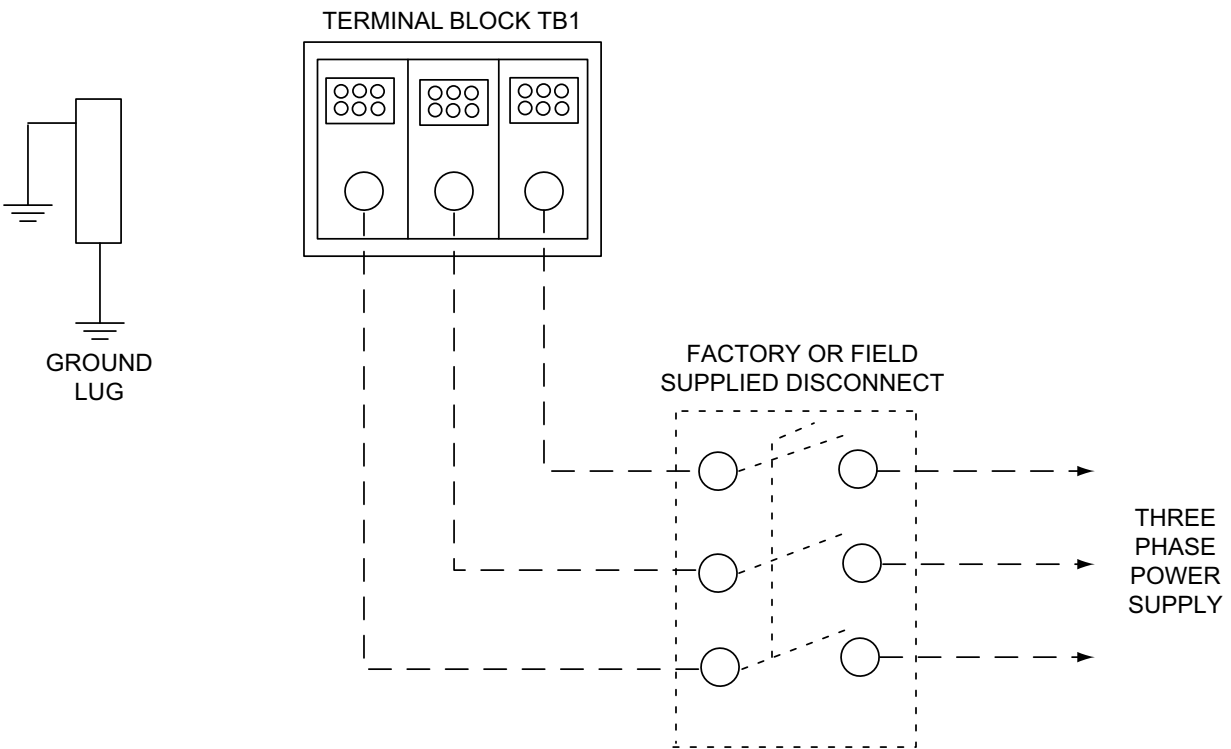


Figure 23: Field wiring disconnect - cooling unit with or without electric heat

Thermostat wiring

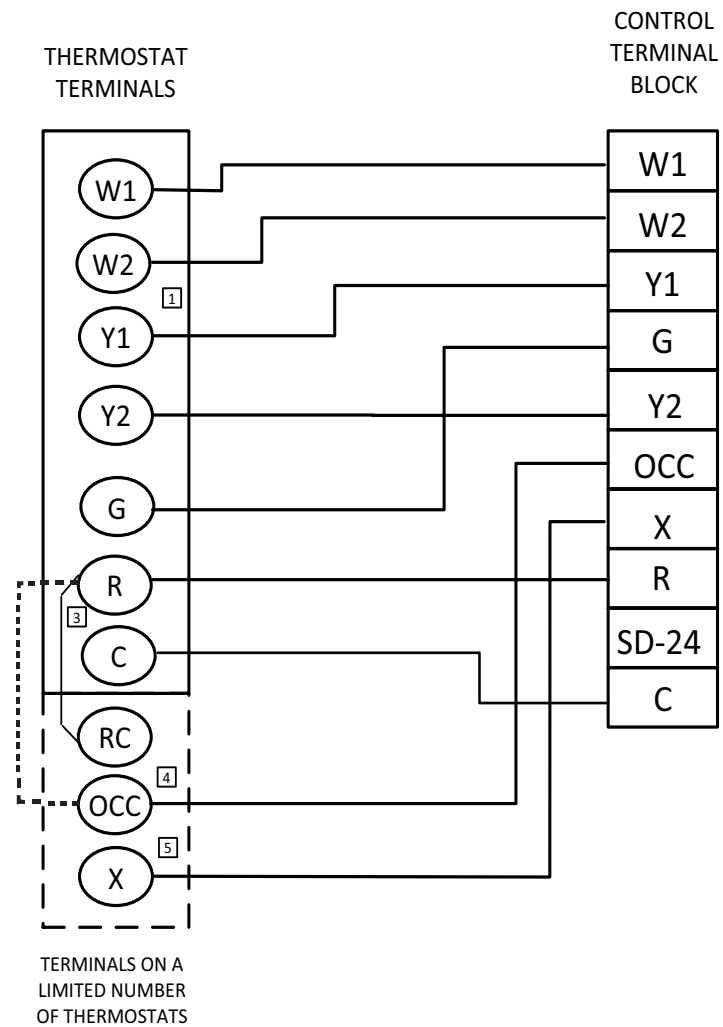
Install the thermostat on an inside wall approximately 56 inches above the floor. The thermostat must not be subject to drafts, sun exposure, or heat from electrical fixtures or appliances.

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 Table 9 for control wire sizing and maximum length.

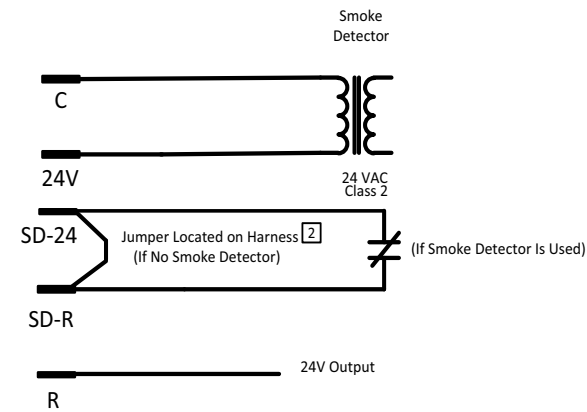
Table 9: Control wire sizes

Wire size	Maximum length ¹
18 AWG	150 feet

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



R~Occ Jumper:
Smart Equipment Control boards come from the factory with a jumper wire between R and OCC terminals on the thermostat terminal strip. Failure to remove this jumper will place the unit into the Occupied mode no matter what the occupancy demand is from the thermostat or EMS system. To allow Thermostat or EMS control of the Occupied mode for the unit, this jumper must be removed during commissioning.



- 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.

Figure 24: Typical electronic thermostat field wiring

Table 10: Electrical data**XP078-150 standard motor - without powered convenience outlet**

Size (tons)	Volt	Compressors (each)			OD fan motors (each)	Supply blower motor	Pwr exh motor	Pwr conv outlet	Electric heat option				MCA ¹ (amps)	MCA ¹ with pwr exh (amps)	Max fuse ² / breaker ³ size (amps)	Max fuse ¹ / breaker ³ size with pwr exh (amps)
		RLA	LRA	MCC					Model	kW	Stages	Amps				
078 (6.5)	208	13.5	88.0	21.1	2.1	5.2	5.5	0.0	None	-	-	-	39.8	45.3	50	50
									E09	6.8	1	18.9	63.4	68.9	70	70
									E18	13.5	2	37.5	86.6	92.1	90	100
									E24	18.0	2	50.0	102.2	107.7	110	110
									E36	25.5	2	70.8	128.3	133.8	150	150
	230	13.5	88.0	21.1	2.1	5.2	5.5	0.0	None	-	-	-	39.8	45.3	50	50
									E09	9.0	1	21.7	66.8	72.3	70	80
									E18	18.0	2	43.3	93.9	99.4	100	100
									E24	24.0	2	57.7	111.9	117.4	125	125
									E36	34.0	2	81.8	142.0	147.5	150	150
	460	6.0	44.0	9.3	1.3	2.6	2.2	0.0	None	-	-	-	18.6	20.8	20	25
									E09	9.0	1	10.8	32.2	34.4	35	35
									E18	18.0	2	21.7	45.7	47.9	50	50
									E24	24.0	2	28.9	54.7	56.9	60	60
									E36	34.0	2	40.9	69.7	71.9	70	80
	575	4.9	34.0	7.7	0.7	2.0	1.8	0.0	None	-	-	-	14.3	16.1	15	20
									E09	9.0	1	8.7	25.2	27.0	30	30
									E18	18.0	2	17.3	36.0	37.8	40	40
									E24	24.0	2	23.1	43.2	45.0	45	45
									E36	34.0	2	32.7	55.2	57.0	60	60
090 (7.5)	208	13.7	83.1	21.4	2.1	5.2	5.5	0.0	None	-	-	-	40.2	45.7	50	50
									E09	6.8	1	18.9	63.8	69.3	70	70
									E18	13.5	2	37.5	87.1	92.6	90	100
									E24	18.0	2	50.0	102.7	108.2	110	110
									E36	25.5	2	70.8	128.7	134.2	150	150
	230	13.7	83.1	21.4	2.1	5.2	5.5	0.0	None	-	-	-	40.2	45.7	50	50
									E09	9.0	1	21.7	67.3	72.8	70	80
									E18	18.0	2	43.3	94.4	99.9	100	100
									E24	24.0	2	57.7	112.4	117.9	125	125
									E36	34.0	2	81.8	142.5	148.0	150	150
	460	6.2	41.0	9.7	1.3	2.6	2.2	0.0	None	-	-	-	19.1	21.3	25	25
									E09	9.0	1	10.8	32.6	34.8	35	35
									E18	18.0	2	21.7	46.1	48.3	50	50
									E24	24.0	2	28.9	55.2	57.4	60	60
									E36	34.0	2	40.9	70.2	72.4	80	80
	575	4.8	33.0	7.5	0.7	2.0	1.8	0.0	None	-	-	-	14.1	15.9	15	20
									E09	9.0	1	8.7	24.9	26.7	25	30
									E18	18.0	2	17.3	35.8	37.6	40	40
									E24	24.0	2	23.1	43.0	44.8	45	45
									E36	34.0	2	32.7	55.0	56.8	60	60
102 (8.5)	208	14.5	98.0	22.6	2.1	6.8	5.5	0.0	None	-	-	-	43.6	49.1	50	60
									E09	6.8	1	18.9	67.2	72.7	70	80
									E18	13.5	2	37.5	90.5	96.0	100	100
									E24	18.0	2	50.0	106.1	111.6	110	125
									E36	25.5	2	70.8	132.1	137.6	150	150
	230	14.5	98.0	22.6	2.1	6.8	5.5	0.0	None	-	-	-	43.6	49.1	50	60
									E09	9.0	1	21.7	70.7	76.2	80	80
									E18	18.0	2	43.3	97.8	103.3	100	110
									E24	24.0	2	57.7	115.8	121.3	125	125
									E36	34.0	2	81.8	145.9	151.4	150	175
	460	6.3	55.0	9.9	1.3	3.4	2.2	0.0	None	-	-	-	20.1	22.3	25	25
									E09	9.0	1	10.8	33.6	35.8	35	40
									E18	18.0	2	21.7	47.2	49.4	50	50
									E24	24.0	2	28.9	56.2	58.4	60	60
									E36	34.0	2	40.9	71.2	73.4	80	80
	575	6.0	41.0	9.4	0.7	2.4	1.8	0.0	None	-	-	-	17.2	19.0	20	25
									E09	9.0	1	8.7	28.0	29.8	30	30
									E18	18.0	2	17.3	38.9	40.7	40	45
									E24	24.0	2	23.1	46.1	47.9	50	50
									E36	34.0	2	32.7	58.1	59.9	60	60

XP078-150 standard motor - without powered convenience outlet (continued)

Size (tons)	Volt	Compressors (each)			OD fan motors (each)	Supply blower motor	Pwr exh motor	Pwr conv outlet	Electric heat option				MCA ¹ (amps)	MCA ¹ with pwr exh (amps)	Max fuse ² / breaker ³ size (amps)	Max fuse ¹ / breaker ³ size with pwr exh (amps)
		RLA	LRA	MCC					Model	kW	Stages	Amps				
120 (10)	208	16.0	110.0	24.9	2.1	6.8	5.5	0.0	None	-	-	-	47.0	52.5	60	60
									E18	13.5	2	37.5	93.8	99.3	100	100
									E24	18.0	2	50.0	109.5	115.0	110	125
									E36	25.5	2	70.8	135.5	141.0	150	150
									E54	40.6	2	112.7	149.4	156.2	150	175
	230	16.0	110.0	24.9	2.1	6.8	5.5	0.0	None	-	-	-	47.0	52.5	60	60
									E18	18.0	2	43.3	101.1	106.6	110	110
									E24	24.0	2	57.7	119.2	124.7	125	125
									E36	34.0	2	81.8	149.2	154.7	150	175
									E54	54.0	2	129.9	149.2	154.7	150	175
	460	7.8	52.0	12.1	1.3	3.4	2.2	0.0	None	-	-	-	23.5	25.7	30	30
									E18	18.0	2	21.7	50.5	52.7	60	60
									E24	24.0	2	28.9	59.6	61.8	60	70
									E36	34.0	2	40.9	74.6	76.8	80	80
									E54	54.0	2	65.0	74.6	76.8	80	80
	575	5.7	38.9	8.9	0.7	2.4	1.8	0.0	None	-	-	-	16.5	18.3	20	20
									E18	18.0	2	17.3	38.2	40.0	40	40
									E24	24.0	2	23.1	45.4	47.2	50	50
									E36	34.0	2	32.7	57.4	59.2	60	60
									E54	54.0	2	52.0	57.4	59.2	60	60
150 (12.5)	208	22.4	149	35	2.1	8.2	5.5		None	-	-	-	67	72.5	80	90
									E18	13.5	2	37.5	113.9	119.4	125	125
									E24	18	2	50	129.5	135	150	150
									E36	25.5	2	70.8	155.5	161	175	175
									E54	40.6	2	112.7	155.5	161	175	175
	230	22.4	149	35	2.1	8.2	5.5		None	-	-	-	67	72.5	80	90
									E18	18	2	43.3	121.1	126.6	125	150
									E24	24	2	57.7	139.1	144.6	150	150
									E36	34	2	81.8	169.3	174.8	175	175
									E54	54	2	129.9	169.3	174.8	175	175
	460	10.6	75	17	1.26	4.1	2.2		None	-	-	-	33	35.2	40	45
									E18	18	2	21.7	60.1	62.3	70	70
									E24	24	2	28.9	69.1	71.3	70	80
									E36	34	2	40.9	84.1	86.3	90	90
									E54	54	2	65	84.1	86.3	90	90
	575	7.7	54	12	0.66	3.1	1.8		None	-	-	-	23	24.8	30	30
									E18	18	2	17.3	44.6	46.4	45	50
									E24	24	2	23.1	51.9	53.7	60	60
									E36	34	2	32.7	63.9	65.7	70	70
									E54	54	2	52	63.9	65.7	70	70

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

XP078-150 high static motor - without powered convenience outlet

Size (tons)	Volt	Compressors (each)			OD fan motors (each)	Supply blower motor	Pwr exh motor	Pwr conv outlet	Electric heat option				MCA ¹ (amps)	MCA ¹ with pwr exh (amps)	Max fuse ² / breaker ³ size (amps)	Max fuse ¹ / breaker ³ size with pwr exh (amps)
		RLA	LRA	MCC					Model	kW	Stages	Amps				
078 (6.5)	208	13.5	88.0	21.1	2.1	6.8	5.5	0.0	None	-	-	-	41.4	46.9	50	60
									E09	6.8	1	18.9	65.0	70.5	70	80
									E18	13.5	2	37.5	88.2	93.7	90	100
									E24	18.0	2	50.0	103.8	109.3	110	110
									E36	25.5	2	70.8	129.9	135.4	150	150
	230	13.5	88.0	21.1	2.1	6.8	5.5	0.0	None	-	-	-	41.4	46.9	50	60
									E09	9.0	1	21.7	68.4	73.9	70	80
									E18	18.0	2	43.3	95.5	101.0	100	110
									E24	24.0	2	57.7	113.5	119.0	125	125
									E36	34.0	2	81.8	143.6	149.1	150	150
	460	6.0	44.0	9.3	1.3	3.4	2.2	0.0	None	-	-	-	19.4	21.6	25	25
									E09	9.0	1	10.8	33.0	35.2	35	40
									E18	18.0	2	21.7	46.5	48.7	50	50
									E24	24.0	2	28.9	55.5	57.7	60	60
									E36	34.0	2	40.9	70.5	72.7	80	80
	575	4.9	34.0	7.7	0.7	2.4	1.8	0.0	None	-	-	-	14.7	16.5	15	20
									E09	9.0	1	8.7	25.6	27.4	30	30
									E18	18.0	2	17.3	36.4	38.2	40	40
									E24	24.0	2	23.1	43.6	45.4	45	50
									E36	34.0	2	32.7	55.6	57.4	60	60
090 (7.5)	208	13.7	83.1	21.4	2.1	9.6	5.5	0.0	None	-	-	-	44.6	50.1	50	60
									E09	6.8	1	18.9	68.2	73.7	70	80
									E18	13.5	2	37.5	91.5	97.0	100	100
									E24	18.0	2	50.0	107.1	112.6	110	125
									E36	25.5	2	70.8	133.1	138.6	150	150
	230	13.7	83.1	21.4	2.1	9.6	5.5	0.0	None	-	-	-	44.6	50.1	50	60
									E09	9.0	1	21.7	71.7	77.2	80	80
									E18	18.0	2	43.3	98.8	104.3	100	110
									E24	24.0	2	57.7	116.8	122.3	125	125
									E36	34.0	2	81.8	146.9	152.4	150	175
	460	6.2	41.0	9.7	1.3	4.7	2.2	0.0	None	-	-	-	21.2	23.4	25	25
									E09	9.0	1	10.8	34.7	36.9	35	40
									E18	18.0	2	21.7	48.2	50.4	50	60
									E24	24.0	2	28.9	57.3	59.5	60	60
									E36	34.0	2	40.9	72.3	74.5	80	80
	575	4.8	33.0	7.5	0.7	3.6	1.8	0.0	None	-	-	-	15.7	17.5	20	20
									E09	9.0	1	8.7	26.5	28.3	30	30
									E18	18.0	2	17.3	37.4	39.2	40	40
									E24	24.0	2	23.1	44.6	46.4	45	50
									E36	34.0	2	32.7	56.6	58.4	60	60
102 (8.5)	208	14.5	98.0	22.6	2.1	9.6	5.5	0.0	None	-	-	-	46.4	51.9	60	60
									E09	6.8	1	18.9	70.0	75.5	70	80
									E18	13.5	2	37.5	93.3	98.8	100	100
									E24	18.0	2	50.0	108.9	114.4	110	125
									E36	25.5	2	70.8	134.9	140.4	150	150
	230	14.5	98.0	22.6	2.1	9.6	5.5	0.0	None	-	-	-	46.4	51.9	60	60
									E09	9.0	1	21.7	73.5	79.0	80	80
									E18	18.0	2	43.3	100.6	106.1	110	110
									E24	24.0	2	57.7	118.6	124.1	125	125
									E36	34.0	2	81.8	148.7	154.2	150	175
	460	6.3	55.0	9.9	1.3	4.7	2.2	0.0	None	-	-	-	21.4	23.6	25	25
									E09	9.0	1	10.8	34.9	37.1	35	40
									E18	18.0	2	21.7	48.5	50.7	50	60
									E24	24.0	2	28.9	57.5	59.7	60	60
									E36	34.0	2	40.9	72.5	74.7	80	80
	575	6.0	41.0	9.4	0.7	3.6	1.8	0.0	None	-	-	-	18.4	20.2	20	25
									E09	9.0	1	8.7	29.2	31.0	30	35
									E18	18.0	2	17.3	40.1	41.9	45	45
									E24	24.0	2	23.1	47.3	49.1	50	50
									E36	34.0	2	32.7	59.3	61.1	60	70

XP078-150 high static motor - without powered convenience outlet (continued)

Size (tons)	Volt	Compressors (each)			OD fan motors (each)	Supply blower motor	Pwr exh motor	Pwr conv outlet	Electric heat option				MCA ¹ (amps)	MCA ¹ with pwr exh (amps)	Max fuse ² / breaker ³ size (amps)	Max fuse ¹ / breaker ³ size with pwr exh (amps)
		RLA	LRA	MCC					Model	kW	Stages	Amps				
120 (10)	208	16.0	110.0	24.9	2.1	9.6	5.5	0.0	None	-	-	-	49.8	55.3	60	70
									E18	13.5	2	37.5	96.6	102.1	100	110
									E24	18.0	2	50.0	112.3	117.8	125	125
									E36	25.5	2	70.8	138.3	143.8	150	150
									E54	40.6	2	112.7	152.9	159.7	175	175
	230	16.0	110.0	24.9	2.1	9.6	5.5	0.0	None	-	-	-	49.8	55.3	60	70
									E18	18.0	2	43.3	103.9	109.4	110	110
									E24	24.0	2	57.7	122.0	127.5	125	150
									E36	34.0	2	81.8	152.0	157.5	175	175
									E54	54.0	2	129.9	152.0	157.5	175	175
	460	7.8	52.0	12.1	1.3	4.7	2.2	0.0	None	-	-	-	24.8	27.0	30	30
									E18	18.0	2	21.7	51.8	54.0	60	60
									E24	24.0	2	28.9	60.9	63.1	70	70
									E36	34.0	2	40.9	75.9	78.1	80	80
									E54	54.0	2	65.0	75.9	78.1	80	80
	575	5.7	38.9	8.9	0.7	3.6	1.8	0.0	None	-	-	-	17.7	19.5	20	25
									E18	18.0	2	17.3	39.4	41.2	40	45
									E24	24.0	2	23.1	46.6	48.4	50	50
									E36	34.0	2	32.7	58.6	60.4	60	70
									E54	54.0	2	52.0	58.6	60.4	60	70
150 (12.5)	208	22.4	149	35	2.1	14	5.5		None	-	-	-	72.8	78.3	90	100
									E18	13.5	2	37.5	119.7	125.2	125	150
									E24	18	2	50	135.3	140.8	150	150
									E36	25.5	2	70.8	161.3	166.8	175	175
									E54	40.6	2	112.7	161.3	166.8	175	175
	230	22.4	149	35	2.1	14	5.5		None	-	-	-	72.8	78.3	90	100
									E18	18	2	43.3	126.9	132.4	150	150
									E24	24	2	57.7	144.9	150.4	150	175
									E36	34	2	81.8	175.1	180.6	200	200
									E54	54	2	129.9	175.1	180.6	200	200
	460	10.6	75	17	1.26	6.6	2.2		None	-	-	-	35.5	37.7	45	45
									E18	18	2	21.7	62.6	64.8	70	70
									E24	24	2	28.9	71.6	73.8	80	80
									E36	34	2	40.9	86.6	88.8	90	90
									E54	54	2	65	86.6	88.8	90	90
	575	7.7	54	12	0.66	5.2	1.8		None	-	-	-	25.1	26.9	30	30
									E18	18	2	17.3	46.7	48.5	50	50
									E24	24	2	23.1	54	55.8	60	60
									E36	34	2	32.7	66	67.8	70	70
									E54	54	2	52	66	67.8	70	70

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

XP078-150 standard motor - with powered convenience outlet

Size (tons)	Volt	Compressors (each)			OD fan motors (each)	Supply blower motor	Pwr exh motor	Pwr conv outlet	Electric heat option				MCA ¹ (amps)	MCA ¹ with pwr exh (amps)	Max fuse ² / breaker ³ size (amps)	Max fuse ¹ / breaker ³ size with pwr exh (amps)
		RLA	LRA	MCC					Model	kW	Stages	Amps				
078 (6.5)	208	13.5	88.0	21.1	2.1	5.2	5.5	10.0	None	-	-	-	49.8	55.3	60	60
									E09	6.8	1	18.9	73.4	78.9	80	80
									E18	13.5	2	37.5	96.6	102.1	100	110
									E24	18.0	2	50.0	112.2	117.7	125	125
									E36	25.5	2	70.8	138.3	143.8	150	150
	230	13.5	88.0	21.1	2.1	5.2	5.5	10.0	None	-	-	-	49.8	55.3	60	60
									E09	9.0	1	21.7	76.8	82.3	80	90
									E18	18.0	2	43.3	103.9	109.4	110	110
									E24	24.0	2	57.7	121.9	127.4	125	150
									E36	34.0	2	81.8	152.0	157.5	175	175
	460	6.0	44.0	9.3	1.3	2.6	2.2	5.0	None	-	-	-	23.6	25.8	25	30
									E09	9.0	1	10.8	37.2	39.4	40	40
									E18	18.0	2	21.7	50.7	52.9	60	60
									E24	24.0	2	28.9	59.7	61.9	60	70
									E36	34.0	2	40.9	74.7	76.9	80	80
	575	4.9	34.0	7.7	0.7	2.0	1.8	4.0	None	-	-	-	18.3	20.1	20	25
									E09	9.0	1	8.7	29.2	31.0	30	35
									E18	18.0	2	17.3	40.0	41.8	40	45
									E24	24.0	2	23.1	47.2	49.0	50	50
									E36	34.0	2	32.7	59.2	61.0	60	70
090 (7.5)	208	13.7	83.1	21.4	2.1	5.2	5.5	10.0	None	-	-	-	50.2	55.7	60	60
									E09	6.8	1	18.9	73.8	79.3	80	80
									E18	13.5	2	37.5	97.1	102.6	100	110
									E24	18.0	2	50.0	112.7	118.2	125	125
									E36	25.5	2	70.8	138.7	144.2	150	150
	230	13.7	83.1	21.4	2.1	5.2	5.5	10.0	None	-	-	-	50.2	55.7	60	60
									E09	9.0	1	21.7	77.3	82.8	80	90
									E18	18.0	2	43.3	104.4	109.9	110	110
									E24	24.0	2	57.7	122.4	127.9	125	150
									E36	34.0	2	81.8	152.5	158.0	175	175
	460	6.2	41.0	9.7	1.3	2.6	2.2	5.0	None	-	-	-	24.1	26.3	30	30
									E09	9.0	1	10.8	37.6	39.8	40	40
									E18	18.0	2	21.7	51.1	53.3	60	60
									E24	24.0	2	28.9	60.2	62.4	70	70
									E36	34.0	2	40.9	75.2	77.4	80	80
	575	4.8	33.0	7.5	0.7	2.0	1.8	4.0	None	-	-	-	18.1	19.9	20	20
									E09	9.0	1	8.7	28.9	30.7	30	35
									E18	18.0	2	17.3	39.8	41.6	40	45
									E24	24.0	2	23.1	47.0	48.8	50	50
									E36	34.0	2	32.7	59.0	60.8	60	70
102 (8.5)	208	14.5	98.0	22.6	2.1	6.8	5.5	10.0	None	-	-	-	53.6	59.1	60	70
									E09	6.8	1	18.9	77.2	82.7	80	90
									E18	13.5	2	37.5	100.5	106.0	110	110
									E24	18.0	2	50.0	116.1	121.6	125	125
									E36	25.5	2	70.8	142.1	147.6	150	150
	230	14.5	98.0	22.6	2.1	6.8	5.5	10.0	None	-	-	-	53.6	59.1	60	70
									E09	9.0	1	21.7	80.7	86.2	90	90
									E18	18.0	2	43.3	107.8	113.3	110	125
									E24	24.0	2	57.7	125.8	131.3	150	150
									E36	34.0	2	81.8	155.9	161.4	175	175
	460	6.3	55.0	9.9	1.3	3.4	2.2	5.0	None	-	-	-	25.1	27.3	30	30
									E09	9.0	1	10.8	38.6	40.8	40	45
									E18	18.0	2	21.7	52.2	54.4	60	60
									E24	24.0	2	28.9	61.2	63.4	70	70
									E36	34.0	2	40.9	76.2	78.4	80	80
	575	6.0	41.0	9.4	0.7	2.4	1.8	4.0	None	-	-	-	21.2	23.0	25	25
									E09	9.0	1	8.7	32.0	33.8	35	35
									E18	18.0	2	17.3	42.9	44.7	45	45
									E24	24.0	2	23.1	50.1	51.9	60	60
									E36	34.0	2	32.7	62.1	63.9	70	70

XP078-150 standard motor - with powered convenience outlet (continued)

Size (tons)	Volt	Compressors (each)			OD fan motors (each)	Supply blower motor	Pwr exh motor	Pwr conv outlet	Electric heat option				MCA ¹ (amps)	MCA ¹ with pwr exh (amps)	Max fuse ² / breaker ³ size (amps)	Max fuse ¹ / breaker ³ size with pwr exh (amps)
		RLA	LRA	MCC					FLA	FLA	FLA	FLA				
120 (10)	208	16.0	110.0	24.9	2.1	6.8	5.5	10.0	None	-	-	-	57.0	62.5	70	70
									E18	13.5	2	37.5	103.8	109.3	110	110
									E24	18.0	2	50.0	119.5	125.0	125	125
									E36	25.5	2	70.8	145.5	151.0	150	175
									E54	40.6	2	112.7	161.9	168.7	175	175
	230	16.0	110.0	24.9	2.1	6.8	5.5	10.0	None	-	-	-	57.0	62.5	70	70
									E18	18.0	2	43.3	111.1	116.6	125	125
									E24	24.0	2	57.7	129.2	134.7	150	150
									E36	34.0	2	81.8	159.2	164.7	175	175
									E54	54.0	2	129.9	159.2	164.7	175	175
	460	7.8	52.0	12.1	1.3	3.4	2.2	5.0	None	-	-	-	28.5	30.7	35	35
									E18	18.0	2	21.7	55.5	57.7	60	60
									E24	24.0	2	28.9	64.6	66.8	70	70
									E36	34.0	2	40.9	79.6	81.8	80	90
									E54	54.0	2	65.0	79.6	81.8	80	90
	575	5.7	38.9	8.9	0.7	2.4	1.8	4.0	None	-	-	-	20.5	22.3	25	25
									E18	18.0	2	17.3	42.2	44.0	45	45
									E24	24.0	2	23.1	49.4	51.2	50	60
									E36	34.0	2	32.7	61.4	63.2	70	70
									E54	54.0	2	52.0	61.4	63.2	70	70
150 (12.5)	208	22.4	149	35	2.1	8.2	5.5	20	None	-	-	-	77	82.5	90	100
									E18	13.5	2	37.5	123.9	129.4	125	150
									E24	18	2	50	139.5	145	150	150
									E36	25.5	2	70.8	165.5	171	175	175
									E54	40.6	2	112.7	165.5	171	175	175
	230	22.4	149	35	2.1	8.2	5.5	20	None	-	-	-	77	82.5	90	100
									E18	18	2	43.3	131.1	136.6	150	150
									E24	24	2	57.7	149.1	154.6	150	175
									E36	34	2	81.8	179.3	184.8	200	200
									E54	54	2	129.9	179.3	184.8	200	200
	460	10.6	75	17	1.26	4.1	2.2	20	None	-	-	-	38	40.2	45	50
									E18	18	2	21.7	65.1	67.3	70	70
									E24	24	2	28.9	74.1	76.3	80	80
									E36	34	2	40.9	89.1	91.3	90	100
									E54	54	2	65	89.1	91.3	90	100
	575	7.7	54	12	0.66	3.1	1.8	20	None	-	-	-	27	28.8	30	35
									E18	18	2	17.3	48.6	50.4	50	60
									E24	24	2	23.1	55.9	57.7	60	60
									E36	34	2	32.7	67.9	69.7	70	70
									E54	54	2	52	67.9	69.7	70	70

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

XP078-150 high static motor - with powered convenience outlet

Size (tons)	Volt	Compressors (each)			OD fan motors (each)	Supply blower motor	Pwr exh motor	Pwr conv outlet	Electric heat option				MCA ¹ (amps)	MCA ¹ with pwr exh (amps)	Max fuse ² / breaker ³ size (amps)	Max fuse ¹ / breaker ³ size with pwr exh (amps)
		RLA	LRA	MCC					Model	kW	Stages	Amps				
078 (6.5)	208	13.5	88.0	21.1	2.1	6.8	5.5	10.0	None	-	-	-	51.4	56.9	60	70
									E09	6.8	1	18.9	75.0	80.5	80	90
									E18	13.5	2	37.5	98.2	103.7	100	110
									E24	18.0	2	50.0	113.8	119.3	125	125
									E36	25.5	2	70.8	139.9	145.4	150	150
	230	13.5	88.0	21.1	2.1	6.8	5.5	10.0	None	-	-	-	51.4	56.9	60	70
									E09	9.0	1	21.7	78.4	83.9	80	90
									E18	18.0	2	43.3	105.5	111.0	110	125
									E24	24.0	2	57.7	123.5	129.0	125	150
									E36	34.0	2	81.8	153.6	159.1	175	175
	460	6.0	44.0	9.3	1.3	3.4	2.2	5.0	None	-	-	-	24.4	26.6	30	30
									E09	9.0	1	10.8	38.0	40.2	40	45
									E18	18.0	2	21.7	51.5	53.7	60	60
									E24	24.0	2	28.9	60.5	62.7	70	70
									E36	34.0	2	40.9	75.5	77.7	80	80
	575	4.9	34.0	7.7	0.7	2.4	1.8	4.0	None	-	-	-	18.7	20.5	20	25
									E09	9.0	1	8.7	29.6	31.4	30	35
									E18	18.0	2	17.3	40.4	42.2	45	45
									E24	24.0	2	23.1	47.6	49.4	50	50
									E36	34.0	2	32.7	59.6	61.4	60	70
090 (7.5)	208	13.7	83.1	21.4	2.1	9.6	5.5	10.0	None	-	-	-	54.6	60.1	60	70
									E09	6.8	1	18.9	78.2	83.7	80	90
									E18	13.5	2	37.5	101.5	107.0	110	110
									E24	18.0	2	50.0	117.1	122.6	125	125
									E36	25.5	2	70.8	143.1	148.6	150	150
	230	13.7	83.1	21.4	2.1	9.6	5.5	10.0	None	-	-	-	54.6	60.1	60	70
									E09	9.0	1	21.7	81.7	87.2	90	90
									E18	18.0	2	43.3	108.8	114.3	110	125
									E24	24.0	2	57.7	126.8	132.3	150	150
									E36	34.0	2	81.8	156.9	162.4	175	175
	460	6.2	41.0	9.7	1.3	4.7	2.2	5.0	None	-	-	-	26.2	28.4	30	30
									E09	9.0	1	10.8	39.7	41.9	40	45
									E18	18.0	2	21.7	53.2	55.4	60	60
									E24	24.0	2	28.9	62.3	64.5	70	70
									E36	34.0	2	40.9	77.3	79.5	80	80
	575	4.8	33.0	7.5	0.7	3.6	1.8	4.0	None	-	-	-	19.7	21.5	20	25
									E09	9.0	1	8.7	30.5	32.3	35	35
									E18	18.0	2	17.3	41.4	43.2	45	45
									E24	24.0	2	23.1	48.6	50.4	50	60
									E36	34.0	2	32.7	60.6	62.4	70	70
102 (8.5)	208	14.5	98.0	22.6	2.1	9.6	5.5	10.0	None	-	-	-	56.4	61.9	70	70
									E09	6.8	1	18.9	80.0	85.5	80	90
									E18	13.5	2	37.5	103.3	108.8	110	110
									E24	18.0	2	50.0	118.9	124.4	125	125
									E36	25.5	2	70.8	144.9	150.4	150	175
	230	14.5	98.0	22.6	2.1	9.6	5.5	10.0	None	-	-	-	56.4	61.9	70	70
									E09	9.0	1	21.7	83.5	89.0	90	90
									E18	18.0	2	43.3	110.6	116.1	125	125
									E24	24.0	2	57.7	128.6	134.1	150	150
									E36	34.0	2	81.8	158.7	164.2	175	175
	460	6.3	55.0	9.9	1.3	4.7	2.2	5.0	None	-	-	-	26.4	28.6	30	30
									E09	9.0	1	10.8	39.9	42.1	40	45
									E18	18.0	2	21.7	53.5	55.7	60	60
									E24	24.0	2	28.9	62.5	64.7	70	70
									E36	34.0	2	40.9	77.5	79.7	80	80
	575	6.0	41.0	9.4	0.7	3.6	1.8	4.0	None	-	-	-	22.4	24.2	25	30
									E09	9.0	1	8.7	33.2	35.0	35	35
									E18	18.0	2	17.3	44.1	45.9	45	50
									E24	24.0	2	23.1	51.3	53.1	60	60
									E36	34.0	2	32.7	63.3	65.1	70	70

XP078-150 high static motor - with powered convenience outlet (continued)

Size (tons)	Volt	Compressors (each)			OD fan motors (each)	Supply blower motor	Pwr exh motor	Pwr conv outlet	Electric heat option				MCA ¹ (amps)	MCA ¹ with pwr exh (amps)	Max fuse ² / breaker ³ size (amps)	Max fuse ¹ / breaker ³ size with pwr exh (amps)
		RLA	LRA	MCC					FLA	FLA	FLA	FLA				
120 (10)	208	16.0	110.0	24.9	2.1	9.6	5.5	10.0	None	-	-	-	59.8	65.3	70	80
									E18	13.5	2	37.5	106.6	112.1	110	125
									E24	18.0	2	50.0	122.3	127.8	125	150
									E36	25.5	2	70.8	148.3	153.8	150	175
									E54	40.6	2	112.7	165.4	172.2	175	175
	230	16.0	110.0	24.9	2.1	9.6	5.5	10.0	None	-	-	-	59.8	65.3	70	80
									E18	18.0	2	43.3	113.9	119.4	125	125
									E24	24.0	2	57.7	132.0	137.5	150	150
									E36	34.0	2	81.8	162.0	167.5	175	175
									E54	54.0	2	129.9	162.0	167.5	175	175
	460	7.8	52.0	12.1	1.3	4.7	2.2	5.0	None	-	-	-	29.8	32.0	35	35
									E18	18.0	2	21.7	56.8	59.0	60	60
									E24	24.0	2	28.9	65.9	68.1	70	70
									E36	34.0	2	40.9	80.9	83.1	90	90
									E54	54.0	2	65.0	80.9	83.1	90	90
	575	5.7	38.9	8.9	0.7	3.6	1.8	4.0	None	-	-	-	21.7	23.5	25	25
									E18	18.0	2	17.3	43.4	45.2	45	50
									E24	24.0	2	23.1	50.6	52.4	60	60
									E36	34.0	2	32.7	62.6	64.4	70	70
									E54	54.0	2	52.0	62.6	64.4	70	70
150 (12.5)	208	22.4	149	35	2.1	14	5.5		None	-	-	-	72.8	78.3	90	100
									E18	13.5	2	37.5	119.7	125.2	125	150
									E24	18	2	50	135.3	140.8	150	150
									E36	25.5	2	70.8	161.3	166.8	175	175
									E54	40.6	2	112.7	161.3	166.8	175	175
	230	22.4	149	35	2.1	14	5.5		None	-	-	-	72.8	78.3	90	100
									E18	18	2	43.3	126.9	132.4	150	150
									E24	24	2	57.7	144.9	150.4	150	175
									E36	34	2	81.8	175.1	180.6	200	200
									E54	54	2	129.9	175.1	180.6	200	200
	460	10.6	75	17	1.26	6.6	2.2		None	-	-	-	35.5	37.7	45	45
									E18	18	2	21.7	62.6	64.8	70	70
									E24	24	2	28.9	71.6	73.8	80	80
									E36	34	2	40.9	86.6	88.8	90	90
									E54	54	2	65	86.6	88.8	90	90
	575	7.7	54	12	0.66	5.2	1.8		None	-	-	-	25.1	26.9	30	30
									E18	18	2	17.3	46.7	48.5	50	50
									E24	24	2	23.1	54	55.8	60	60
									E36	34	2	32.7	66	67.8	70	70
									E54	54	2	52	66	67.8	70	70

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

Table 11: XP078-150 physical data

Component	Models				
	XP078	XP090	XP102	XP120	XP150
Nominal tonnage	6.5	7.5	8.5	10	12.5
AHRI cooling performance					
Gross capacity @ AHRI A point (Mbh)	80000	92550	105600	122000	153000
AHRI net capacity (Mbh)	78000	90000	100000	114000	145000
EER	12.0	11.4	11.2	11.0	10.6
IEER with Constant Volume	12.2	12.2	12.4	11.6 ¹	10.8 ¹
IEER with Intellispeed	13.2	12.6	13.5	13.5	13.5
Nominal CFM	2600	3000	3750	3750	4700
System power (KW)	6.78	8.18	9.27	10.45	13.59
Refrigerant type	R-410A	R-410A	R-410A	R-410A	R-410A
Refrigerant charge (lb-oz)					
System 1	14-2	13-0	13-12	12-14	17-2
System 2	12-10	13-2	13-13	12-12	15-8
AHRI heating performance					
47°F capacity rating (Mbh)	75.0	88.0	94.0	106.0	135.0
System power (KW) / COP	6.2 / 3.40	7.7 / 3.40	7.9 / 3.40	8.6 / 3.40	13.2 / 3.2
17°F capacity rating (Mbh)	43.0	51.0	53.0	59.0	90.0
System power (KW) / COP	5.7 / 2.25	6.4 / 2.25	6.9 / 2.25	7.8 / 2.25	12.1 / 2.05
Dimensions (inches)					
Length	89	89	89	89	119-7/16
Width	59	59	59	59	59
Height	50-3/4	50-3/4	50-3/4	50-3/4	50-3/4
Operating weight (lbs.)	1080	1090	1137	1135	1403
Compressors²					
Type	Scroll	Scroll	Scroll	Scroll	Scroll
Quantity	2	2	2	2	2
Unit capacity steps (%)	50 / 100	50 / 100	50 / 100	50 / 100	50/100
Condenser coil data					
Face area (sq. ft)	29.0	29.0	29.0	29.0	47.5
Rows	2	2	2	2	2
Fins per inch	16	16	16	16	15
Tube diameter (in.)	3/8	3/8	3/8	3/8	3/8
Circuitry type	Split-face	Split-face	Split-face	Split-face	Split-face
Refrigerant control	TXV	TXV	TXV	TXV	TXV
Evaporator coil data					
Face area (sq. ft)	13.2	13.2	13.2	13.2	13.2
Rows	4	4	4	4	4
Fins per inch	15	15	15	15	15
Tube diameter	3/8	3/8	3/8	3/8	3/8
Circuitry type	Split-face	Split-face	Split-face	Split-face	Split-face
Refrigerant control	TXV	TXV	TXV	TXV	TXV

Table 11: XP078-150 physical data (continued)

Component	Models									
	XP078		XP090		XP102		XP120		XP150	
Nominal tonnage	6.5		7.5		8.5		10		12.5	
Condenser fan data										
Quantity of fans	2		2		2		2		4	
Fan diameter (inches)	24		24		24		24		24	
Type	Prop		Prop		Prop		Prop		Prop	
Drive type	Direct		Direct		Direct		Direct		Direct	
Quantity of motors	2		2		2		2		4	
Motor HP each	1/3		1/3		1/3		1/3		1/3	
No. of speeds	1		1		1		1		1	
RPM	850		850		850		850		850	
Nominal total CFM	6800		6800		6800		6800		14000	
Belt drive evap. fan data										
Quantity	1		1		1		1		1	
Fan size (inches)	15 x 15		15 x 15		15 x 15		15 x 15		15 x 15	
Type	Centrifugal		Centrifugal		Centrifugal		Centrifugal		Centrifugal	
Motor sheave	VL40	VL44	1VL40	1VM50	1VP50	1VP50	1VM50	1VM50	1VM50	1VP56
Blower sheave	AK84	AK71	AK69	AK69	AK89	AK74	AK84	AK74	AK74	BK77
Belt	A54	A52	A52	A54	A56	A54	A56	A54	A54	BX56
Motor HP each	1-1/2	2	1-1/2	3	2	3	2	3	3	5
RPM	1725	1725	1725	1725	1725	1725	1725	1725	1725	1725
Frame size	56	56	56	56	56	56	56	56	56	184T
Filters										
Quantity - size	4 - (24 x 20 x 2) ^{3,4}		4 - (24 x 20 x 2) ^{3,4}		4 - (24 x 20 x 2) ^{3,4}		4 - (24 x 20 x 2) ^{3,4}		4 - (24 x 20 x 2) ^{3,4}	
	4 - (24 x 20 x 2) ⁵		4 - (24 x 20 x 4) ⁵		4 - (24 x 20 x 4) ⁵		4 - (24 x 20 x 2) ⁵		4 - (24 x 20 x 4) ⁵	

1. Does not meet DOE 2018 minimum efficiency requirements.
2. XP078, XP090, XP102, XP120, XP150 have crankcase heaters standard
3. 2 in. throwaway, standard, MERV (Minimum Efficiency Reporting Value) 3.
4. 2 in. pleated, optional, MERV 8.
5. 4 in. pleated, optional, MERV 13.

Optional electric heat

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 into the supply air chamber.

Fuses are supplied, where required, by the factory. Some kW sizes require fuses and others do not. See Table 12 for minimum CFM limitations. See Table 10 for electrical data.

Table 12: Electric heat minimum supply air

Size (tons)	Model	Voltage	Minimum supply air (CFM)				
			Heater kW				
			9	18	24	36	54
078 (6.5)	XP	208/230-3-60	1950	1950	1950	1950	-
		460-3-60	1950	1950	1950	1950	-
		600-3-60	1950	1950	1950	1950	-
090 (7.5)	XP	208/230-3-60	2250	2250	2250	2250	-
		460-3-60	2250	2250	2250	2250	-
		600-3-60	2250	2250	2250	2250	-
102 (8.5)	XP	208/230-3-60	2550	2550	2550	2550	-
		460-3-60	2550	2550	2550	2550	-
		600-3-60	2550	2550	2550	2550	-
120 (10)	XP	208/230-3-60	-	3000	3000	3000	3500
		460-3-60	-	3000	3000	3000	3000
		600-3-60	-	3000	3000	3000	3500
150 (12.5)	XP	208/230-3-60	-	3750	3750	3750	4000
		460-3-60	-	3750	3750	3750	3750
		600-3-60	-	3750	3750	3750	3750

Options and accessories

Electric heat

Electric heaters are available as factory-installed options or field-installed accessories. Refer to electric heat instructions for installation. These heaters mount in the heat compartment with the heating elements extending into the supply air chamber. All electric heaters are fused and intended for use with single point power supply.

Motorized outdoor damper

The motorized outdoor damper can be a factory-installed option or a field-installed accessory. If factory installed, refer to the instructions included with the outdoor air hood to complete the assembly. Field-installed motorized outdoor damper accessories include complete instructions for installation.

Economizer

The economizer can be a factory-installed option or a field-installed accessory. If factory installed, refer to the instructions included with the economizer to complete the assembly. Field-installed economizer accessories include complete instructions for installation.

There are two economizer options:

1. Down flow, end return horizontal applications that include a fresh air hood and exhaust hood with barometric relief.
2. Horizontal flow application (field-installed kit only) that requires the purchase of a barometric relief hood.

Note: For the down flow, end return horizontal application, you must keep the two side panels for the economizer hood tops (See Figure 21).

Power exhaust

The power exhaust can be a factory installed-option or a field-installed accessory. If factory installed, refer to the instructions included with the power exhaust to complete the assembly. Field-installed power exhaust accessories include complete instructions for installation.

The power exhaust factory-installed option is for down flow application only.

There are two field-installed power exhaust accessories:

1. Down flow application.
2. Horizontal flow application that requires the purchase of a barometric relief hood.

Rain hood

For factory-installed options, all of the hood components, including the filters, the gasketing, and the hardware for assembling, are packaged and located between the condenser coil section and the main unit cabinet. For field-installed accessories, all parts necessary for the installation come in the accessory kit.

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. On a constant volume single speed supply fan system both setpoints should be set to the same value.

Free cooling

Four types of free cooling options are available: dry bulb changeover, single enthalpy, dual enthalpy changeover, and Auto.

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.

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:

- 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 will always be 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) will be turned on. Second stage compressor (C2) will be 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%.

Once 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 will a compressor output be 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 will modulate to minimum position and the compressor outputs will be 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
- Econo damper position for exh fan ON Percent
- Econo damper position for exh fan OFF Percent

Inputs

No inputs are present for non-modulating power exhaust.

Outputs

- 2-10 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:

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

Smart Equipment™ economizer board

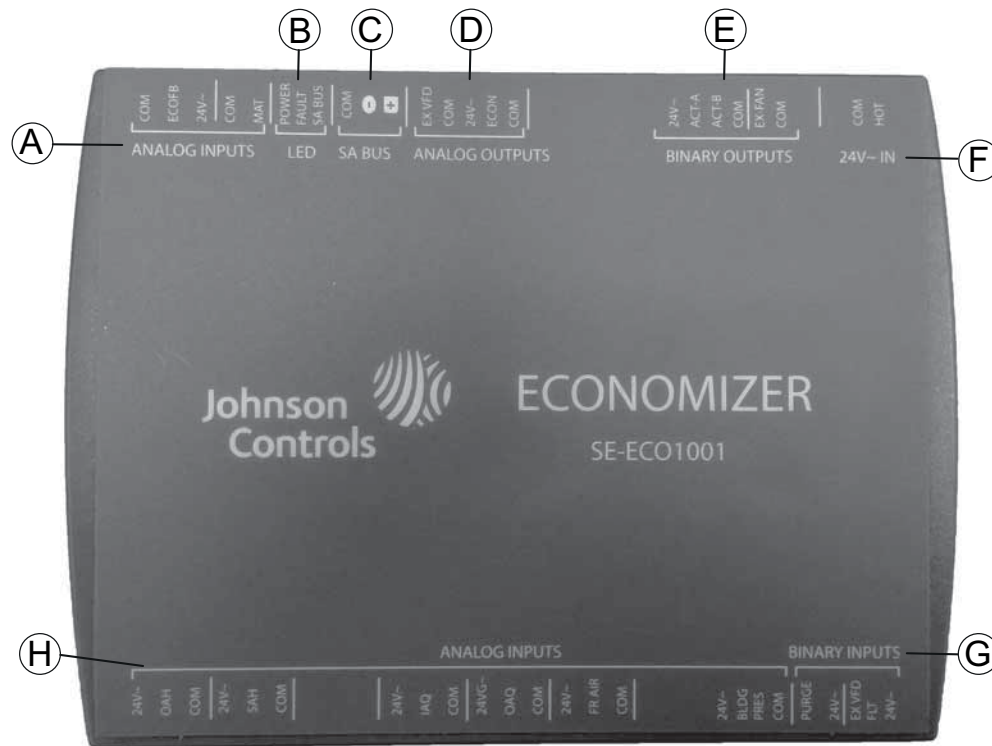


Figure 25: SE-ECO1001-0 economizer controller

The following tables describe the details of the economizer board. See Figure 25 for connection locations.

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		
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.

Smart Equipment™ economizer board - analog inputs (continued)

Location	Board label	Cover label	Description	Function and comments
H	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 (0-5000CFM/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

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, etc.) 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

Smart Equipment™ economizer board - SA bus details

Location	Board label	Cover label	Description	Function and comments
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 & 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 to 3.5 volts reading to C; at least 0.25 volts 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 & 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 to 3.5 volts reading to C; at least 0.25 volts 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 & diagnostics board

1. When wiring the unit and other devices using the SA Bus and FC Bus, see Table 32.

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

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

Smart Equipment™ economizer board - 24V~ 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.

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%.
		24V~	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	ExFanVFDFit parameter reports input status (Normal with 0 VAC input-Alarm with 24 VAC input) when ExFType selection is Variable Frequency Fan. When ExFanVFDFit status is Alarm, EX-FAN fan output is prevented.
		24V~	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 to +10 VDC signal with respect to the IAQ terminal. When the signal is below its setpoint, the actuator is allowed to 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 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 max. 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 CO² space sensor kit - part no. 2AQ04700524
- Optional CO² sensor kit - part no. 2AQ04700624

Phasing

XP078-150 units are properly phased at the factory. Check for proper 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 proper 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 proper supply air blower rotation. If the blower is rotating backwards, the line voltage at the unit point of power connection is misphased. See *Phasing* on page 37.

Table 13: Supply air limitations

Unit size (ton)	Minimum	Maximum
078 (6.5)	1950	3250
090 (7.5)	2250	3750
102 (8.5)	2550	4250
120 (10)	3000	5000
150 (12.5)	3750	6250

Adjusting the belt tension

To adjust the belt tension complete the following steps.

1. Loosen the six belt nuts at the top and bottom. See Figure 26

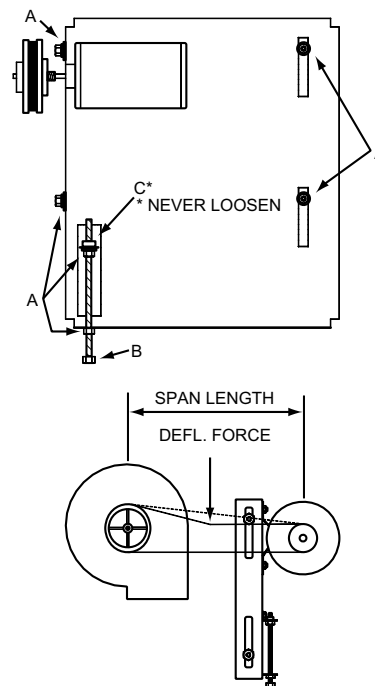
Note: Never loosen the static nut at the top of the adjustment bolt.

2. Turn the adjustment bolt.
3. Use a belt tension checker to apply a perpendicular force to one belt at the midpoint of the span shown in Figure 26. A deflection distance of 4 mm (5/32 in.) is obtained.
4. To determine the deflection distance from normal position, use a straight edge from sheave to sheave as a reference line.

The recommended deflection force is as follows:

Tension new belts at the max. deflection force recommended for the belt section.

5. Re-tighten the belt nuts.



Item	Component
A	Belt nuts
B	Adjustment bolt
C	Static nut

Figure 26: Belt adjustment

CAUTION

Check the belt tension at least two times during the first 24 hours of operation. Any retensioning must fall between the min. and max. deflection force values.

CFM static pressure and power-altitude and temperature corrections

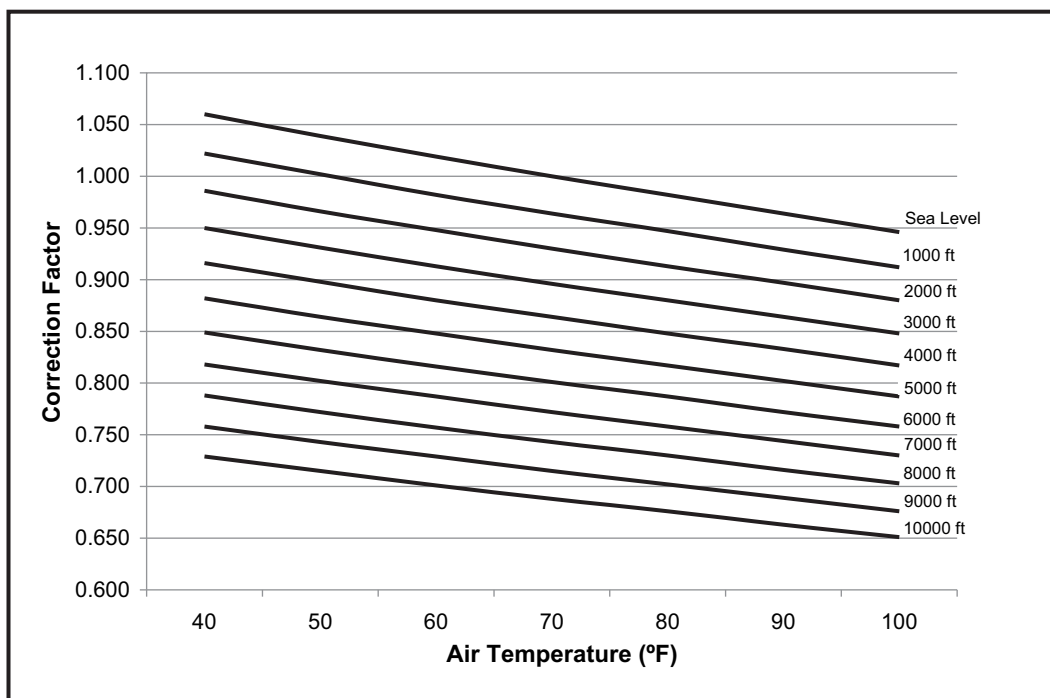
Use the information below to assist in the application of the product at altitudes at or exceeding 1000 feet above sea level.

The air flow rates listed in the standard blower performance tables are based on standard air at sea level. As the altitude or temperature increases, the density of air decreases. In order to use the indoor blower tables for high altitude applications, certain corrections are necessary.

A centrifugal fan is a constant volume device. This means that, if the RPM remains constant, the CFM delivered is the same regardless of the density of the air. However, since the air at high altitude is less dense, less static pressure is generated and less power is required than a similar application at sea level. Air density correction factors are shown in Table 14 and Figure 27.

Table 14: Altitude/temperature correction factors

Air temp.	Altitude (ft.)										
	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
40	1.060	1.022	0.986	0.950	0.916	0.882	0.849	0.818	0.788	0.758	0.729
50	1.039	1.002	0.966	0.931	0.898	0.864	0.832	0.802	0.772	0.743	0.715
60	1.019	0.982	0.948	0.913	0.880	0.848	0.816	0.787	0.757	0.729	0.701
70	1.000	0.964	0.930	0.896	0.864	0.832	0.801	0.772	0.743	0.715	0.688
80	0.982	0.947	0.913	0.880	0.848	0.817	0.787	0.758	0.730	0.702	0.676
90	0.964	0.929	0.897	0.864	0.833	0.802	0.772	0.744	0.716	0.689	0.663
100	0.946	0.912	0.880	0.848	0.817	0.787	0.758	0.730	0.703	0.676	0.651

**Figure 27: Altitude/temperature correction factors**

Use the examples below to assist in determining the airflow performance of the product at altitude.

Example 1: What are the corrected CFM, static pressure, and BHP at an elevation of 5,000 ft. if the blower performance data is 6,000 CFM, 1.5 IWC and 4.0 BHP?

Solution: At an elevation of 5,000 ft. the indoor blower will still deliver 6,000 CFM if the RPM is unchanged. However, Table 14 must be used to determine the static pressure and BHP. Since no temperature data is given, we will assume an air temperature of 70°F. Table 15 shows the correction factor to be 0.832.

$$\text{Corrected static pressure} = 1.5 \times 0.832 = 1.248 \text{ IWC}$$

$$\text{Corrected BHP} = 4.0 \times 0.832 = 3.328$$

Example 2: A system, located at 5,000 feet of elevation, is to deliver 6,000 CFM at a static pressure of 1.5 in. Use the unit

blower tables to select the blower speed and the BHP requirement.

Solution: As in the example above, no temperature information is given so 70°F is assumed.

The 1.5 in. static pressure given is at an elevation of 5,000 ft. The first step is to convert this static pressure to equivalent sea level conditions.

$$\text{Sea level static pressure} = 1.5 / .832 = 1.80"$$

Enter the blower table at 6000 sCFM and static pressure of 1.8 in. The RPM listed will be the same RPM needed at 5,000 ft.

Suppose that the corresponding BHP listed in the table is 3.2. This value must be corrected for elevation.

$$\text{BHP at 5,000 ft.} = 3.2 \times .832 = 2.66$$

Drive selection

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

Example

1. 2600 CFM
2. 1.6 iwg
3. Using the supply air blower performance table below, the following data point was located: 1268 RPM & 1.95 BHP.
4. Using the RPM selection table below, Size X and Model Y is found.
5. 1.95 BHP exceeds the maximum continuous BHP rating of the 1.5 HP motor. The 2 HP motor is required.
6. 1268 RPM is within the range of the 2 HP drives.
7. Using the 2 HP motor and drive, .5 turns open will achieve 1268 RPM.

Example supply air blower performance

Air flow (CFM)	Available external static pressure - IWG															
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	1.5 HP and field supplied drive						Standard 1.5 HP and drive						Alternate 2 HP and drive			
2200	804	0.50	866	0.71	925	0.90	982	1.06	1038	1.21	1092	1.35	1147	1.48	1203	1.61
2400	835	0.66	897	0.87	956	1.06	1013	1.22	1069	1.37	1124	1.51	1178	1.64	1234	1.77
2600	869	0.84	931	1.05	990	1.24	1047	1.40	1103	1.55	1158	1.69	1212	1.82	1268	1.95
2800	906	1.03	968	1.25	1027	1.43	1084	1.60	1139	1.75	1194	1.89	1249	2.02	1304	2.14
															1361	2.27
															-	-

Table X: RPM selection

Size (tons)	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
X	Y	1.5	1.73	1VM50	AK74	N/A	897	945	991	1035	1079	1126
		2	2.30	1VM50	AK64	N/A	1039	1094	1150	1207	1256	1308

Airflow performance

Table 15: Airflow performance - side duct application
XP078 (6.5 ton) side duct

Air flow (CFM)	Available external static pressure - IWG ¹																							
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0					
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP				
	FS ⁴				Standard 1.5 HP and drive						High static 2 HP and drive													
1800	441	0.44	552	0.54	639	0.63	719	0.72	785	0.81	859	0.99	920	1.16	966	1.25	1018	1.35	1066	1.43				
2000	470	0.48	571	0.59	654	0.69	730	0.79	795	0.89	870	1.09	932	1.25	978	1.35	1030	1.44	1078	1.53				
2200	500	0.54	591	0.66	669	0.76	743	0.87	806	0.97	882	1.18	944	1.35	990	1.44	1042	1.54	1090	1.62				
2400	529	0.60	612	0.73	686	0.85	756	0.96	819	1.07	894	1.29	956	1.45	1002	1.55	1054	1.64	1102	1.73				
2600	558	0.68	635	0.82	705	0.94	771	1.05	832	1.17	906	1.40	968	1.56	1014	1.66	1066	1.75	1114	1.84				
2800	587	0.78	658	0.92	725	1.04	788	1.16	847	1.29	918	1.51	980	1.68	1026	1.77	1078	1.87	1126	1.95				
3000	616	0.88	683	1.02	746	1.15	806	1.28	863	1.41	931	1.63	992	1.80	1038	1.89	1090	1.99	1138	2.07				
3200	645	1.00	710	1.14	768	1.27	825	1.41	879	1.55	943	1.76	1005	1.92	1051	2.02	1103	2.12	1151	2.20				
3400	674	1.14	737	1.27	792	1.40	846	1.55	897	1.70	956	1.89	1018	2.06	1064	2.15	1116	2.25	-	-				
	FS ⁴																							

1. Blower performance includes gas heat exchangers and 2" filters. See the static resistance table for additional applications.
2. See the RPM selection table to determine the required motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x .932.
4. Field supplied drive.

XP090 (7.5 ton) side duct

Air flow (CFM)	Available external static pressure - IWG ¹																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	FS ⁴				Standard 1.5 HP and drive								High static 3 HP and drive							
2000	-	-	656	0.24	711	0.48	768	0.73	826	0.96	886	1.19	945	1.41	1003	1.61	1058	1.79	1110	1.95
2200	619	0.07	670	0.32	724	0.57	781	0.81	840	1.04	899	1.27	959	1.49	1016	1.69	1072	1.87	1124	2.04
2400	631	0.16	682	0.41	736	0.66	793	0.90	852	1.14	911	1.36	970	1.58	1028	1.78	1084	1.97	1136	2.13
2600	642	0.27	692	0.52	747	0.76	804	1.01	862	1.24	922	1.47	981	1.69	1039	1.89	1094	2.07	1146	2.24
2800	652	0.39	703	0.64	757	0.88	814	1.13	873	1.36	932	1.59	992	1.81	1049	2.01	1105	2.19	1157	2.36
3000	663	0.53	714	0.77	768	1.02	825	1.26	884	1.50	943	1.73	1003	1.94	1060	2.14	1116	2.33	1168	2.49
3200	675	0.68	726	0.92	780	1.17	837	1.41	896	1.65	955	1.88	1014	2.09	1072	2.29	1128	2.48	1180	2.64
3400	688	0.84	739	1.09	793	1.34	850	1.58	909	1.82	968	2.04	1027	2.26	1085	2.46	1141	2.65	1193	2.81
3600	703	1.03	753	1.28	807	1.52	864	1.76	923	2.00	983	2.23	1042	2.44	1100	2.64	1155	2.83	-	-
3800	718	1.23	769	1.47	823	1.72	880	1.96	939	2.20	998	2.43	1058	2.64	1115	2.84	1171	3.03	-	-

1. Blower performance includes gas heat exchangers and 2 in. filters. See the static resistance table for additional applications.
2. See the RPM selection table to determine the required motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.
4. Field supplied drive.

XP102 (8.5 ton) side duct

Air flow (CFM)	Available external static pressure - IWG ¹																			
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	2 HP and field supplied drive				Standard 2 HP and drive								High static 3 HP and drive							
2200	632	0.23	684	0.44	734	0.65	783	0.84	830	1.03	876	1.21	921	1.39	966	1.56	1009	1.74	1051	1.91
2400	639	0.32	691	0.53	741	0.74	790	0.93	837	1.12	883	1.30	928	1.48	972	1.65	1015	1.83	1058	2.00
2600	646	0.41	698	0.62	748	0.82	797	1.02	844	1.21	890	1.39	936	1.57	980	1.74	1023	1.92	1065	2.09
2800	654	0.50	706	0.71	756	0.92	805	1.11	852	1.30	898	1.48	943	1.66	987	1.83	1031	2.01	1073	2.18
3000	663	0.60	714	0.81	765	1.02	813	1.21	861	1.40	907	1.58	952	1.76	996	1.93	1039	2.11	1082	2.28
3200	673	0.71	724	0.93	774	1.13	823	1.32	871	1.51	917	1.69	962	1.87	1006	2.05	1049	2.22	1091	2.39
3400	684	0.84	735	1.05	785	1.25	834	1.45	882	1.63	928	1.82	973	2.00	1017	2.17	1060	2.34	1102	2.52
3600	696	0.98	747	1.19	798	1.39	846	1.59	894	1.78	940	1.96	985	2.14	1029	2.31	1072	2.48	1115	2.66
3800	709	1.14	761	1.35	811	1.55	860	1.75	907	1.93	953	2.12	999	2.29	1043	2.47	1086	2.64	1128	2.81
4000	724	1.31	776	1.52	826	1.72	874	1.92	922	2.11	968	2.29	1013	2.47	1057	2.64	1100	2.82	1143	2.99
4200	740	1.50	792	1.71	842	1.92	890	2.11	938	2.30	984	2.48	1029	2.66	1073	2.83	1116	3.01	1159	3.18
	3 HP and field supplied drive																			

1. Blower performance includes 2 in. filters. See the static resistance table for additional applications.
2. See the RPM selection table to determine the required motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

XP120 (10 ton) side duct

Air flow (CFM)	Available external static pressure - IWG ¹													
	0.2		0.4		0.6		0.8		1.0		1.2		1.4	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	2 HP and field supplied drive				Standard 2 HP and drive				High static 3 HP and drive					
2600	646	0.41	698	0.62	748	0.82	797	1.02	844	1.21	890	1.39	936	1.57
2800	654	0.50	706	0.71	756	0.92	805	1.11	852	1.30	898	1.48	943	1.66
3000	663	0.60	714	0.81	765	1.02	813	1.21	861	1.40	907	1.58	952	1.76
3200	673	0.71	724	0.93	774	1.13	823	1.32	871	1.51	917	1.69	962	1.87
3400	684	0.84	735	1.05	785	1.25	834	1.45	882	1.63	928	1.82	973	2.00
3600	696	0.98	747	1.19	798	1.39	846	1.59	894	1.78	940	1.96	985	2.14
3800	709	1.14	761	1.35	811	1.55	860	1.75	907	1.93	953	2.12	999	2.29
4000	724	1.31	776	1.52	826	1.72	874	1.92	922	2.11	968	2.29	1013	2.47
4200	740	1.50	792	1.71	842	1.92	890	2.11	938	2.30	984	2.48	1029	2.66
4400	757	1.71	809	1.92	859	2.13	908	2.32	955	2.51	1001	2.69	1046	2.87
4600	776	1.94	827	2.15	877	2.35	926	2.55	974	2.74	1020	2.92	1065	3.10
4800	795	2.19	847	2.40	897	2.60	946	2.79	993	2.98	1040	3.16	1085	3.34
5000	816	2.45	868	2.66	918	2.86	967	3.06	1014	3.25	1061	3.43	-	-
													3 HP and field supplied drive	

1. Blower performance includes 2 in. filters. See the static resistance table for additional applications.
2. See the RPM selection table to determine the required motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

XP150 (12.5 ton) side duct

Air flow (CFM)	Available external static pressure - IWG ¹													
	0.2		0.4		0.6		0.8		1.0		1.2		1.4	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	3 HP and field supplied drive				Standard 3 HP and drive				High static 5 HP and drive					
3200	673	0.71	724	0.93	774	1.13	823	1.32	871	1.51	917	1.69	962	1.87
3400	684	0.84	735	1.05	785	1.25	834	1.45	882	1.63	928	1.82	973	2.00
3600	696	0.98	747	1.19	798	1.39	846	1.59	894	1.78	940	1.96	985	2.14
3800	709	1.14	761	1.35	811	1.55	860	1.75	907	1.93	953	2.12	999	2.29
4000	724	1.31	776	1.52	826	1.72	874	1.92	922	2.11	968	2.29	1013	2.47
4200	740	1.50	792	1.71	842	1.92	890	2.11	938	2.30	984	2.48	1029	2.66
4400	757	1.71	809	1.92	859	2.13	908	2.32	955	2.51	1001	2.69	1046	2.87
4600	776	1.94	827	2.15	877	2.35	926	2.55	974	2.74	1020	2.92	1065	3.10
4800	795	2.19	847	2.40	897	2.60	946	2.79	993	2.98	1040	3.16	1085	3.34
5000	816	2.45	868	2.66	918	2.86	967	3.06	1014	3.25	1061	3.43	1106	3.61
5200	839	2.73	890	2.94	940	3.14	989	3.34	1037	3.53	1083	3.71	1128	3.89
5400	862	3.03	914	3.24	964	3.44	1012	3.64	1060	3.82	1106	4.01	1151	4.18
5600	886	3.34	938	3.55	988	3.76	1037	3.95	1084	4.14	1131	4.32	1176	4.50
5800	912	3.67	964	3.89	1014	4.09	1063	4.28	1110	4.47	1156	4.65	1201	4.83
6000	939	4.02	990	4.23	1041	4.44	1089	4.63	1137	4.82	1183	5.00	1228	5.18
6200	967	4.39	1018	4.60	1068	4.80	1117	4.99	1165	5.18	1211	5.36	1256	5.54
													5 HP and field supplied drive	

1. Blower performance includes 2 in. filters. See the static resistance table for additional applications.
2. See the RPM selection table to determine the required motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

Table 16: Airflow performance - bottom duct application**XP078 (6.5 ton) bottom duct**

Air flow (CFM)	Available external static pressure - IWG ¹																					
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0			
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP		
	FS ⁴				Standard 1.5 HP and drive				High static 2 HP and drive													
1800	445	0.63	559	0.66	648	0.69	730	0.72	799	0.75	875	0.89	937	0.99	984	1.05	1038	1.08	1086	1.11		
2000	486	0.71	589	0.76	674	0.79	753	0.83	820	0.87	898	1.02	960	1.13	1007	1.18	1061	1.21	1109	1.25		
2200	530	0.84	624	0.90	705	0.94	781	0.99	846	1.03	924	1.19	988	1.31	1034	1.35	1088	1.39	1137	1.42		
2400	567	0.91	653	0.98	729	1.04	801	1.09	867	1.14	944	1.31	1007	1.41	1055	1.47	1108	1.50	1156	1.54		
2600	605	1.02	685	1.10	758	1.16	826	1.21	889	1.27	965	1.45	1028	1.55	1075	1.60	1128	1.63	1178	1.67		
2800	645	1.16	719	1.24	788	1.29	854	1.36	915	1.43	988	1.60	1051	1.71	1099	1.75	1151	1.80	1201	1.83		
3000	686	1.31	757	1.39	822	1.46	885	1.53	943	1.60	1013	1.77	1076	1.88	1123	1.93	1176	1.97	1225	2.00		
3200	729	1.49	797	1.57	858	1.64	917	1.73	972	1.81	1038	1.96	1102	2.07	1149	2.11	1203	2.16	1252	2.19		
3400	772	1.70	839	1.77	897	1.84	953	1.93	1005	2.03	1066	2.16	1130	2.27	1177	2.31	1230	2.36	FS ⁴			

1. Blower performance includes gas heat exchangers and 2" filters. See the static resistance table for additional applications.
2. See the RPM selection table to determine the required motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x .932.
4. Field supplied drive.

XP090 (7.5 ton) bottom duct

Air flow (CFM)	Available external static pressure - IWG ¹																					
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0			
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP		
	FS ⁴		Standard 1.5 HP and drive																High static 3 HP and drive			
2000	644	0.11	698	0.38	755	0.62	814	0.85	874	1.06	933	1.26	990	1.46	1043	1.66	1090	1.87	1131	2.09		
2200	666	0.26	720	0.53	777	0.77	836	1.00	896	1.21	956	1.41	1012	1.61	1065	1.81	1113	2.02	1153	2.24		
2400	689	0.42	743	0.69	800	0.93	859	1.16	919	1.37	978	1.57	1035	1.77	1088	1.97	1135	2.18	1176	2.40		
2600	712	0.60	766	0.87	823	1.11	882	1.34	942	1.55	1002	1.75	1058	1.95	1111	2.15	1159	2.36	1199	2.58		
2800	736	0.80	790	1.06	847	1.31	906	1.53	967	1.74	1026	1.94	1082	2.14	1135	2.34	1183	2.55	1223	2.78		
3000	761	1.00	815	1.27	872	1.52	931	1.74	991	1.95	1051	2.15	1107	2.35	1160	2.55	1208	2.76	1248	2.98		
3200	787	1.22	840	1.49	898	1.74	957	1.96	1017	2.17	1076	2.37	1133	2.57	1186	2.77	1233	2.98	1274	3.20		
3400	813	1.46	867	1.73	924	1.97	984	2.19	1044	2.40	1103	2.61	1160	2.80	1212	3.01	1260	3.21	-	-		
3600	841	1.70	894	1.97	952	2.21	1011	2.44	1071	2.65	1130	2.85	1187	3.05	-	-	-	-	-	-		
3800	869	1.96	923	2.22	980	2.47	1039	2.69	1099	2.90	1158	3.10	1215	3.30	-	-	-	-	-	-		
	3 HP and field supplied drive																					

1. Blower performance includes gas heat exchangers and 2 in. filters. See the static resistance table for additional applications.
2. See the RPM selection table to determine the required motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.
4. Field supplied drive.

XP102 (8.5 ton) bottom duct

Air flow (CFM)	Available external static pressure - IWG ¹																					
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0			
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP		
	2 HP and field supplied drive				Standard 2 HP and drive								High static 3 HP and drive									
2200	662	0.53	717	0.68	770	0.83	821	0.96	870	1.09	918	1.22	965	1.35	1010	1.47	1055	1.59	1098	1.71		
2400	677	0.63	732	0.78	784	0.93	835	1.06	885	1.19	933	1.32	979	1.44	1025	1.57	1069	1.69	1112	1.81		
2600	693	0.75	748	0.90	801	1.04	852	1.18	901	1.31	949	1.44	996	1.56	1041	1.68	1085	1.80	1129	1.92		
2800	712	0.88	767	1.03	819	1.17	871	1.31	920	1.44	968	1.57	1014	1.69	1060	1.81	1104	1.94	1148	2.06		
3000	733	1.03	788	1.18	841	1.33	892	1.46	941	1.59	989	1.72	1036	1.84	1081	1.97	1125	2.09	1169	2.21		
3200	757	1.20	811	1.36	864	1.50	915	1.64	964	1.77	1012	1.89	1059	2.02	1104	2.14	1149	2.26	1192	2.38		
3400	782	1.40	837	1.55	890	1.69	941	1.83	990	1.96	1038	2.09	1085	2.21	1130	2.33	1174	2.45	1218	2.58		
3600	810	1.61	865	1.76	918	1.91	969	2.04	1018	2.18	1066	2.30	1113	2.43	1158	2.55	1203	2.67	1246	2.79		
3800	841	1.85	896	2.00	948	2.14	999	2.28	1049	2.41	1097	2.54	1143	2.66	1189	2.78	1233	2.91	1276	3.03		
4000	874	2.11	928	2.26	981	2.40	1032	2.54	1082	2.67	1130	2.80	1176	2.92	1222	3.04	1266	3.16	1309	3.28		
4200	909	2.38	963	2.53	1016	2.68	1067	2.81	1117	2.95	1164	3.07	1211	3.20	1256	3.32	1301	3.44	-	-		
	3 HP and field supplied drive																					

1. Blower performance includes 2 in. filters. See the static resistance table for additional applications.
2. See the RPM selection table to determine the required motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

XP120 (10 ton) bottom duct

Air flow (CFM)	Available external static pressure - IWG ¹											
	0.2		0.4		0.6		0.8		1.0		1.2	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	2 HP and field supplied drive				Standard 2 HP and drive				High static 3 HP and drive			
2600	693	0.75	748	0.90	801	1.04	852	1.18	901	1.31	949	1.44
2800	712	0.88	767	1.03	819	1.17	871	1.31	920	1.44	968	1.57
3000	733	1.03	788	1.18	841	1.33	892	1.46	941	1.59	989	1.72
3200	757	1.20	811	1.36	864	1.50	915	1.64	964	1.77	1012	1.89
3400	782	1.40	837	1.55	890	1.69	941	1.83	990	1.96	1038	2.09
3600	810	1.61	865	1.76	918	1.91	969	2.04	1018	2.18	1066	2.30
3800	841	1.85	896	2.00	948	2.14	999	2.28	1049	2.41	1097	2.54
4000	874	2.11	928	2.26	981	2.40	1032	2.54	1082	2.67	1130	2.80
4200	909	2.38	963	2.53	1016	2.68	1067	2.81	1117	2.95	1164	3.07
4400	946	2.68	1000	2.83	1053	2.98	1104	3.11	1154	3.24	1202	3.37
4600	985	3.00	1040	3.15	1092	3.29	1143	3.43	-	-	-	-
4800	1026	3.33	-	-	-	-	-	-	-	-	-	-

3 HP and field supplied drive

1. Blower performance includes 2 in. filters. See the static resistance table for additional applications.
2. See the RPM selection table to determine the required motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

XP150 (12.5 ton) bottom duct

Air flow (CFM)	Available external static pressure - IWG ¹											
	0.2		0.4		0.6		0.8		1.0		1.2	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	3 HP and field supplied drive				Standard 3 HP and drive				High static 5 HP and drive			
3200	757	1.20	811	1.36	864	1.50	915	1.64	964	1.77	1012	1.89
3400	782	1.40	837	1.55	890	1.69	941	1.83	990	1.96	1038	2.09
3600	810	1.61	865	1.76	918	1.91	969	2.04	1018	2.18	1066	2.30
3800	841	1.85	896	2.00	948	2.14	999	2.28	1049	2.41	1097	2.54
4000	874	2.11	928	2.26	981	2.40	1032	2.54	1082	2.67	1130	2.80
4200	909	2.38	963	2.53	1016	2.68	1067	2.81	1117	2.95	1164	3.07
4400	946	2.68	1000	2.83	1053	2.98	1104	3.11	1154	3.24	1202	3.37
4600	985	3.00	1040	3.15	1092	3.29	1143	3.43	1193	3.56	1241	3.69
4800	1026	3.33	1081	3.48	1133	3.63	1184	3.76	1234	3.90	1282	4.02
5000	1069	3.69	1124	3.84	1177	3.98	1228	4.12	1277	4.25	1325	4.38
5200	1114	4.06	1169	4.21	1222	4.35	1273	4.49	1322	4.62	1370	4.75
5400	1161	4.45	1216	4.60	1268	4.74	1319	4.88	1369	5.01	1417	5.14
5600	1210	4.86	1264	5.01	1317	5.15	1368	5.29	1418	5.42	1465	5.55
5800	1260	5.28	1315	5.43	1367	5.57	1418	5.71	-	-	-	-

5 HP and field supplied drive

1. Blower performance includes 2 in. filters. See the static resistance table for additional applications.
2. See the RPM selection table to determine the required motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.932.

Table 17: RPM selection

Size (tons)	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
078 (6.5)	XP	1.5	1.73	VL40	AK84	NA	576	618	661	702	748	792
		2.0	2.30	VL44	AK71	NA	790	843	887	936	989	1041
090 (7.5)	XP	1.5	1.73	1VL40	AK69	N/A	690	743	796	849	902	955
		3	3.45	1VM50	AK69	N/A	955	1008	1062	1115	1168	1221
102 (8.5)	XP	2	2.30	1VP50	AK89	N/A	735	775	815	851	889	930
		3	3.45	1VP50	AK74	N/A	880	928	972	1016	1067	1110
120 (10)	XP	2	2.30	1VM50	AK84	N/A	785	821	858	901	940	980
		3	3.45	1VM50	AK74	N/A	880	928	972	1016	1067	1110
150 (12.5)	XP	3	3.45	1VM50	AK74	N/A	880	928	972	1016	1067	1110
		5	5.75	1VP56	BK77	1052	1095	1136	1175	1216	1272	N/A

Table 18: Indoor blower specifications

Size (tons)	Model	Motor					Motor sheave			Blower sheave			Belt
		HP	RPM	Eff.	SF	Frame	Datum dia. (in.)	Bore (in.)	Model	Datum dia. (in.)	Bore (in.)	Model	
078 (6.5)	XP	1-1/2	1725	0.8	1.15	56	2.4 - 3.4	7/8	VL40	8.1	1	AK84	A54
		2	1725	0.8	1.15	56	2.8 - 3.8	7/8	VL44	6.7	1	AK71	A52
090 (7.5)	XP	1-1/2	1725	0.8	1.15	56	2.6 - 3.6	7/8	1VL40	6.5	1	AK69	A52
		3	1725	0.8	1.15	56	3.6 - 4.6	7/8	1VM50	6.5	1	AK69	A54
102 (8.5)	XP	2	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VP50	8.5	1	AK89	A56
		3	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VP50	7.0	1	AK74	A54
120 (10)	XP	2	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	8.0	1	AK84	A56
		3	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	7.0	1	AK74	A54
150 (12.5)	XP	3	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	7.0	1	AK74	A54
		5	1725	0.87	1.15	184T	4.3 - 5.3	1-1/8	1VP56	6.7	1	BK77	BX56

Table 19: Power exhaust specifications

Model	Voltage	Motor			Unit (per circuit)			Fuse size	CFM @ 0.1 ESP
		HP	RPM ¹	QTY	LRA	FLA	MCA		
2PE04704706	208/230-1-60	3/4	1075	1	24.9	5	6.3	10	4800
2PE04704746	460-1-60	3/4	1075	1	N/A	2.2	2.8	5	4800
2PE04704758	575-1-60	3/4	1050	1	N/A	1.5	1.9	4	4800

1. Motors are multi-tapped and factory wired for high speed.

Air balance

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.

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 10-12 hours of run time.

- Use an inclined manometer or Magnehelic® to determine the pressure drop across a dry evaporator coil. The moisture on an evaporator coil can 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 de-activated while the test is being run.

Note: De-energize the compressors before you take any test measurements to ensure that the evaporator coil is dry.

- Use the pressure drop indicated by the manometer and the graph in Figure 28 to determine the unit CFM. In order to obtain an accurate measurement, verify that the air filters are clean.
- To adjust measured CFM to required CFM, see *Supply air drive adjustment* on page 46.
- After you note the readings, remove the tubes and replace the dot plugs.
- Tighten the blower pulley and motor sheave set screws after any adjustments. Re-check the set screws after 10-12 hours run time.

Checking air quantity

Method one

- Remove the dot plugs from the duct panel. See Figures 12 and 13.
- Insert eight-inches of 1/4 inch metal tubing into the airflow on both sides of the indoor coil.

Note: You must 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.

WARNING

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

Method two

- Drill two 5/16 inch holes, one in the return air duct as close to the inlet of the unit as possible, and another in the supply air duct as close to the outlet of the unit as possible.

2. Using the hole drilled in step 1, insert eight inches of 1/4 inch metal tubing into the airflow of the return and supply air ducts of the unit.

Note: You must 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 or Magnehelic® to determine the pressure drop across the unit. This is the external static pressure (ESP). In order to obtain an accurate measurement, verify that the air filters are clean.
4. Determine the number of turns the variable motor sheave is open.
5. Select the correct blower performance table for the unit from Tables 15 and 16. Tables are presented for side and bottom duct configuration.
6. Determine the unit measured CFM from the blower performance table, external static pressure, and the number of turns the variable motor sheave is open.

7. To adjust measured CFM to required CFM, see *Supply air drive adjustment* on page 46.
8. After you note the reading, remove the tubes and seal the holes.
9. Tighten the blower pulley and motor sheave set screws after any adjustments. Re-check the set screws after 10-12 hours run time.

Note: You must repeat this procedure with the addition of field-installed accessories.

WARNING

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

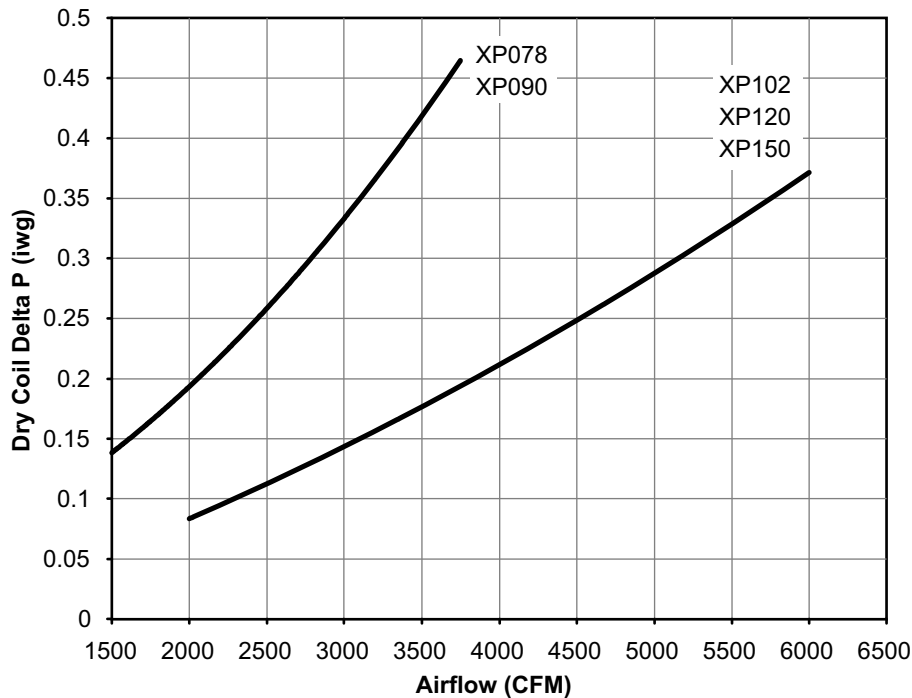


Figure 28: Dry coil delta P

Supply air drive adjustment

CAUTION

Before you make any blower speed changes, review the installation for any installation errors, leaks, or undesirable systems effects that can result in loss of airflow.

Even small changes in blower speed can result in substantial changes in static pressure and BHP. BHP and AMP draw of the blower motor increase by the cube of the blower speed. Static pressure increases by the square of the blower speed. Only qualified personnel can make blower speed changes, strictly adhering to the fan laws.

At unit start-up, the measured CFM may be higher or lower than the required CFM. To achieve the required CFM, you may need to adjust the speed of the drive by changing the datum diameter (DD) of the variable pitch motor sheave as described below:

$$\left(\frac{4,000 \text{ CFM}}{3,800 \text{ CFM}} \right) \cdot 4.0 \text{ in.} = 4.21 \text{ in.}$$

Use the following tables and the DD calculated per the above equation to adjust the motor variable pitch sheave.

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 10-12 hours of run time.

Example

A 12.5 ton unit was selected to deliver 4,000 CFM with a 3 HP motor, but the unit is delivering 3,800 CFM. The variable pitch motor sheave is set at 2 turns open.

Use the equation to determine the required DD for the new motor sheave,

$$\left(\frac{\text{Required CFM}}{\text{Measured CFM}} \right) \cdot \text{Existing DD} = \text{New DD}$$

Use Table 20 to locate the DD nearest to 4.21 in. Close the sheave to 1 turn open.

New BHP

$$= (\text{Speed increase})^3 \cdot \text{BHP at 3,800 CFM}$$

$$= (\text{Speed increase})^3 \cdot \text{Original BHP}$$

$$= \text{New BHP}$$

New motor Amps

$$= (\text{Speed increase})^3 \cdot \text{Amps at 3,800 CFM}$$

$$= (\text{Speed increase})^3 \cdot \text{Original Amps}$$

$$= \text{New Amps}$$

Table 20: Motor sheave datum diameters

1VM50x7/8 (1-1/2, 2, and 3 HP motor)		1VP56x1-1/8 (5 HP motor)	
Turns open	Datum diameter	Turns open	Datum diameter
0	4.4	1	5.3
1/2	4.3	1-1/2	5.2
1	4.2	2	5.1
1-1/2	4.1	2-1/2	5.0
2	4.0	3	4.9
2-1/2	3.9	3-1/2	4.8
3	3.8	4	4.7
3-1/2	3.7	4-1/2	4.6
4	3.6	5	4.5
4-1/2	3.5	5-1/2	4.4
5	3.4	6	4.3

Table 21: Additional static resistance

Size (tons)	Model	CFM	Economizer ^{1 2}	4 in. filter ²	Electric heat kW ¹				
					9	18	24	36	54
078 (6.5) 090 (7.5) 102 (8.5) 120 (10) 150 (12.5)	XP	1900	0.02	0.12	0.05	0.06	0.07	0.08	0.10
		2100	0.02	0.13	0.06	0.07	0.08	0.09	0.11
		2300	0.04	0.14	0.07	0.08	0.09	0.10	0.13
		2500	0.11	0.16	0.08	0.09	0.10	0.11	0.14
		2700	0.18	0.17	0.09	0.10	0.12	0.13	0.16
		2900	0.25	0.19	0.10	0.11	0.13	0.14	0.18
		3100	0.31	0.20	0.12	0.13	0.15	0.16	0.20
		3300	0.37	0.22	0.13	0.14	0.17	0.18	0.22
		3500	0.43	0.26	0.15	0.16	0.19	0.20	0.24
		3700	0.49	0.27	0.17	0.18	0.21	0.22	0.26
		3900	0.54	0.29	0.19	0.20	0.23	0.24	0.28
		4100	0.58	0.32	0.21	0.22	0.25	0.26	0.31
		4300	0.65	0.35	0.23	0.24	0.28	0.29	0.34
		4500	0.69	0.38	0.25	0.26	0.30	0.31	0.37
		4700	0.74	0.41	0.28	0.29	0.33	0.34	0.40
		4900	0.78	0.44	0.30	0.31	0.35	0.37	0.43
		5100	0.82	0.47	0.33	0.34	0.38	0.40	0.46
		5300	0.86	0.51	0.35	0.37	0.41	0.43	0.49
		5500	0.89	0.55	0.38	0.40	0.44	0.46	0.53
		5700	0.93	0.58	0.41	0.43	0.47	0.49	0.56
		5900	0.96	0.62	0.44	0.46	0.50	0.53	0.59
		6100	0.98	0.67	0.47	0.49	0.53	0.56	0.62
		6300	1.01	0.71	0.50	0.53	0.56	0.59	0.65

1. Deduct these values from the available external static pressure shown in the respective blower performance tables.

2. 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 will deliver less CFM during full economizer operation.

Operation

Cooling sequence of operation

Note: For more in-depth sequence of operation of the Smart Equipment™ control, refer to the *Smart Equipment™ Controls Sequence of Operation Overview LIT-12011950* available from your equipment dealer or distributor.

For the XP series of units, the thermostat makes a circuit between R and Y1 for the first stage of cooling. The call is passed to the **Unit Control Board (UCB)**, which then determines whether the requested operation is available and, if so, energizes ID fan contactor M3, compressor #1 contactor M1, condenser fans contactor M4 and reversing valves relay RW1. If the (UCB) receives call for second stage cooling from the thermostat, R and Y2, then the UCB energizes compressor #2 contactor M2 for full cooling operation.

If at any time a call for both heating and cooling are present, the heating operation will be performed. If operating, the cooling system is halted as with a completion of a call for cooling. Heating always takes priority.

Continuous blower

By setting the room thermostat fan switch 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.

No outdoor air options

When the thermostat calls for the first stage of cooling, the low-voltage control circuit from R to Y1 and G is completed. The UCB energizes the economizer (if installed and free cooling is available) or the first available compressor* and the condenser fans. For first stage cooling, compressor #1 is energized. If compressor #1 is unavailable, compressor #2 is energized. After completing the specified fan on delay for cooling, the UCB energizes the blower motor.

When the thermostat calls for the second stage of cooling, the low-voltage control circuit from R to Y2 is completed. The control board energizes the first available compressor. If free cooling is being used for the first stage of cooling, compressor #1 is energized. If compressor #1 is active for first stage cooling or the first compressor is locked-out, compressor #2 is energized. In free-cooling mode, if the call for the second stage

of cooling continues for 20 minutes, compressor #2 is energized, provided it has not been locked-out.

If there is an initial call for both stages of cooling, the UCB delays energizing compressor #2 by 30 seconds in order to avoid a power rush.

When the thermostat is satisfied, it de-energizes Y1 and Y2. If the compressors have satisfied their minimum run times, the compressors and condenser fans are de-energized. Otherwise, the unit operates each cooling system until the minimum run times for the compressors have been completed. Upon the final compressor de-energizing, the blower is stopped following the elapse of the fan off delay for cooling.

* To be available, a compressor must not be locked-out due to a high or low-pressure switch or the **Evaporator Low Limit Sensor (EC1, 2)** detects a temperature below 26°F and the **Anti-Short Cycle Delay (ASCD)** must have elapsed.

Economizer with single enthalpy sensor

When the room thermostat calls for first-stage cooling, the low voltage control circuit from R to G and Y1 is completed. The UCB energizes the blower motor (if the fan switch on the room thermostat is set in the AUTO position) and drives the economizer dampers from fully closed to their minimum position. If the enthalpy of the outdoor air is below the setpoint of the enthalpy controller (previously determined), Y1 energizes the economizer. The dampers modulate to maintain a constant supply air temperature as monitored by the discharge air sensor. If the outdoor air enthalpy is above the setpoint, Y1 energizes compressor #1.

When the thermostat calls for second-stage cooling, the low voltage control circuit from R to Y2 is completed. The UCB energizes the first available compressor. If the enthalpy of the outdoor air is below the setpoint of the enthalpy controller (i.e. first stage has energized the economizer), Y2 energizes compressor #1. If the outdoor air is above the setpoint, Y2 energizes compressor #2.

When the thermostat is satisfied, it de-energizes Y1 and Y2. If the compressors have satisfied their minimum run times, the compressors and condenser fans are de-energized. Otherwise, the unit operates each cooling system until the minimum run times for the compressors are completed. Upon the final compressor de-energizing, the blower is stopped following the elapse of the fan off delay for cooling, and the economizer damper goes to the closed position. If the unit is in continuous fan operation, the economizer damper goes to the minimum position.

Economizer with dual enthalpy sensors

The operation with the dual enthalpy sensors is identical to the single sensor except that a second enthalpy sensor is mounted in the return air. This return air sensor allows the economizer to choose between outdoor air and return air, whichever has the lowest enthalpy value, to provide maximum operating efficiency.

Economizer with power exhaust

A unit equipped with an economizer (single or dual enthalpy) and a power exhaust operates as specified above with one addition. The power exhaust motor is energized 45 seconds after the actuator position exceeds the exhaust fan set point on the economizer control. As always, the R to G connection provides minimum position but does not provide power exhaust operation.

Motorized outdoor air dampers

This system operation is the same as the units with no outdoor air options with one exception. When the R to G circuit is complete, the motorized damper drives open to a position set by the thumbwheel on the damper motor. When the R to G circuit is opened, the damper spring returns fully closed.

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.

1. Local LCD on the unit control board.
- OR
2. Mobile Access Portal (MAP) Gateway (Portable).
 - 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 ASCD (Anti-short cycle delay), 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 de-energized.

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.

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 de-energized.

Evaporator low limit

During cooling operation, if the **Evaporator Low Limit Sensor (EC1, 2)** (Located on the Suction Line at the Evaporator Coil.) detects a temperature below 26°F (default), the UCB de-energizes the associated compressor, initiate the ASCD, and, if the other compressor is idle, stop 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 45°F (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 this 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 26°F will de-energize 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 will resume operation.

Safety controls

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

1. An evaporator low limit sensor (**EC1, 2**) (Located on the Suction Line at the Evaporator Coil.) to protect against low evaporator temperatures due to a low airflow or a low return air temperature, set at 26°F.

2. A high-pressure switch to protect against excessive discharge pressures due to a blocked condenser coil or a condenser motor failure, (opens at 625 ± 25 psig).
3. A low-pressure switch to protect against loss of refrigerant charge, (opens at 22 ± 5 psig).

The above 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/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 units with electric heat.

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 will open 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.

Heating sequence of operation

With electric heat

When the thermostat calls for heating, the low voltage control circuit is completed between R and W1 for heating. The call is passed to the UCB, which then determines whether the requested operation is available and if so, energizes ID fan contactor M3, compressor #1 contactor M1. After a two second delay, it then energizes compressor #2 contactor M2. Therefore, on a call for heat from W1, both sets of compressors are always energized, unless one or the other is locked out by the UCB. Also on the call for heat, the UCB energizes the M4 contactor which brings on the condenser fans.

If the compressors alone cannot satisfy the heating requirements a second stage call from the thermostat completes the circuit between R and W2. The call is passed through the UCB to the electric heat section (if available). For the 9 kW heater 9 kW is energized, for the 18 kW heater 18 kW is energized, for the 24 kW heater 24 kW is energized, for the 36 kW heater 36 kW is energized, and for 54 kW heater 36 kW is energized. In the event that all compressors are locked out by the UCB, the total available kW of electric heat is energized.

In the event of a needed defrost the defrost control signals the UCB, which de-energizes the condenser fans contactor M4 and energizes the reversing valves relay RW1, putting the unit into defrost.

Without electric heat

When the thermostat calls for heating, the low voltage control circuit is completed between R and W1 for heating. The call is passed to the UCB, which then determines whether the requested operation is available and if so, energizes ID fan contactor M3, compressor #1 contactor M1. After a two second delay, it then energizes compressor #2 contactor M2. Therefore, on a call for heat from W1, both sets of compressors are always energized, unless one or the other is locked out by the UCB. Also on the call for heat, the UCB energizes the M4 contactor which brings on the condenser fans.

In the event of a needed defrost, the defrost control signals the UCB, which de-energizes the condenser fans contactor M4 and energize the reversing valves relay RW1, putting the unit into defrost.

Defrost initiation

Defrost control implements a temperature differential, demand defrost algorithm. The heat pump is allowed to operate in the heating mode until the combination of outdoor ambient temperature and outdoor coil temperature indicate that defrosting is necessary. When the coil temperature is maintained below the initiate point for a given ambient temperature, continuously for 4-1/2 minutes, the heat pump is put into a defrost cycle. This 4-1/2 minute timer eliminates unnecessary defrost cycles caused by refrigeration surges such as those that occur at the start of a heating cycle.

For defrost, the UCB signals the energizing of the reversing valve and de-energizing the systems condenser fan motors. The unit's optional electric first-stage heater is also energized via a 24-volt VAC output terminal labeled H2.

Defrost termination

The UCB terminates the defrost mode when either of the following two conditions are met:

1. The outdoor coil temperature sensor reaches 50°F, or
2. The maximum allowable defrost run time of 8 minutes.

Interval between defrosts

A timed inhibit feature prevents the system from responding to a call for defrost less than 40 minutes after the initiation of the previous defrost. After this inhibit time has expired, temperature conditions must call for defrost continuously for 4- 1/2 minutes before another defrost cycle is initiated. A temperature inhibit feature prohibits defrost if the coil temperature is above 40°F. All defrost timing occurs only while the compressor is on.

Forced defrost

A forced-defrost feature puts the system into a defrost cycle every 6 hours and 4 minutes to recirculate lubricants, unless the coil temperature is above 40°F. All defrost timing occurs only while the compressor is on.

For trouble shooting purposes, the defrost cycle can be manually initiated by selecting Test Defrost in the UCB menu.

Electric heat operation errors

Temperature limit

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

This limit is monitored regardless of unit operation status, that is. the limit is monitored at all times.

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

Safety controls

The UCB monitors the temperature limit switch of electric heat units.

The control circuit includes the following safety controls:

Limit Switch (LS)

The limit switch (LS) is located inside the heater compartment and is set to open at the temperature indicated in Table 22, *Electric heat limit setting 50 in. cabinet*, on page 50. 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 energizes the blower.

Table 22: Electric heat limit setting 50 in. cabinet

Unit (tons)	Voltage	Heater kW	Limit switch opens °F
XP078, 090, 102 (6.5, 7.5, 8.5)	208/230	9	150
		18	150
		24	150
		34	150
XP 120, 150 (10, 12.5)		18	150
		24	150
		34	150
		54	130
XP078, 090, 102 (6.5, 7.5, 8.5)	480	9	150
		18	150
		24	150
		34	150
XP 120, 150 (10, 12.5)		18	150
		24	150
		34	150
		54	130
XP078, 090, 102 (6.5, 7.5, 8.5)	600	9	150
		18	150
		24	150
		34	150
XP 120, 150 (10, 12.5)		18	150
		24	150
		34	150
		54	130

Reset

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

Electric heat anticipator setpoints

The anticipator setpoint must be correct. Too high of a setting results in longer heat cycles and a greater temperature swing in the conditioned space. Reducing the value below the correct setpoint gives shorter ON cycles and may result in the lowering of the temperature within the conditioned space. See Table 23 for the required electric heat anticipator setting.

Table 23: Electric heat anticipator setpoints

Setting, amps	
W1	W2
0.13	0.1

Cooling start-up

Pre-start checklist

When the installation is complete, perform the following checks:

1. Check the electrical supply voltage being supplied. 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 on page 45*.
 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.

Note: Before each cooling season, you must energize the crankcase heaters at least 10 hours before the system is put into operation.

2. Set the room thermostat setting lower than the room temperature.

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

The second stage of the thermostat energizes the second stage compressor if needed.

Post-start checklist

1. Verify proper system pressures for both circuits.
2. Measure the temperature drop across the evaporator coil.

Charging the unit

All XP units use thermal expansion devices. Charge the unit to nameplate charge.

Navigation components for the Smart Equipment™ control board

The following components are needed to access the control points in the Smart Equipment™ control. Installation and operation guides are available from your equipment dealer or distributor.

1. Local LCD on the unit control board.
2. Mobile Access Portal (MAP) Gateway (Portable).
 - Source 1 P/N S1-JC-MAP1810-OP
3. *MAP Gateway Quick Start Guide* P/N 24-10737-16
4. *MAP Gateway Instruction* P/N 24-10737-8

For more information on the Smart Equipment™ unit control board navigation, refer to the *Smart Equipment™ Quick Start Guide*.

Note: For more in-depth sequence of operation of the Smart Equipment™ control, refer to the *Smart Equipment™ Controls Sequence of Operation Overview* LIT-12011950.

Smart Equipment™ unit control board

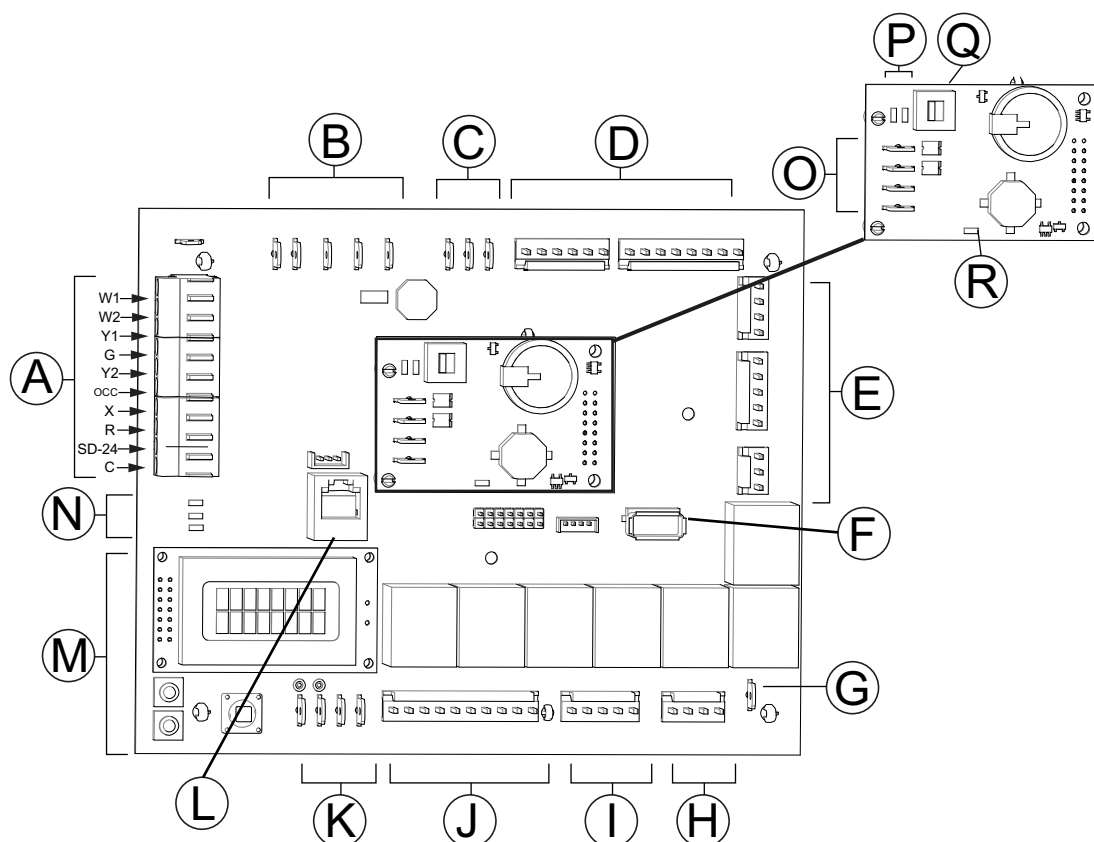


Figure 29: Unit control board

The following tables describe the details of the UCB, see Figure 29 for the connection locations.

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, condensate overflow 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, condensate overflow 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	

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 will bring 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, condensate overflow 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, condensate overflow 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

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

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.

Smart Equipment™ UCB - temperature sensor connections (continued)

Location	Label	Description	Function and comments
D	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.

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.
	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
	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

Smart Equipment™ UCB - USB connector

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

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

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

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

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.

Smart Equipment™ UCB - refrigerant circuit safety switch and indoor blower overload connections (continued)

Location	Label	Description	Function and comments
J	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.

Smart Equipment™ UCB - SA BUS¹ connections

Location	Label	Description	Function and comments
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 & 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 & 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 32.

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	

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, etc.) 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

Smart Equipment™ UCB - optional communication sub-board

Location	Label	Description	Function and comments
O¹ 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 24: Cable 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.
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): 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. We strongly recommend 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. We recommend 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.

Start-up sheet

START-UP & SERVICE DATA INSTRUCTION

COMMERCIAL PACKAGE UNITS

3.0 To 40.0 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

Johnson Controls/Ducted Systems 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 Johnson Controls/Ducted Systems 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 Johnson Controls/Ducted Systems 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 Mobile Access Portal (MAP) Gateway 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:

Johnson Controls/Ducted Systems
Technical Services Department
5005 York Drive
Norman, OK 73069

1034349-UCL-F-0318

SAFETY WARNINGS

The inspections and recording of data outlined in this procedure are required for start-up of Johnson Controls/Ducted Systems' 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:

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REFERENCE

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

Air Moving Inspection	Completed	See Notes
Alignment of drive components	<input type="checkbox"/>	<input type="checkbox"/>
Belt tension adjusted properly	<input type="checkbox"/>	<input type="checkbox"/>
Blower pulleys tight on shaft, bearing set screws tight, wheel tight to shaft	<input type="checkbox"/>	<input type="checkbox"/>
Pressure switch or transducer tubing installed properly	<input type="checkbox"/>	<input type="checkbox"/>

Exhaust Inspection Powered <input type="checkbox"/> Barometric Relief <input type="checkbox"/>	Completed	See Notes
Check hub for tightness	<input type="checkbox"/>	<input type="checkbox"/>
Check fan blade for clearance	<input type="checkbox"/>	<input type="checkbox"/>
Check for proper rotation	<input type="checkbox"/>	<input type="checkbox"/>
Check for proper mounting (screen faces towards unit)	<input type="checkbox"/>	<input type="checkbox"/>
Prove operation by increasing minimum setting on economizer	<input type="checkbox"/>	<input type="checkbox"/>

Economizer Inspection Standard <input type="checkbox"/> BAS <input type="checkbox"/>	Completed	See Notes
CO ₂ sensor installed Yes <input type="checkbox"/> No <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Check economizer setting (Reference Smart Equipment™ Control Board LCD menu location)	<input type="checkbox"/>	<input type="checkbox"/>
Prove economizer open/close through Smart Equipment™ Board Setting	<input type="checkbox"/>	<input type="checkbox"/>

Reheat Mode Normal <input type="checkbox"/> or Alternate <input type="checkbox"/> Not Applicable <input type="checkbox"/>
Humidity Sensor (2SH0401) _____

Ducted Systems

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 <input type="checkbox"/>	Exh. Fans <input type="checkbox"/>	Cond. Fans <input type="checkbox"/>
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 or 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.

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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

REFRIGERANT SAFETIES

Action	Completed	See Notes
Prove Compressor Rotation (3 phase only) by gauge pressure	<input type="checkbox"/>	<input type="checkbox"/>
Prove High Pressure Safety, All Systems	<input type="checkbox"/>	<input type="checkbox"/>
Prove Low Pressure Safety, All Systems	<input type="checkbox"/>	<input type="checkbox"/>

OPERATING MEASUREMENTS - GAS HEATINGFuel Type: ☐ Natural Gas ☐ LP Gas

Action	Completed	See Notes
Check for gas leaks	<input type="checkbox"/>	<input type="checkbox"/>
Prove Ventor Motor Operation	<input type="checkbox"/>	<input type="checkbox"/>
Prove Primary Safety Operation	<input type="checkbox"/>	<input type="checkbox"/>
Prove Auxiliary Safety Operation	<input type="checkbox"/>	<input type="checkbox"/>
Prove Rollout Switch Operation	<input type="checkbox"/>	<input type="checkbox"/>
Prove Smoke Detector Operation	<input type="checkbox"/>	<input type="checkbox"/>
Manifold Pressure	Stage 1	IWC <input type="checkbox"/>
	Stage 2 (If Equipped)	IWC <input type="checkbox"/>
	Stage 3 (If Equipped)	IWC <input type="checkbox"/>
Supply gas pressure at full fire	IWC	<input type="checkbox"/>
Check temperature rise ¹	<input type="checkbox"/> measured at full fire	°F <input type="checkbox"/>

1. $\text{Input X Eff. (BTU output)}$
 $1.08 \times \text{Temp. Rise}$

Ducted Systems

OPERATIONAL 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.	<input type="checkbox"/>
Create a heating demand at the Thermostat, BAS System or Smart Equipment™ Verify that heating stages are energized.	<input type="checkbox"/>
Verify Proper Operation of the Variable Frequency Drive (If Required)	
Verify that motor speed modulates with duct pressure change.	<input type="checkbox"/>

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.	<input type="checkbox"/>
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)	<input type="checkbox"/>
Verify that all access panels have been closed and secured	<input type="checkbox"/>
Save a backup file from the unit control board onto a USB flash drive.	<input type="checkbox"/>

OBSERVED PRODUCT DEFICIENCIES & CONCERNS:

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. The paper has a slight shadow on its right side, suggesting it's resting on a surface.