

## Installation, Operation and Maintenance Manual

Please read and save these instructions. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage! Retain instructions for future reference.

### Model PVe



### General Safety Information

Only qualified personnel should install this system. Personnel should have a clear understanding of these instructions and should be aware of general safety precautions. Improper installation can result in electric shock, possible injury due to coming in contact with moving parts, as well as other potential hazards. Other considerations may be required if high winds or seismic activity are present. If more information is needed, contact a licensed professional engineer before moving forward.

#### **DANGER**

Always disconnect power before working on or near this equipment. Lock and tag the disconnect switch or breaker to prevent accidental power up.

#### **CAUTION**

When servicing the unit, the internal components may be hot enough to cause pain or injury. Allow time for cooling before servicing.

#### **CAUTION**

Precaution should be taken in explosive atmospheres.

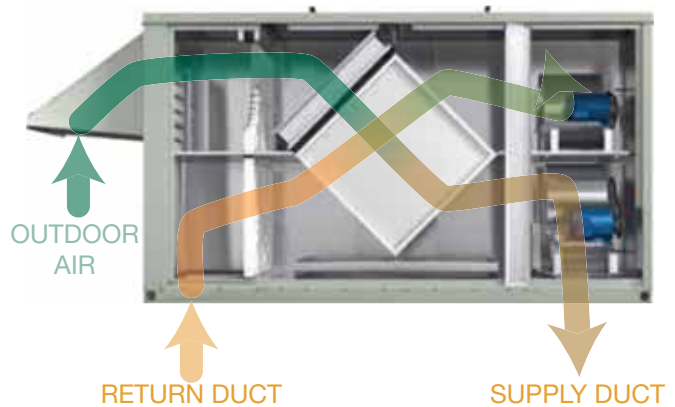
1. Follow all local electrical and safety codes, as well as the National Electrical Code (NEC), the National Fire Protection Agency (NFPA), where applicable. Follow the Canadian Electric Code (CEC) in Canada.
2. All moving parts must be free to rotate without striking or rubbing any stationary objects.
3. Unit must be securely and adequately grounded.
4. Do not spin fan wheel faster than maximum cataloged fan RPM. Adjustments to fan speed significantly affects motor load. If the fan RPM is changed, the motor current should be checked to make sure it is not exceeding the motor nameplate amps.
5. Do not allow the power cable to kink or come in contact with oil, grease, hot surfaces or chemicals. Replace cord immediately if damaged.
6. Verify that the power source is compatible with the equipment.
7. Never open access doors to the unit while it is running.

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## Product Overview

The unit brings in fresh outdoor air and removes stale exhaust air from the building. Prior to discharging the exhaust air, the plate heat exchanger transfers energy from the exhaust air to the incoming outdoor air. When used in the cooling mode, heat energy is transferred from incoming outdoor air to the exhaust air. Simply put, this unit preconditions the outdoor air to save money on heating and cooling costs.



## Receiving

This product may have been subject to road salt during transit. If so, immediately wash off all visible white residue from all exterior surfaces. Upon receiving the product, check to ensure all line items are accounted for by referencing the delivery receipt or packing list. Inspect each crate or carton for shipping damage before accepting delivery. Alert the carrier if any damage is detected, **do not refuse shipment**. The customer shall make notation of damage (or shortage of items) on the delivery receipt and all copies of the bill of lading which should be countersigned by the delivering carrier. If damaged, immediately contact your manufacturer's representative. Any physical damage to the unit after acceptance is not the responsibility of the manufacturer.

## Handling

Units are to be rigged and moved by the lifting brackets provided or by the skid when a forklift is used. Location of brackets varies by model and size. Handle in such a manner as to keep from scratching or chipping the coating. Damaged finish may reduce ability of unit to resist corrosion.

## Unpacking

Verify that all required parts and the correct quantity of each item have been received. If any items are missing, report shortages to your local representative to arrange for obtaining missing parts. Sometimes it is not possible that all items for the unit be shipped together due to availability of transportation and truck space. Confirmation of shipment(s) must be limited to only items on the bill of lading.

## Storage

Units are protected against damage during shipment. If the unit cannot be installed and operated immediately, precautions need to be taken to prevent deterioration of the unit during storage. The user assumes responsibility of the unit and accessories while in storage. The manufacturer will not be responsible for damage during storage. These suggestions are provided solely as a convenience to the user.

The ideal environment for the storage of units and accessories is indoors, above grade, in a low humidity atmosphere which is sealed to prevent the entry of blowing dust, rain, or snow. Units designed for outdoor applications may be stored outdoors. All accessories must be stored indoors in a clean, dry atmosphere.

### Indoor

Maintain temperatures evenly to prevent condensation. Remove any accumulations of dirt, water, ice, or snow and wipe dry before moving to indoor storage. To avoid condensation, allow cold parts to reach room temperature. Leave coverings loose to permit air

circulation and to allow for periodic inspection.

The unit should be stored at least 3½ in. (89 mm) off the floor. Clearance should be provided to permit air circulation and space for inspection.

### Outdoor

The unit should be placed on a level surface to prevent water from leaking into the unit. The unit should be elevated so that it is above water and snow levels. Ensure sufficient support to prevent unit from settling into soft ground. Locate parts far enough apart to permit air circulation, sunlight, and space for periodic inspection. To minimize water accumulation, place all unit parts on blocking supports so that rain water will run off.

Do not cover parts with plastic film or tarps as these cause condensation of moisture from the air passing through heating and cooling cycles.

### Inspection and Maintenance

While in storage, inspect units once per month. Keep a record of inspection and maintenance performed.

If moisture or dirt accumulations are found on parts, the source should be located and eliminated. At each inspection, rotate the fan wheel by hand ten to fifteen revolutions to distribute lubricant on motor. If paint deterioration begins, consideration should be given to touch-up or repainting. Units with special coatings may require special techniques for touch-up or repair.

Machined parts coated with rust preventive should be restored to good condition promptly if signs of rust occur. Immediately remove the original rust preventive coating with petroleum solvent and clean with lint-free cloths. Polish any remaining rust from surface with crocus cloth or fine emery paper and oil. Do not destroy the continuity of the surfaces. Wipe thoroughly clean with Tectyl® 506 (Ashland Inc.) or the equivalent. For hard to reach internal surfaces or for occasional use, consider using Tectyl® 511M Rust Preventive, WD-40® or the equivalent.

### Removing from Storage

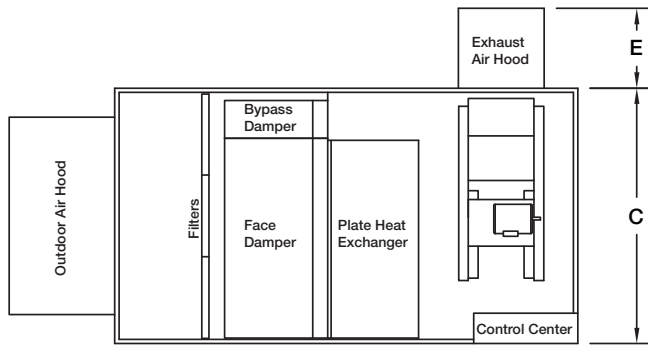
As units are removed from storage to be installed in their final location, they should be protected and maintained in a similar fashion until the equipment goes into operation.

Prior to installing the unit and system components, inspect the unit assembly to make sure it is in working order.

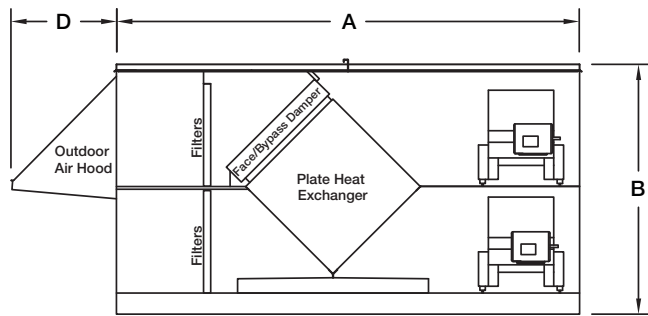
1. Check all fasteners, set screws on the fan, wheel, bearings, drive, motor base, and accessories for tightness.
2. Rotate the fan wheel(s) by hand and assure no parts are rubbing.

# Installation

## Unit Dimensions and Weights



Top view

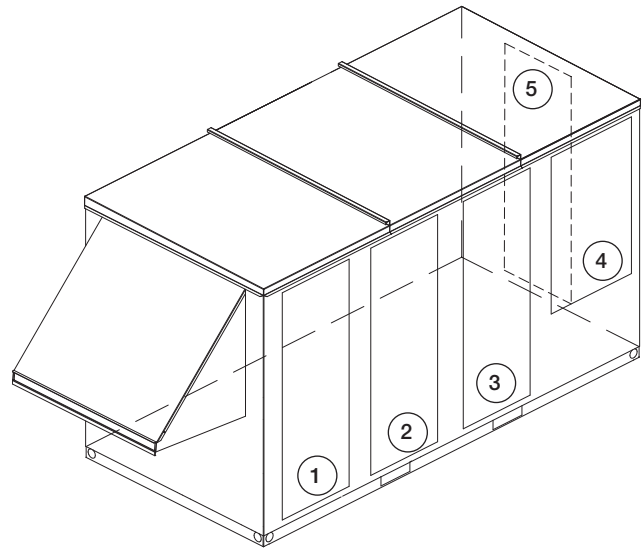


Side view

Unit Size	A	B	C	D	E	Approx. Weight (lbs.)
PVe-20	104.1	59.7	41.5	20.3	20.7	1300
PVe-35	104.1	59.7	49.2	25.2	17.7	1600
PVe-45	110.6	59.7	61.1	25.2	19.0	2100
PVe-55	116.5	59.7	76.1	25.2	23.8	2700

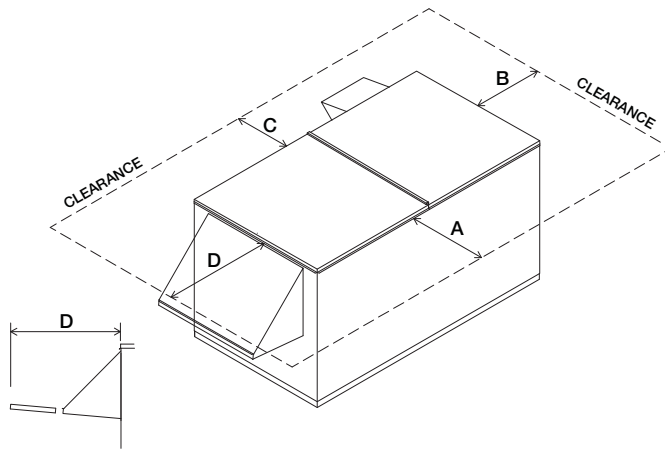
All dimensions are shown in inches.

## Access Panel Description and Location



①	Filters Optional OA (Outdoor Air) Damper Optional RA (Return Air) Damper
②	Optional Face and Bypass Dampers Plate Heat Exchanger
③	Plate Heat Exchanger
④	Control Center
⑤	Blowers

## Service Clearances



Unit Size	A	B	C	D
PVe-20	36	36	36	60
PVe-35	48	36	36	60
PVe-45	60	36	36	60
PVe-55	72	36	36	60

All dimensions are shown in inches. The weatherhoods include 2-inch aluminum mesh filters that are removed out of the end of the hood as shown in this drawing and require extra clearance for removal.

## Handling

While this unit was constructed with quality and dependability in mind, damage still may occur during handling of the unit for installation. Exercise extreme caution to prevent any damage from occurring to the refrigerant system. This unit could contain a system pressurized with refrigerant that, if damaged, could leak into the atmosphere or cause bodily harm due to the extreme cold nature of expanding refrigerant. Use protective equipment such as gloves and safety glasses to minimize or prevent injury in case of a system leak during installation.

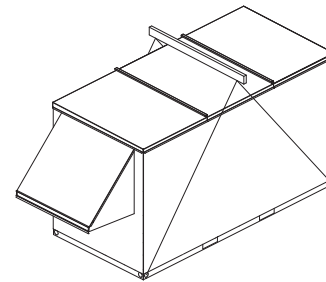
The system design and installation should follow accepted industry practice, such as described in the ASHRAE Handbook. Adequate space should be left around the unit for piping coils and drains, filter replacement, and maintenance. Sufficient space should be provided on the side of the unit for routine service and component removal should that become necessary.

## Lifting

### WARNING

All factory-provided lifting lugs must be used when lifting the units. Failure to comply with this safety precaution could result in property damage, serious injury, or death.

1. Before lifting, be sure that all shipping material has been removed from unit.
2. To assist in determining rigging requirements, weights are provided in the Installation, Unit Dimensions and Weights section of this manual.
3. Unit must be lifted by all lifting lugs provided on base structure.
4. Rigger to use suitable mating hardware to attach to unit lifting lugs.
5. Spreader bar(s) must span the unit to prevent damage to the cabinet by the lift cables.



6. Always test-lift the unit to check for proper balance and rigging before hoisting to desired location.
7. Never lift units by weatherhoods.
8. Never lift units in windy conditions.
9. Preparation of curb and roof openings should be completed prior to lifting unit to the roof.
10. Check to be sure that gasketing (supplied by others) has been applied to the curb prior to lifting the unit and setting on curb.

### Lifting with a Forklift

Unit base rail includes forklift lifting locations. Use weights in the Installation, Unit Dimensions and Weights section of this manual to determine forklift size requirements.

## Roof Curb Mounting

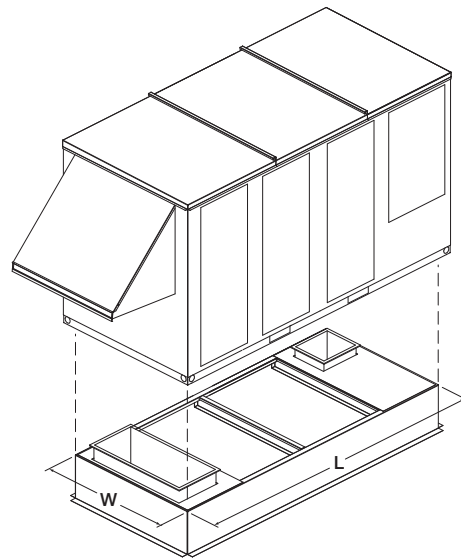
Rooftop units require curbs to be mounted first, in accordance with their appropriate instructions. Curb unit is to be installed and then duct connections are to be made prior to setting of the unit.

Position the unit roof opening such that the supply discharge and exhaust inlet of the unit will line up with the corresponding ductwork. Be sure to allow for the recommended service clearances when positioning opening.

Do not face the outdoor air intake of the unit into prevailing wind and keep the intake away from any other exhaust fans. Likewise, position the exhaust discharge opening away from outdoor air intakes of any other equipment.

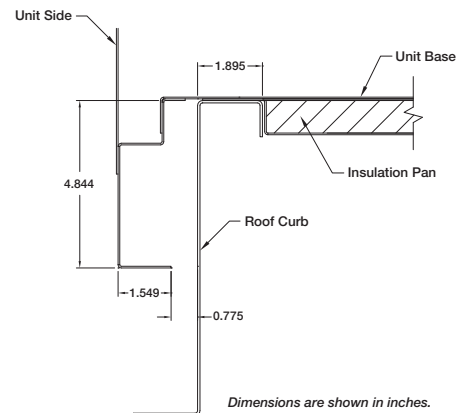
- 1. Factory Supplied Roof Curbs:** Roof curbs are Model GKD. The GKD ships in a knockdown kit (which includes duct adapter) and requires field assembly by others. Assembly instructions are included with the GKD curbs.
- 2. Install Curb:** Locate the assembled curb over roof opening and verify precise location of curb relative to the roof opening, in accordance with dimensions given previously. Fasten curb loosely in place and then shim as needed to ensure a level installation. Tighten roof fastening hardware and then recheck for level. Verify that diagonal dimensions of installed curb are plus or minus 1/8-inch of each other.
- 3. Install Ductwork:** Install needed ductwork in accordance with SMACNA and AMCA guidelines. Duct adapter is provided to support ducts prior to setting the unit.
- 4. Install Insulation:** One-inch deep insulation pans are provided with the curb assembly. Set the insulation pans per instructions and then install insulation in the pans prior to setting the unit. Insulation is not provided by the unit manufacturer, it is to be supplied by others.
- 5. Set the Unit:** Lift unit to a point directly above the curb and duct openings. Guide unit carefully while lowering in order to align with duct openings. The roof curb will seat in a recess in the base of the unit. Verify that the unit is properly seated on the curb and is level.

## Curb Outside Dimensions and Weights



Unit Size	L	W	Curb Weight (lbs.)
PVe-20	99.4	36.8	195
PVe-35	99.4	44.6	216
PVe-45	105.9	56.3	261
PVe-55	111.7	71.3	316

All dimensions are shown in inches.

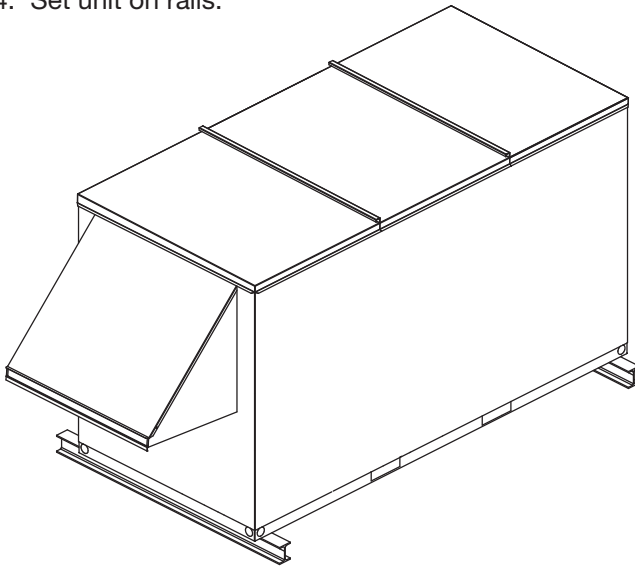


Curb Cap Details for Factory Supplied Roof Curbs

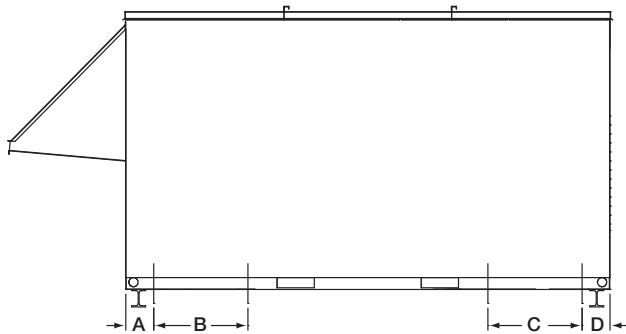


## Rail Mounting / Layout

1. Rails designed to handle the weight of the unit should be positioned as shown on the diagram (rails by others).
2. Make sure that rail positioning does not interfere with the supply air discharge opening or the exhaust air intake opening on the unit. Avoid areas dimensioned "B or C" below.
3. Rails should run the width of the unit and extend beyond the unit a minimum of 12 inches on each side.
4. Set unit on rails.



Isometric view of unit on rails



Side view of unit on rails

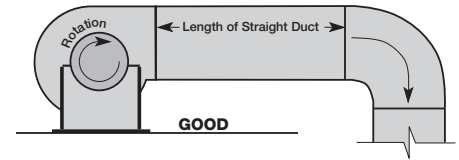
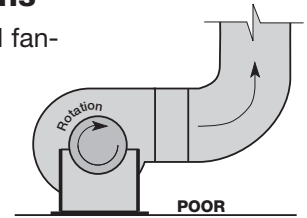
Unit Size	A	B*	C*	D
PVe-20	5	14	13.25	7.75
PVe-35	5	14	12.00	6.50
PVe-45	5	14	15.50	10.5
PVe-55	5	14	18.75	13.25

All dimensions are shown in inches.

\*Zones B and C identify regions/zones where rails may not be placed due to ductwork.

## Ductwork Connections

Examples of poor and good fan-to-duct connections are shown. Airflow out of the fan should be directed straight or curve the same direction as the fan wheel rotates. Poor duct installation will result in low airflow and other system effects.



Recommended Discharge Duct Size and Length			
Unit Size	Blower Size	Duct Size	Straight Duct Length
PVe-20	9	14 x 14	36
PVe-35	10	20 x 20	36
PVe-45	12	20 x 20	36
PVe-55	15	28 x 28	60

All dimensions are shown in inches.

- Recommended duct sizes are based on velocities across the cfm range of each model at approximately 800 feet per minute (FPM) at minimum airflow and up to 1600 fpm at maximum airflow. Recommended duct sizes are only intended to be a guide and may not satisfy the requirements of the project. Refer to plans for appropriate job specific duct size and/or velocity limitations.
- Straight duct lengths were calculated based on 100% effective duct length requirements as prescribed in AMCA Publication 201. Calculated values have been rounded up to nearest foot.

# Electrical Installation

## WARNING

The roof lining contains high voltage wiring. To prevent electrocution, do not puncture the interior or exterior panels of the roof.

## WARNING

To prevent injury or death due to electrocution or contact with moving parts, lock disconnect switch open.

For units with a gas furnace, if you turn off the power supply, turn off the gas.

## IMPORTANT

Before connecting power to the unit, read and understand the following instructions and wiring diagrams. Complete wiring diagrams are attached on the inside of the control center door(s).

## IMPORTANT

All wiring should be done in accordance with the latest edition of the National Electrical Code ANSI/NFPA 70 and any local codes that may apply. In Canada, wiring should be done in accordance with the Canadian Electrical Code.

## IMPORTANT

The equipment must be properly grounded and bonded. Any wiring running through the unit in the airstream must be protected by metal conduit, metal clad cable or raceways.

## CAUTION

If replacement wire is required, it must have a temperature rating of at least 105°C, except for an energy cut-off or sensor lead wire which must be rated to 150°C.

## DANGER

High voltage electrical input is needed for this equipment. This work should be performed by a qualified electrician.

## CAUTION

Any wiring deviations may result in personal injury or property damage. Manufacturer is not responsible for any damage to, or failure of the unit caused by incorrect final wiring.

### 1. Determine the Size of the Main Power Lines

The unit's nameplate states the voltage and the unit's MCA. The main power lines to the unit should be sized accordingly. The nameplate is located on the outside of the unit on the control panel side.

### 2. Provide the Opening(s) for the Electrical Connections

Electrical openings vary by unit size and arrangement and are field-supplied.

### 3. Connect the Power Supplies

Connect the main power lines and electric heater power lines to the disconnect switches or terminal blocks and main grounding lug(s). Torque field connections to manufacturer's recommendations.

### 4. Wire the Optional Convenience Outlet

The convenience outlet requires a separate 115V power supply circuit. The circuit must include short circuit protection which may need to be supplied by others.

### 5. Connect Field-Wired Low Voltage Components

Most factory-supplied electrical components are prewired. To determine what electrical accessories require additional field-wiring, refer to the unit-specific wiring diagram located on the inside of the control center access door.

Control wires should not be run inside the same conduit as that carrying the supply power. Make sure that field-supplied conduit does not interfere with access panel operation. All low voltage wiring should be run in conduit wherever it may be exposed to the weather.

The low voltage control circuit is 24 VAC and control wiring should not exceed 0.75 ohms. If wire resistance exceeds 0.75 ohms, an isolation relay should be added to the unit control center and wired in place of the remote switch (typically between terminal blocks R and G on the terminal strip. The relay must be rated for at least 5 amps and have a 24 VAC coil. Failure to comply with these guidelines may cause motor starters to "chatter" or not pull in which can cause contactor failures and/or motor failures.



### Field-Provided Disconnect

If field-installing an additional disconnect switch, it is recommended that there is at least four feet of service room between the switch and system access panels. When providing or replacing fuses in a fusible disconnect, use dual element time delay fuses and size according to the rating plate.

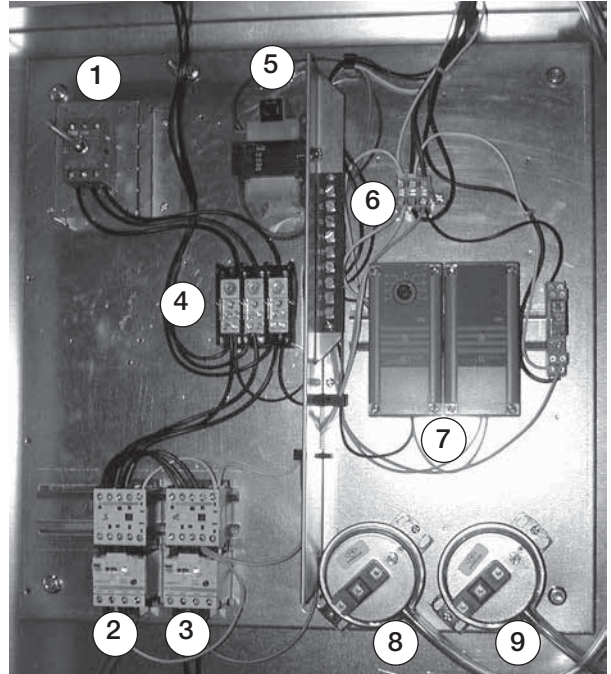
### Discharge Air Temperature Sensor

The discharge air temperature sensor is factory-mounted in the blower discharge section of the unit behind the blower cut off plate.



### Typical Control Center Components

1. Main Disconnect (non-fusible, lockable)
2. Motor Starter
3. Motor Starter
4. Power Distribution Blocks
5. 24 VAC Control Transformer
6. 24 VAC Terminal Strip
7. Temperature Sensor with Override (used for Economizer Mode)
8. Dirty Filter Sensor
9. Dirty Filter Sensor



## Optional Accessory Wiring Schematics

The remote panel is a series of interconnected junction boxes with a stainless steel faceplate. The remote panel is available with a number of different alarm lights and switches to control the unit. The remote panel ships loose and requires mounting and wiring in the field

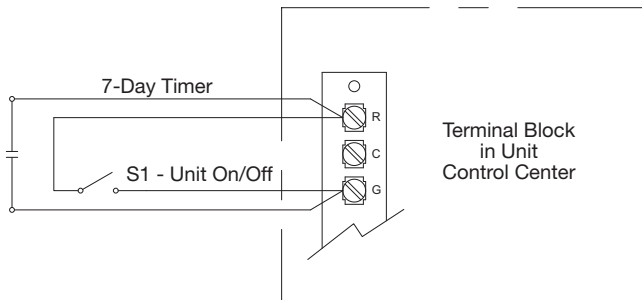
The remote panel is available with the following options:

- Unit on/off switch
- Unit on/off light
- 7-day time clock
- Hand/off/auto switch
- Time delay override
- Economizer light
- Frost control light
- Exhaust air dirty filter light
- Outdoor air dirty filter light



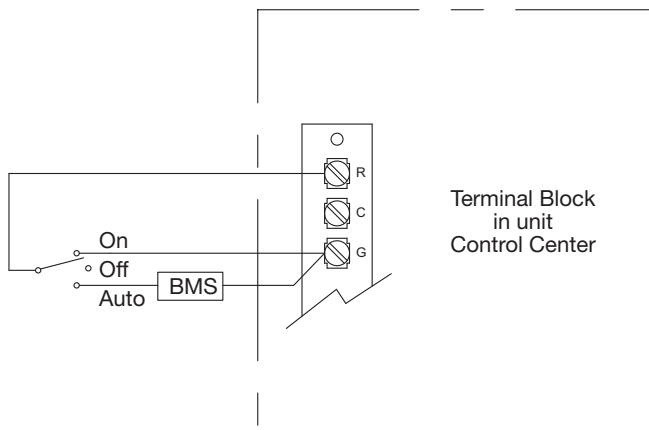
Refer to *Electrical Connections* section for *Field Control Wiring* recommendations.

### 7-Day Timer or On/Off Switch



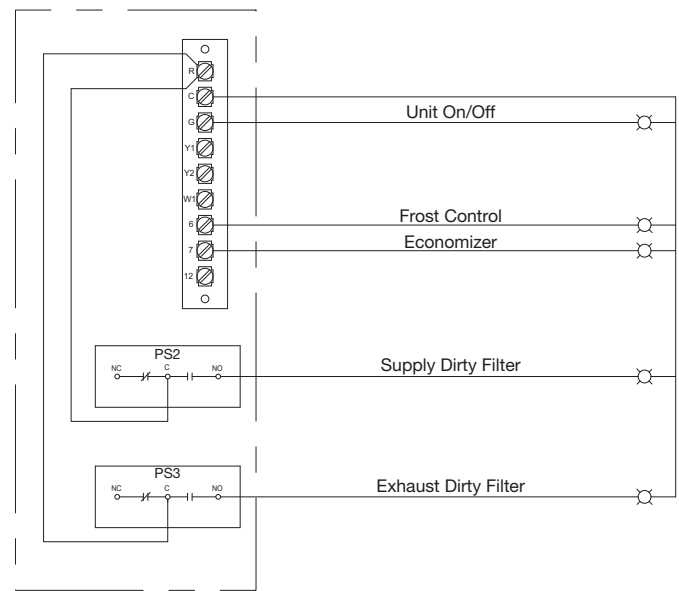
For 7-Day Timer, use blue and black wires. Red wires should be capped off.

### Hand/Off/Auto Switch

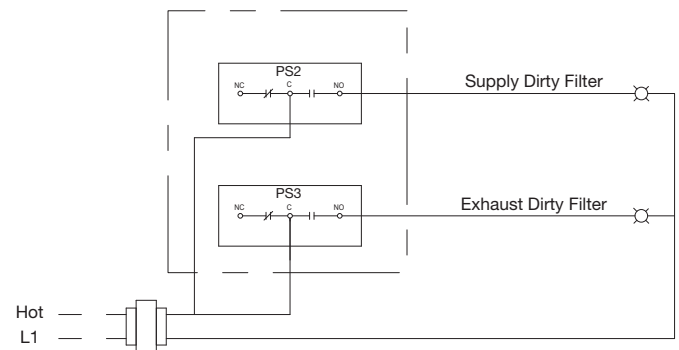


Hand/Off/Auto Switch allows the unit to  
 “Off” - off  
 “On” - Manual Operation  
 “Auto” - Unit is controlled by BMS, RTU, etc.  
 NOTE: RTU controllers are by others.

## Indicator Lights powered by the ER Unit



### Dirty Filter Indicator (power by others)



Refer to *Pressure Switch* for voltage and load ratings.

## Piping Installation

### Condensate Drain Trap

This unit is equipped with a stainless steel condensate pan with a 1-inch MPT stainless steel drain connection. It is important that the drain connection be fitted with a P trap to ensure proper drainage of condensate while maintaining internal static pressures.

A P trap assembly (kit) is supplied with each unit and is to be assembled and installed as local conditions require and according to the assembly instructions provided with the P trap. If local and area codes permit, the condensate may be drained back onto the roof, but a drip pad should be provided beneath the outlet. If local and area codes require a permanent drain line, it should be fabricated and installed in accordance with Best Practices and all codes.

In some climates, it will be necessary to provide freeze protection for the P trap and drain line. The P trap should be kept filled with water or glycol solution at all times and it should be protected from freezing to protect the P trap from damage. If severe weather conditions occur, it may be necessary to fabricate a P trap and drain line of metal and install a heat tape to prevent freezing.



## Unit Overview

### Basic Unit

The units are prewired such that when a call for outside air is made (via field supplied 24 VAC control signal wired to unit control center), the supply and exhaust fan are energized and optional motorized dampers open. The unit is normally interlocked (24 volt) to the roof top air handler. When the roof top air handler starts, the auxiliary contactor in the air handler closes to start the unit.

### Summer Operation

Outdoor air is preconditioned (temperature is decreased) by the transfer of energy from the cooler, drier, exhaust air via the aluminum heat exchanger. The preconditioned air is typically mixed with return air going back to the air handler for final conditioning.

### Winter Operation

Outdoor air is preconditioned (temperature is increased) by the transfer of energy from the warmer, more humid exhaust air via the aluminum heat exchanger. The preconditioned air is typically mixed with return air going back to the air handler for final conditioning.

## Optional Component Overview

### Economizer

Under certain conditions, the most efficient use of the unit includes bypassing the incoming outdoor air around the plate heat exchanger. When cooling air is being called for and the outdoor air temperature is below a pre-set point, the unit will switch to economizer mode. Integral face and bypass dampers will cycle into a bypass condition, allowing incoming cool air to flow past the cube, rather than flow through it. Economizer mode is strictly temperature initiated and dependent on the temperature sensor with override located in the control center.

### Frost Control

Cold climates, in combination with higher indoor humidity levels, may cause frost to form on the plate heat exchanger. To protect against the formation of frost, a temperature sensor is installed to measure the temperature of the air leaving the plates in the exhaust airstream. There are two different methods of frost control that may optionally be used. These options are installed, wired and pre-set at the factory. To identify specific components, see the included unit-specific schematic wiring diagram.

#### 1. Timed exhaust frost control

The supply blower cycles on and off based on a factory provided and installed timer. The timer is located on the right hand side (low voltage side) of the control module.

#### 2. Plate heat exchanger bypass – open/closed

When the exhaust air leaving the exchanger (cube) drops below the adjustable set-point, both the face and bypass dampers will allow air to bypass the cube. This allows warm exhaust air to melt any frost on the cube. Once the exhaust air temperature rises above the set-point, the unit returns to normal operation.

**Timed exhaust frost control** includes a timer in addition to the thermostat and pressure sensor. The timer is located on the right hand side of the control module (low voltage side). When timed exhaust frost control is initiated, the timer will turn the supply blower on and off to allow the warm exhaust air to defrost the cube. Default factory settings are 5 minutes off and 30 minutes on.

**Plate (cube) bypass** - The plate bypass frost control function is essentially the same as economizer mode except that it is initiated by temperature sensors for the purpose of frost removal or prevention.

### Exhaust Only Operation

This option allows for the exhaust fan to run continuously while the supply fan is off.

## Variable Frequency Drives (VFD)

Variable frequency drives are used to control the speed of the fan as either multi-speed or modulating control. Multi-speed VFDs reference a contact which can be made by a switch or a sensor with a satisfied set point. Modulating control references a 2-10 VDC signal to the VFD which will vary the fan speed from a minimum 50% to full 100% rpm. An optional CO<sub>2</sub> sensor is available to provide both a set point contact or a modulating 2-10 VDC signal.

### CO<sub>2</sub> Sensor

This accessory is often used in Demand Control Ventilation (DCV) applications. The factory-provided sensors can either be set to reference a set point for multi-speed operation, or output a 2-10 VDC signal to modulate the fan speed. These can either be shipped loose to mount in the ductwork, or can be factory-mounted in the return air intake. Follow instructions supplied with sensor for installation and wiring details.

### Dirty Filter Sensor

Dirty filter sensors monitor pressure drop across the outdoor air filters, exhaust air filters, or both. If the pressure drop across the filters exceeds the set point, the sensor will close a set of contacts in the unit control center. Field-wiring of a light (or other alarm) to these contacts will notify maintenance personnel when filters need to be replaced. The switch has not been set at the factory due to external system losses that will affect the switch. This switch will need minor field adjustments after the unit has been installed with all ductwork complete. The dirty filter switch is mounted in the exhaust inlet compartment next to the unit control center or in unit control center.

### Service Outlet

120 VAC GFCI service outlet ships loose for field installation. Requires separate power source so power is available when unit main disconnect is turned off for servicing.

### Vapor Tight Lights

Vapor tight lights provide light to each of the compartments in the energy recovery unit. The lights are wired to a junction box mounted on the outside of the unit. The switch to turn the lights on is located in the unit control center. The switch requires a separate power source to allow for power to the lights when the unit main disconnect is off for servicing.

## Unit Start-Up

### DANGER

Electric shock hazard. Can cause injury or death. Before attempting to perform any service or maintenance, turn the electrical power to unit to OFF at disconnect switch(es). Unit may have multiple power supplies.

### CAUTION

Use caution when removing access panels or other unit components, especially while standing on a ladder or other potentially unsteady base. Access panels and unit components can be heavy and serious injury may occur.

### CAUTION

Do not operate energy recovery ventilator without the filters and birdscreens installed. They prevent the entry of foreign objects such as leaves, birds, etc.

### CAUTION

Do not run unit during construction phase. Damage to internal components may result and void warranty.

### SPECIAL TOOLS REQUIRED

- Voltage Meter (with wire probes)
- Amperage Meter
- Thermometer
- Tachometer
- Incline manometer or equivalent

## Start-Up Procedure

The unit will be in operational mode during start-up. Use necessary precautions to avoid injury. All data must be collected while the unit is running. In order to measure volts and amps, the control center door needs to be open and the unit energized.

- Make sure Pre-Start-Up checklist is complete.
- Jumper R to G to enable unit.

## Voltage Imbalance

In a three-phase system, excessive voltage imbalance between phases will cause motors to overheat and eventually fail. Maximum allowable imbalance is 2%. To determine voltage imbalance, use recorded voltage measurements in this formula.

Key: V1, V2, V3 = line voltages as measured  
VA (average) =  $(V1 + V2 + V3) / 3$   
VD = Line voltage (V1, V2 or V3) that deviates farthest from average (VA)

Formula: % Voltage Imbalance =  $[100 \times (VA - VD)] / VA$

## Pre Start-Up

Every installation requires a comprehensive start-up to ensure proper operation of the unit. As part of that process, the following checklist must be completed and information recorded. Starting up the unit in accordance with this checklist will not only ensure proper operation, but will also provide valuable information to personnel performing future maintenance. Should an issue arise which requires factory assistance, this completed document will allow unit experts to provide quicker resolve. Qualified personnel should perform start-up to ensure safe and proper practices are followed.

Unit Model Number \_\_\_\_\_  
(e.g. PVe-20)

Unit Serial Number \_\_\_\_\_  
(e.g. 10111000)

Start-Up Date \_\_\_\_\_

Start-Up Personnel Name \_\_\_\_\_

Start-Up Company \_\_\_\_\_

Phone Number \_\_\_\_\_

## Pre Start-Up Checklist

- Disconnect and lock-out all power switches
- Remove any foreign objects that are located in the energy recovery unit.
- Check all fasteners, set-screws, and locking collars on the fans, bearings, drives, motor bases and accessories for tightness.
- Rotate the fan wheels by hand and ensure no parts are rubbing. If rubbing occurs, refer to Start-Up section for more information.
- Check the fan belt drives for proper alignment and tension (refer to Start-Up section for more information).
- Filters can load up with dirt during building construction. Replace any dirty pleated filters and clean the aluminum mesh filters in the intake hood (refer to Routine Maintenance section).
- Verify that non-motorized dampers open and close properly.
- Check the tightness of all electrical wiring connections.
- Verify control wire gauge.

## Start-Up Checklist

Line Voltage. Check at unit disconnect.

L1-L2 \_\_\_\_\_ Volts

L2-L3 \_\_\_\_\_ Volts

L1-L3 \_\_\_\_\_ Volts

### Motor Amp Draw

Supply Motor Amps L1 \_\_\_\_\_ Amps

L2 \_\_\_\_\_ Amps

L3 \_\_\_\_\_ Amps

Exhaust Motor Amps L1 \_\_\_\_\_ Amps

L2 \_\_\_\_\_ Amps

L3 \_\_\_\_\_ Amps

### Fan RPM

### Correct fan rotation direction?

Supply Fan \_\_\_\_\_ RPM

Supply Fan Yes / No

Measured Airflow \_\_\_\_\_ CFM

Exhaust Fan \_\_\_\_\_ RPM

Exhaust Fan Yes / No

Measured Airflow \_\_\_\_\_ CFM

## Optional Accessories Checklist

Refer to the respective sections in this Installation, Operation and Maintenance Manual for detailed information. Refer to wiring diagram in unit control center to determine what electrical accessories were provided.

### Frost Control Application / Operation Section:

### Setting

### Factory Default

Yes	No			
		Frost Control set point	_____	5°F
		Differential	_____	2°F
		Timer	_____	Refer to IOM
Yes	No	Frost Control Modulating	_____	Refer to IOM

### Economizer Application / Operation Section:

Yes	No			
		Economizer (temperature)		
		Set point	_____	65°F
		Offset	_____	20°F
		Differential	_____	2°F
Yes	No	Economizer (enthalpy)		
		Set point	_____	B

### Optional Accessories Section:

### Operational

Yes	No		Yes	No	N/A
		OA Dirty Filter Sensor			
Yes	No	EA Dirty Filter Sensor	Yes	No	N/A
Yes	No	CO <sub>2</sub> Sensor	Yes	No	N/A
Yes	No	Service Outlet	Yes	No	N/A
Yes	No	Vapor Tight Lights	Yes	No	N/A
Yes	No	Remote Control Panel	Yes	No	N/A

### Variable Frequency Drives Section:

### Operational

Yes	No		Yes	No	N/A
		Blower VFDs			

### Damper Section:

### Operational

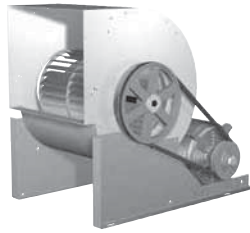
Yes	No		Yes	No	N/A
		Outdoor Air Damper			
Yes	No	Exhaust Air Damper	Yes	No	N/A



## Start-Up Components

### Fans

The unit contains a forward-curved supply fan and a forward curved exhaust fan. These forward-curved fans should be checked for free rotation. If any binding occurs, check for concealed damage and foreign objects in the fan housing. Be sure to check the belt drives per the start-up recommendations in the following section.



**Forward Curved Exhaust Fan**

### CAUTION

When operating conditions of the fan are to be changed (speed, pressure, temperature, etc.), consult manufacturer to determine if the unit can operate safely at the new conditions.

Centering of the fan wheel can be accomplished by loosening the wheel hub set screw and moving the wheel to the desired position.

### Fan Performance Modifications

Due to job specification revisions, it may be necessary to adjust or change the sheave or pulley to obtain the desired airflow at the time of installation. The start-up technician must check blower amperage to ensure that the amperage listed on the motor nameplate is not exceeded. Amperage to be tested with access doors closed and ductwork installed.

### Fan Belt Drives

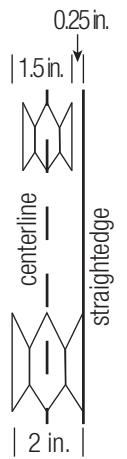
The fan belt drive components, when supplied by manufacturer, have been carefully selected for the unit's specific operating condition. Utilizing different components than those supplied could result in unsafe operating conditions which may cause personal injury or failure of the following components:

- Fan Shaft
- Bearings
- Motor
- Fan Wheel
- Belt

Tighten all fasteners and set screws securely and realign drive pulleys after adjustment. Check pulleys and belts for proper alignment to avoid unnecessary belt wear, noise, vibration and power loss. Motor and drive shafts must be parallel and pulleys in line (see diagrams in Belt Drive Installation section).

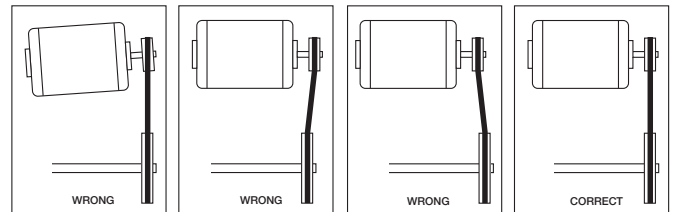
## Belt Drive Installation

1. Remove the protective coating from the end of the fan shaft and assure that it is free of nicks and burrs.
2. Check fan and motor shafts for parallel and angular alignment.
3. Slide sheaves on shafts. Do not drive sheaves on as this may result in bearing damage.
4. Align fan and motor sheaves with a straightedge to centerline.
5. Place belts over sheaves. Do not pry or force belts, as this could result in damage to the cords in the belts.
6. With the fan off, adjust the belt tension by moving the motor base. (See belt tensioning procedures in the Routine Maintenance section of this manual).



**Pulley alignment example**

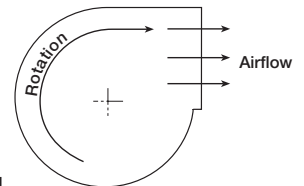
When in operation, the tight side of the belts should be in a straight line from sheave to sheave with a slight bow on the slack side.



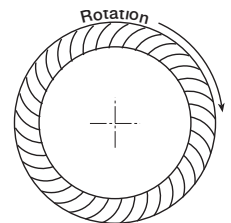
**Proper alignment of motor and drive shaft.**

## Direction of Fan Wheel Rotation

Blower access is labeled on unit. Check for proper wheel rotation by momentarily energizing the fan. Rotation is determined by viewing the wheel from the drive side and should match the rotation decal affixed to the fan housing.



If the wheel is rotating the wrong way, direction can be reversed by interchanging any two of the three electrical leads. Check for unusual noise, vibration, or overheating of bearings. Refer to the Troubleshooting section of this manual if a problem develops.



**Forward Curved**

## Fan RPM

Supply fan and exhaust fan will have an adjustable motor pulley (on 15 HP and below) preset at the factory to the customer-specified RPM. Fan speed can be increased or decreased by adjusting the pitch diameter of the motor pulley. Multi-groove variable pitch pulleys must be adjusted an equal number of turns open or closed. Any increase in fan speed represents a substantial increase in load on the motor. Always check the motor amperage reading and compare it to the amperage rating shown on the motor nameplate when changing fan RPM. All access doors must be installed except the control center door.

## Vibration

Excessive vibration may be experienced during initial start-up and can cause a multitude of problems, including structural and/or component failure.

### Vibration Causes

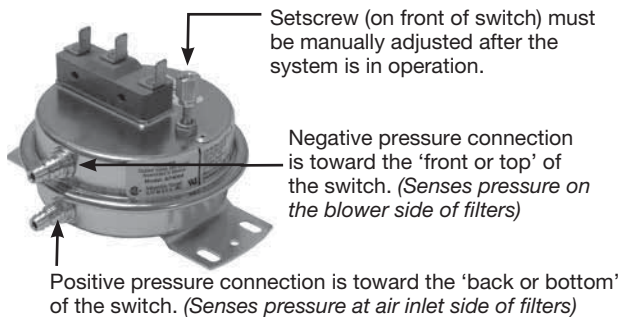
Off axis or loose components  
Drive component unbalance  
Poor inlet / outlet conditions  
Foundation stiffness

Many of these conditions can be discovered by careful observation. Refer to the Troubleshooting section of this manual for corrective actions.

If observation cannot locate the source of vibration, a qualified technician using vibration analysis equipment should be consulted. If the problem is wheel unbalance, in-place balancing can be done.

Generally, fan vibration and noise is transmitted to other parts of the building by the ductwork. To eliminate this undesirable effect, the use of heavy canvas connectors is recommended.

## Optional Start-Up Components



## Dirty Filter Switch

To adjust the switch, the unit must be running with all of the access doors in place, except for the compartment where the switch is located (exhaust intake compartment). The adjusting screw is located on the top of the switch.

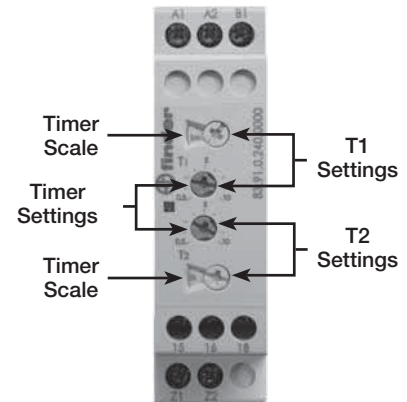
1. Open the filter compartment and place a sheet of plastic or cardboard over 50% of the filter media.
2. Replace the filter compartment door.
3. Check to see if there is power at the alert signal leads (refer to electrical diagram).

4. Whether there is power or not, turn the adjustment screw on the dirty filter gauge (clockwise if you did not have power, counterclockwise if you did have power) until the power comes on or just before the power goes off.
5. Open the filter compartment and remove the obstructing material.
6. Replace the door and check to make sure that you do **not** have power at the alert signal leads. The unit is now ready for operation.

## Frost Control Timed Exhaust

1. Remove power from unit.
2. Jumper the temperature indicating thermodisc in the unit control center. Thermodisc has a pre-set temperature of 5°F.
3. Set the frost control timer scale for T1 and T2 to 1m. Set the timer settings for T1 and T2 to 10.
4. Add power to the unit. Blower should cycle on for one minute, then turn off for one minute.
5. Remove power from unit and remove jumpers that were placed. Reset timer settings.

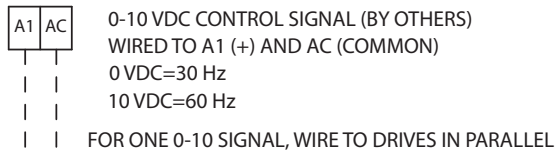
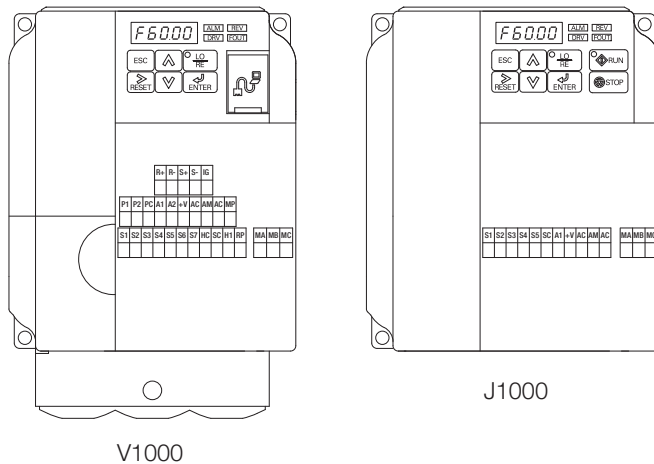
- **T1** timer setting set to **5** and timer scale set to **10m** for 5 minutes of wheel off time.
- **T2** timer setting set to **5** and timer scale set to **1h** for 30 minutes of wheel on time.



## Variable Frequency Drives

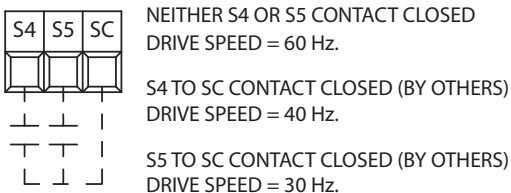
Optional factory-installed, wired, and programmed variable frequency drives (VFDs) may have been provided for modulating or multi-speed control of the blowers and energy recovery wheel for economizer and frost control modes. One VFD, either Yaskawa model V1000 or J1000, is provided for each blower (supply air and exhaust) and one Yaskawa model J1000 is provided for the energy recovery wheel.

Refer to the tables in this section for factory settings and field wiring requirements. Refer to the unit control center for unit specific wiring diagram. When making adjustments outside of the factory set points, refer to Yaskawa VFD instruction manual, which can be found online at [www.drives.com](http://www.drives.com). For technical support, contact Yaskawa direct at 1-800-927-5292.



SEE VFD INSTALLATION MANUAL FOR MORE DETAIL  
 FOR CONTINUOUS 60Hz OPERATION JUMPER TERMINALS A1 AND +V.

OPTION 2 - MULTI SPEED CONTROL  
 USER TO PROVIDE CONTACTS AND ISOLATION  
 AS REQUIRED



SEE VFD INSTALLATION MANUAL FOR MORE DETAIL

TO CHANGE THE FACTORY SET Hz CHANGE THE FOLLOWING PARAMETERS.  
 PARAMETER A1-01 CHANGE TO 2  
 PARAMETER d1-01 FOR NEW 60Hz SETTING  
 PARAMETER d1-02 FOR NEW 40Hz SETTING  
 PARAMETER d1-03 FOR NEW 30Hz SETTING  
 PARAMETER A1-01 CHANGE TO 0

## Factory Set Points

Variable frequency drives (VFDs) for the blowers are factory setup to operate in one of the three following modes:

- **Modulating:** 0-10 VDC signal wired in the field by others varies the speed of the blower between 30 and 60Hz
- **Multi-speed:** Digital contact closures by others command the VFD to run at multiple speed settings:
  - Open - Drive runs at 60Hz
  - SC to S4 - Drive runs at 40Hz
  - SC to S5 - Drive runs at 30Hz
- **CO<sub>2</sub> Sensor:**

Set Point Control: A carbon dioxide sensor is provided from the factory for field-mounting OR unit mounting in the space(s) being served by the energy recovery unit. The CO<sub>2</sub> sensors are wired to the unit VFD's with two preset speeds of 700 PPM or less CO<sub>2</sub> = 50% fan speed and 800 PPM or greater CO<sub>2</sub> = 100% fan speed.

Proportional Control: A carbon dioxide sensor is provided from the factory for field-mounting OR unit mounting in the space(s) being served by the energy recovery unit. The CO<sub>2</sub> sensors are wired to the unit VFD's with default factory settings of 500 PPM or less CO<sub>2</sub> = 50% fan speed and 1000 PPM or greater CO<sub>2</sub> = 100% fan speed. Modulation of VFD occurs proportional to CO<sub>2</sub> between 500 and 1000 PPM.

The terminal locations for Modulating and Multi-speed are shown on the previous page. Most of the set points in the VFDs are Yaskawa factory defaults. However, a few set points are changed at Greenheck and are shown in the tables. These settings are based on the VFD mode selected.

## Change Set Points

To gain access to change set points on the V1000 and J1000 drives, parameter A1-01 needs to be set at "2". To prevent access or tampering with drive settings on either drive, change parameter A1-01 to "0".

- **Drive Operation**
  - SC to S1 contact for On/Off
  - A1 (0-10 VDC) referenced to AC  
**Can use +15 VDC from +V**

## Resetting the V1000 drive to factory defaults

To reset the V1000 drive back to Greenheck factory defaults go to parameter A1-01 and set it to "2". Then go to A1-03 and change it to "1110" and press enter. The drive is now reset back to the settings programmed at Greenheck. This option is not available on the J1000.

<b>MODULATING CONTROL FOR FAN SPEED (0-10 VDC)</b>			
Parameter		Setting	
		V1000	J1000
A1-01	Access Level	2	2
b1-17	VFD Start-Up Setting	1	1
C1-01	Acceleration Time	30 sec.	30 sec.
C1-02	Deceleration Time	30 sec.	30 sec.
C6-02	Carrier Frequency	1	1
d2-02	Ref Lower Limit	50%	50%
E2-01	Motor Rated FLA	Motor FLA	Motor FLA
H3-04	Terminal A1 Bias	50%	50%
A1-01	Access Level	0	0

<b>MULTI-SPEED CONTROL FOR FAN SPEED (1/3 OR 1/2 SPEED REDUCTION)</b>			
Parameter		Setting	
		V1000	J1000
A1-01	Access Level	2	2
b1-01	Reference Source (Frequency)	0	0
b1-17	VFD Start-Up Setting	1	1
C1-01	Acceleration Time	30 sec.	30 sec.
C1-02	Deceleration Time	30 sec.	30 sec.
C6-02	Carrier Frequency	1	1
d1-01	Frequency Reference 1	60 Hz	60 Hz
d1-02	Frequency Reference 2	40 Hz	40 Hz
d1-03	Frequency Reference 3	30 Hz	30 Hz
d1-04	Frequency Reference 4	60 Hz	60 Hz
d2-02	Ref Lower Limit	50%	50%
E2-01	Motor Rated FLA	Motor FLA	Motor FLA
H1-04	Multifunction Input Sel 4 (Terminal S4)	3	3
H1-05	Multifunction Input Sel 5 (Terminal S5)	4	4
H1-06	Multifunction Input Sel 6 (Terminal S6)	5	NA
H3-10	A2 Not Used	F	NA
A1-01	Access Level	0	0

<b>CO<sub>2</sub> SENSOR CONTROL FOR FAN SPEED (1/2 SPEED WHEN CO<sub>2</sub> DROPS BELOW 700 PPM) (FULL SPEED WHEN CO<sub>2</sub> RISES ABOVE 800 PPM)</b>			
Parameter		Setting	
		V1000	J1000
A1-01	Access Level	2	2
b1-01	Reference Source (Frequency)	0	0
b1-17	VFD Start-Up Setting	1	1
C1-01	Acceleration Time	30 sec.	30 sec.
C1-02	Deceleration Time	30 sec.	30 sec.
C6-02	Carrier Frequency	1	1
d1-01	Frequency Reference 1	60 Hz	30 Hz
d1-02	Frequency Reference 2	30 Hz	60 Hz
d2-02	Ref Lower Limit	50%	50%
E2-01	Motor Rated FLA	Motor FLA	Motor FLA
H3-10	A2 Not Used	F	NA
A1-01	Access Level	0	0

## Routine Maintenance

### Overview

The unit is quite simply an interface unit that takes in outdoor air and either heats or cools that air and then delivers that air into the building HVAC system for further heating or cooling. The heating and cooling that is done in this unit is accomplished by taking heat energy out of the air being exhausted to the outdoors and transferring that heat energy to the incoming replacement air. If the outdoor air is being used for cooling, some of the heat energy is transferred from the incoming warm outdoor air to the exhaust air.

Most all the components found in this unit are typical of what would normally be found in other air handlers. There is an air propulsion system consisting of two belt driven blowers; one to draw in outdoor air through the plate heat exchanger, and the other to draw stale indoor air from the building through the plate heat exchanger and then exhaust it. There are various optional motorized dampers and sensors that may also be found in the unit.

The heart of the unit is the plate heat exchanger and this is the component that actually accomplishes heat energy recovery. It has no moving parts and the only real maintenance issues are to keep the internal surfaces clean and to protect the aluminum plates from damage.

In addition to the typical maintenance issues shown in following pages, periodic visual inspection of the plate heat exchanger is required. Such visual inspections should be recorded and record made of any observations.

The surfaces of the flat aluminum plates within the plate heat exchanger permit complete visual inspection of both supply and exhaust sides of the unit. Small amounts of dust present in either side of the plate heat exchanger will not affect performance. If appreciable amounts of dust or dirt accumulate, the plate heat exchanger can be cleaned with hot water (180°F) or a detergent that does not damage aluminum surfaces. Spray water evenly across the surfaces at a pressure between 22 and 55 psi. Do not force sharp objects against the heat transfer surfaces or damage to the flat plates may occur.

### **DANGER**

Electric shock hazard. Can cause injury or death. Before attempting to perform any service or maintenance, turn the electrical power to unit to OFF at disconnect switch(es). Unit may have multiple power supplies.

### **CAUTION**

Use caution when removing access panels or other unit components, especially while standing on a ladder or other potentially unsteady base. Access panels and unit components can be heavy and serious injury may occur.

Once the unit has been put into operation, a routine maintenance program should be set up to preserve reliability and performance. Items to be included in this program are:

#### **Lubrication**

Apply lubrication where required

#### **Dampers**

Check for unobstructed operation

#### **Fan Belts**

Check for wear, tension, alignment

#### **Motors**

Check for cleanliness

#### **Blower Wheel & Fasteners**

Check for cleanliness

Check all fasteners for tightness

Check for fatigue, corrosion, wear

#### **Bearings**

Check for cleanliness

Check set screws for tightness

Lubricate as required

#### **External Filter**

Check for cleanliness - clean if required

#### **Internal Filter**

Check for cleanliness - replace if required

#### **Door Seal**

Check if intact and pliable



## Maintenance Procedures

### WARNING

#### REFER TO GENERAL SAFETY INFORMATION

Do not operate this unit without the filters and birdscreen installed. They prevent the entry of foreign objects such as leaves, birds, etc.

Do not remove access panels or other unit components while standing on a ladder or other unsteady base. Access panels and unit components are heavy and serious injury may occur.

### Lubrication

Check all moving components for proper lubrication. Apply lubrication where required. Any components showing excessive wear should be replaced to maintain the integrity of the unit and ensure proper operation.

### Dampers

Check all dampers to ensure they open and close properly and without binding. Backdraft dampers can be checked by hand to determine if blades open and close freely. Apply power to motorized dampers to ensure the actuator opens and closes the damper as designed.

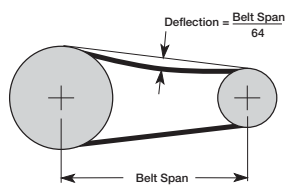
### Fan Belts

Belts must be checked on a regular basis for wear, tension, alignment, and dirt accumulation. Premature or frequent belt failures can be caused by improper belt tension (either too loose or too tight) or misaligned sheaves. Abnormally high belt tension or drive misalignment will cause excessive bearing loads and may result in failure of the fan and/or motor bearings. Conversely, loose belts will cause squealing on start-up, excessive belt flutter, slippage, and overheated sheaves. Both loose and tight belts can cause fan vibration.

When replacing belts on multiple groove drives, all belts should be changed to provide uniform drive loading. Do not pry belts on or off the sheave. Loosen belt tension until belts can be removed by simply lifting the belts off the sheaves. After replacing belts, insure that slack in each belt is on the same side of the drive. Belt dressing should never be used.

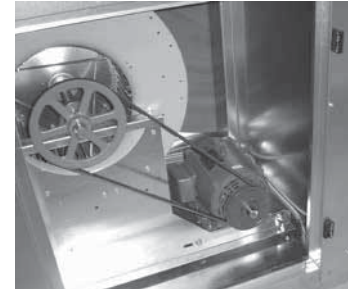
Do not install new belts on worn sheaves. If the sheaves have grooves worn in them, they must be replaced before new belts are installed.

The proper belt setting is the lowest tension at which the belts will not slip under peak load operation. For initial tensioning, set the belt deflection at 1/64-inch for each inch of belt span (measured halfway between sheave centers). For example, if the belt span is 64 inches, the belt deflection should be one inch (using moderate thumb pressure at mid-point of the drive). Check belt tension two times during the first 24 hours of operation and periodically thereafter.



### Fan Motors

Motor maintenance is generally limited to cleaning and lubrication. Cleaning should be limited to exterior surfaces only. Removing dust and grease buildup on the motor housing assists proper motor cooling. Never wash-down motor with high pressure spray. Greasing of motors is only intended when fittings are provided. Many fractional motors are permanently lubricated for life and require no further lubrication.



### Fan Wheel & Fasteners

Wheels require very little attention when moving clean air. Occasionally oil and dust may accumulate on the wheel causing imbalance. When this occurs the wheel and housing should be cleaned to assure smooth and safe operation. Inspect fan impeller and housing for fatigue, corrosion or wear.

Routinely check all fasteners, set screws and locking collars on the fan, bearings, drive, motor base and accessories for tightness. A proper maintenance program will help preserve the performance and reliability designed into the fan.

### Bearings

Most bearings are permanently lubricated and require no further lubrication under normal use. Normal use being considered -20° to 120°F and in a relatively clean environment. Some bearings are relubricatable and will need to be regreased depending on fan use. Check your bearings for grease zerk fittings to find out what type of bearing you have. If your fan is not being operated under normal use, bearings should be checked monthly for lubrication.



## External Filter Maintenance

Aluminum mesh, 2-inch deep filters are located in the supply weatherhood (if the weatherhood option was purchased). Filters should be checked and cleaned on a regular basis for best efficiency. The frequency of cleaning depends upon the cleanliness of the incoming air. These filters should be cleaned prior to start-up.

Clean filters by rinsing with a mild detergent in warm water.

## Internal Filter Maintenance

The units are always provided with 2-inch, pleated filters in the outdoor air and exhaust airstreams. These filters should be checked per a routine maintenance schedule and replaced as necessary to ensure proper airflow through the unit. See table for pleated filter size and quantity for each unit. Replacement filters shall be of same performance and quality as factory installed filters. Filter type must be pleated design with integral metal grid. Two acceptable filter replacements are Aerostar Series 400 or Farr 30/30®.

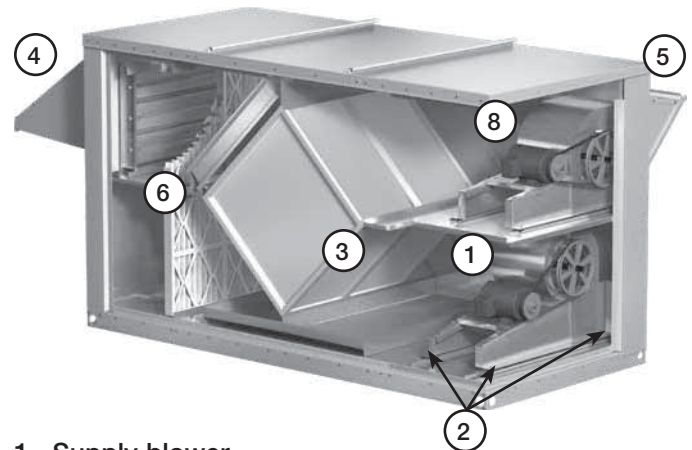
Filter Size and Quantities			
Unit Size	Pleated Filter Size	Quantity	
		Supply and Exhaust	Supply
PVe-20	12 x 25 x 2	3	3
PVe-35	16 x 25 x 2	3	3
PVe-45	20 x 25 x 2	3	3
PVe-55	24 x 24 x 2	3	3

All dimensions in inches.

## Door Seals

Slip-on type seal is installed on the door. Inspect at least annually to ensure that seal is still pliable and intact.

## Parts List



1. Supply blower
  - Forward curved fan
  - Adjustable motor mount for belt tensioning
  - Adjustable sheaves for speed control
2. Vibration isolators (quantity 4 per blower)
  - Neoprene
3. Aluminum plate heat exchanger
4. Supply weatherhood with 2-inch aluminum mesh filter
5. Exhaust weatherhood with birdscreen
6. Supply and exhaust air filter racks for 2-inch pleated, 30% efficient filters
7. Electrical control box (standard features)
  - Single point power
  - Disconnect interlocked with access door
  - Motor starters for the supply and exhaust blower
  - 24 VAC, control circuit with terminal strip  
*Not depicted on this image*
8. Exhaust blower
  - Forward curved fan
  - Adjustable motor mount for belt tensioning
  - Adjustable sheaves for speed control

## Troubleshooting – Airflow

### Test and Balance Report

The Test and Balance Report (TAB) is utilized to determine whether the appropriate amount of outdoor air and exhaust air is being supplied and removed from a building, respectively. There are no set rules on what information must be included in a TAB report. As such, if a TAB report indicates that the airflow on a unit is low, prior to contacting the factory, please determine the following information:

	Unit #1	Unit #2	Unit #3	Unit #4
<b>Model Number</b>				
<b>Serial Number</b>				
<b>Nameplate Information</b>				
Voltage				
Hertz				
Phase				
Outdoor Air Fan Amps				
Exhaust Fan Amps				
Outdoor Air Fan Horsepower				
Exhaust Fan Horsepower				
<b>Design Airflow</b>				
Outdoor Air				
Exhaust				
<b>Measured Airflow</b>				
Outdoor Air				
Exhaust				
<b>Measured Data</b>				
Blower Rotation				
Outdoor Air Fan RPM				
Exhaust Fan RPM				
Outdoor Air Fan Amp Draw				
Exhaust Fan Amp Draw				

Airflow problems can often be tied back to improper ductwork installation. Be sure to install ductwork in accordance with SMACNA and AMCA guidelines.

## Troubleshooting – Unit

Symptom	Possible Cause	Corrective Action
Blower fails to operate	Blown fuse or open circuit breaker.	Replace fuse or reset circuit breaker and check amps.
	Defective motor or capacitor.	Replace.
	Motor overloaded.	Reset VFD and check amps.
	Electrical.	Check for On/Off switches. Check for correct supply voltage. Check Control wiring.
Motor starters “chatter” or do not pull in	Control power (24 VAC) wiring run is too long. (Resistance should not exceed 0.75 ohms).	Shorten wiring run to mechanical room or install a relay to turn unit on/off. Consult factory for relay information. Increase wire gauge size so that resistance is 0.75 ohms or less.
	Incoming supply power is less than anticipated. Voltage supplied to starter coil must be within +10% / -15% of nominal voltage stated on the coil.	Need to increase supply power or use a special control transformer which is sized for the actual supply power.
Motor over amps	Static pressures are higher than design.	Check for dirty filters. Improve ductwork.
	Motor voltage incorrect.	Check motor wiring. Check motor nameplate versus supplied voltage.
	Motor horsepower too low.	See specifications and catalog for fan curves to determine if horsepower is sufficient.
	Shorted windings in motor.	Replace motor.
Low airflow (cfm)	Unit damper not fully open.	Adjust damper linkage or replace damper motor.
	System static pressure too high.	Improve ductwork to eliminate losses using good duct practices.
	Blower speed too low.	Check maximum motor RPM and compare with catalog data. Verify that external control wiring is in place if required.
	Fan wheels are operating backwards.	For 3-phase, see Direction of Fan Wheel Rotation Direction in Start-Up Components section.
	Dirty filter.	Replace filters or follow cleaning procedures in Routine Maintenance section of this manual.
	Leaks in ductwork.	Repair.
	Elbows or other obstructions may be obstructing fan outlet.	Correct or improve ductwork.
High airflow (cfm)	Blower fan speed too high.	Check for correct maximum fan RPM. Decrease maximum fan speed if necessary in the VFD.
	Filter(s) not in place.	Install filters.
	Insufficient static pressure (Ps). (airflow resistance)	Induce Ps into system ductwork. Make sure grilles and access doors are installed. Decrease fan speed if necessary.
Excessive noise or vibration	Fan wheel rubbing on inlet.	Adjust wheel and/or inlet cone. Tighten wheel hub or bearing collars on shaft.
	Bearings.	Replace defective bearing(s). Lubricate bearings. Tighten collars and fasteners.
	Loose wheel on shaft.	Tighten wheel hub.
	Motor base or blower loose.	Tighten mounting bolts.
	Noise being transmitted by duct.	Make sure ductwork is supported properly. Make sure ductwork metal thickness is sized for proper stiffness. Check duct size at discharge to ensure that air velocities are not too high.

*Always have a completed Pre-Start-Up Checklist and Start-Up Checklist prior to requesting parts or service information.*

# Maintenance Log

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# Our Commitment

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*As a result of our commitment to continuous improvement, Greenheck reserves the right to change specifications without notice.*

Specific Greenheck product warranties are located on [greenheck.com](http://greenheck.com) within the product area tabs and in the Library under Warranties.

Greenheck Catalog PVE provides additional information describing the equipment, fan performance, available accessories, and specification data.

AMCA Publication 410-96, Safety Practices for Users and Installers of Industrial and Commercial Fans, provides additional safety information. This publication can be obtained from AMCA International, Inc. at [www.amca.org](http://www.amca.org).

