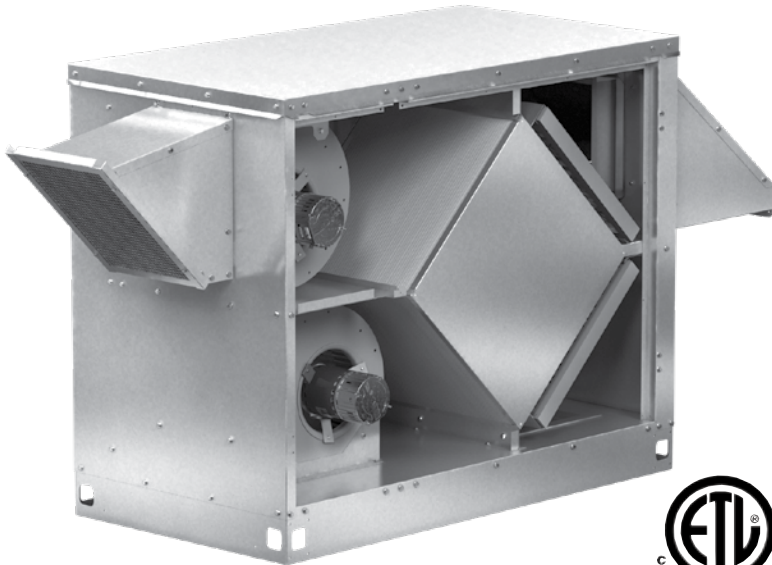


## Installation, Operation and Maintenance Manual

Please read and save these instructions for future reference. 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 these instructions will result in voiding of the product warranty and may result in personal injury and/or property damage.

Energy Recovery Technical Support  
Call 1-800-240-0870



### 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 Electrical 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 effects 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.

## Table of Contents

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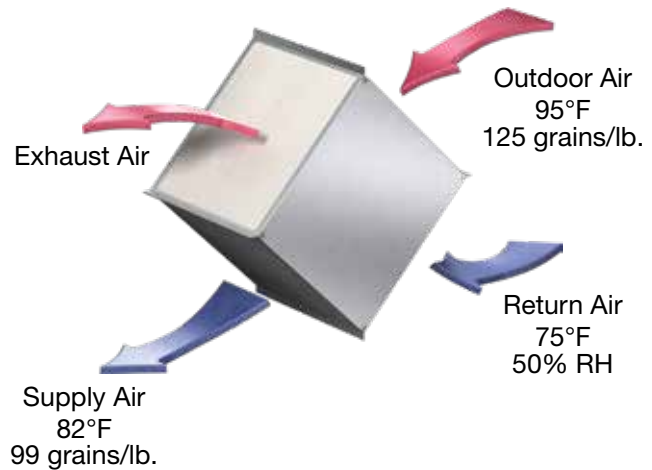
## Unit Overview

### Basic Unit

The unit is 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 fans are energized and optional motorized dampers open. The unit is normally interlocked (24 volt) to the rooftop air handler. When the rooftop air handler starts, the auxiliary contactor in the air handler closes to start the unit.

### Summer Operation

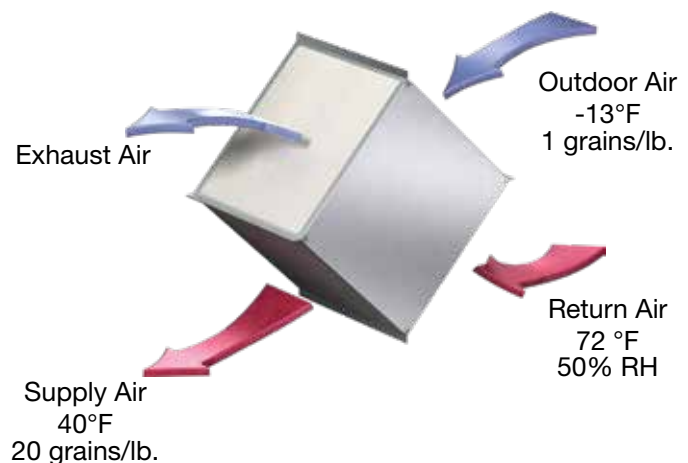
Outdoor air is preconditioned (temperature and moisture levels are decreased) by the transfer of energy from the cooler, drier return air through the energy recovery core. The preconditioned air is typically mixed with return air going back to the air handler for final conditioning.



Summer Operation

### Winter Operation

Outdoor air is preconditioned (temperature and moisture levels are increased) by the transfer of energy from the warmer, more humid return air through the energy recovery core. The preconditioned air is typically mixed with return air going back to the air handler for final conditioning.



Winter Operation

## Receiving

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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 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 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

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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. Inspect interior of unit cabinet for any shipped loose items. 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

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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

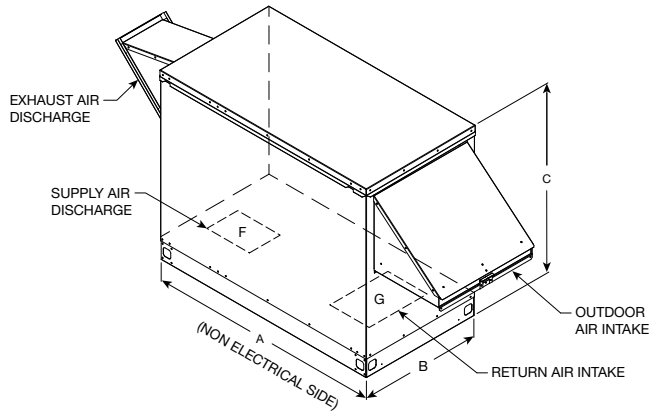
As units are removed from storage to be installed in their final location, they should be protected and maintained in a similar fashion until the equipment goes into operation.

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

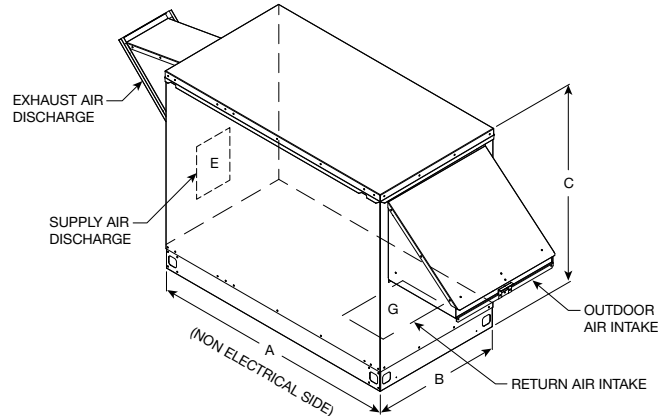
1. Check all fasteners, set screws on the fan, wheel, bearings, drive, motor base, and accessories for tightness.
2. Rotate the fan wheel(s) by hand and assure no parts are rubbing.

# Installation

## Outdoor Mounting Options

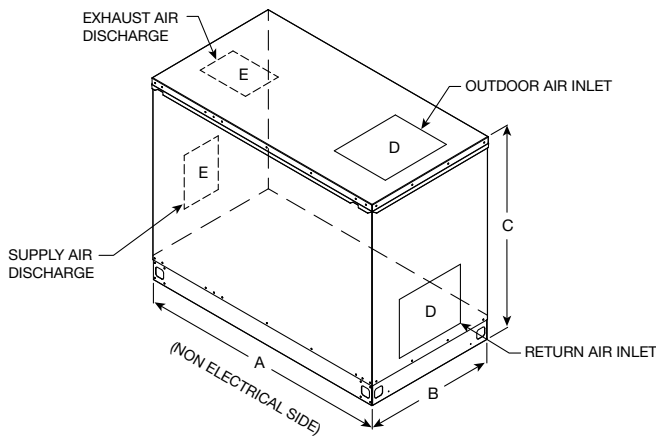


Outdoor Air Discharge Bottom

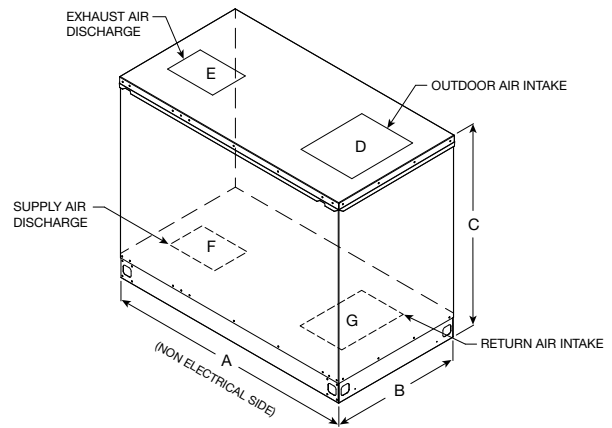


Outdoor Air Discharge End

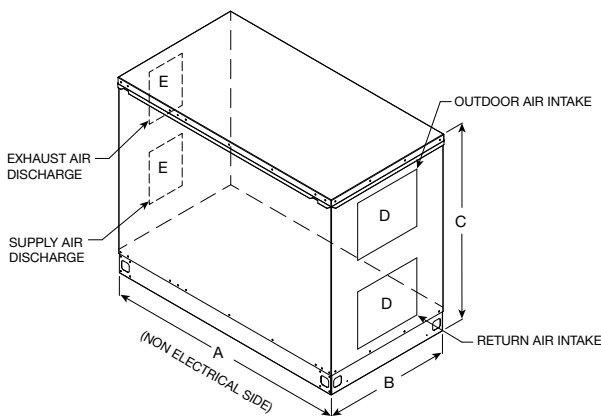
## Indoor Mounting Options



Top and End Connections



Top and Bottom Connections



End Connections

## Dimensional Data and Weights

Unit Size	Exterior Dimensions			Unit Connection Dimensions				Approx. Weight* (lbs.)
	A	B	C	D	E	F	G	
ECV-10	54.8	28.9	43.9	18.4 x 15.9	13.6 x 13.6	8.5 x 11.6	10.3 x 15.2	485
ECV-20	60	43.8	44.9	30.5 x 16	24.5 x 16	23.4 x 14.5	28 x 13.5	813
ECV-30	60	61.3	44.9	50 x 16	44 x 16	38.1 x 14.5	47.5 x 13.5	1075
ECV-40	60	81	44.9	69.3 x 16	52 x 16	52 x 14.5	66.7 x 13.5	1279

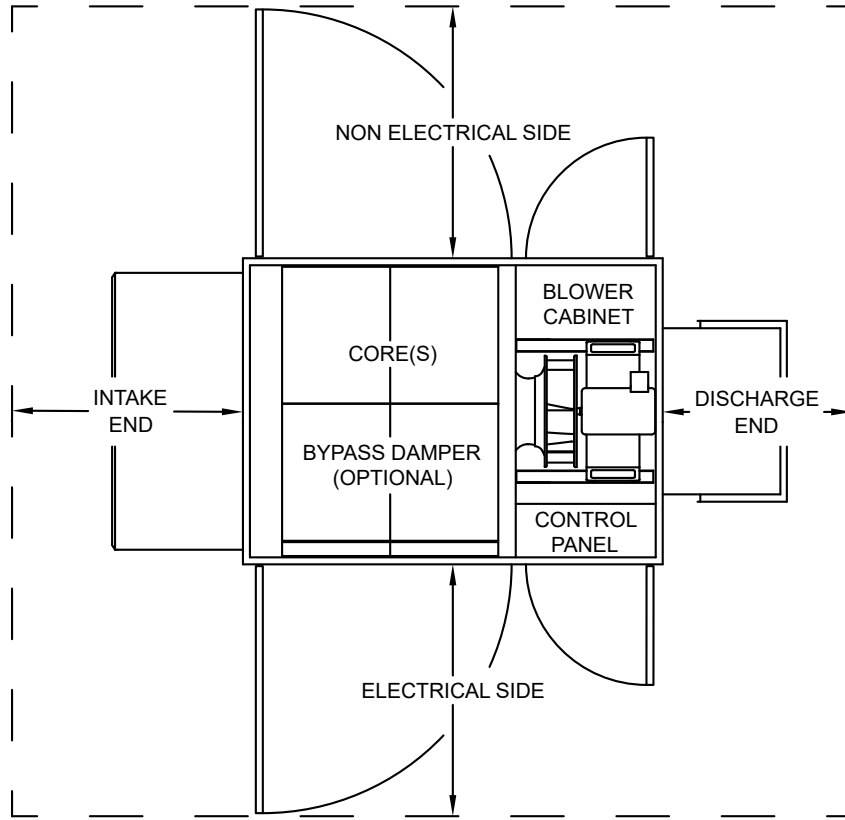
All dimensions are in inches. \*Weight assumes outdoor unit with filters, weatherhoods, outdoor air intake damper, controls and internal double-wall sheet metal.

Intake and Discharge Options				
	Bottom	Top	Side	End
OA Intake		X		X
SA Discharge	X			X
RA Intake	X			X
EA Discharge		X		X

# Installation

## Service Clearances

The ECV unit requires minimum clearances to perform routine maintenance, such as filter replacement and energy core inspection. Blower and motor assemblies, energy recovery core and filter sections are always provided with a service door or panel for proper component access. *Clearances for component removal may be greater than the service clearances, refer to drawing below for these dimensions.*



Hinged Access Service Clearance Requirements									
Unit Size	Electrical Side		Non-Electrical Side		Intake End			Discharge End	
	Recommended	Minimum	Recommended	Minimum	Weatherhood Yes	Weatherhood w/Preheater	Weatherhood No	Weatherhood Yes	Weatherhood No
ECV-10	36	26	36	No Access Required	33	39	No Access Required	24	No Access Required
ECV-20									
ECV-30									
ECV-40									

All dimensions are in inches.

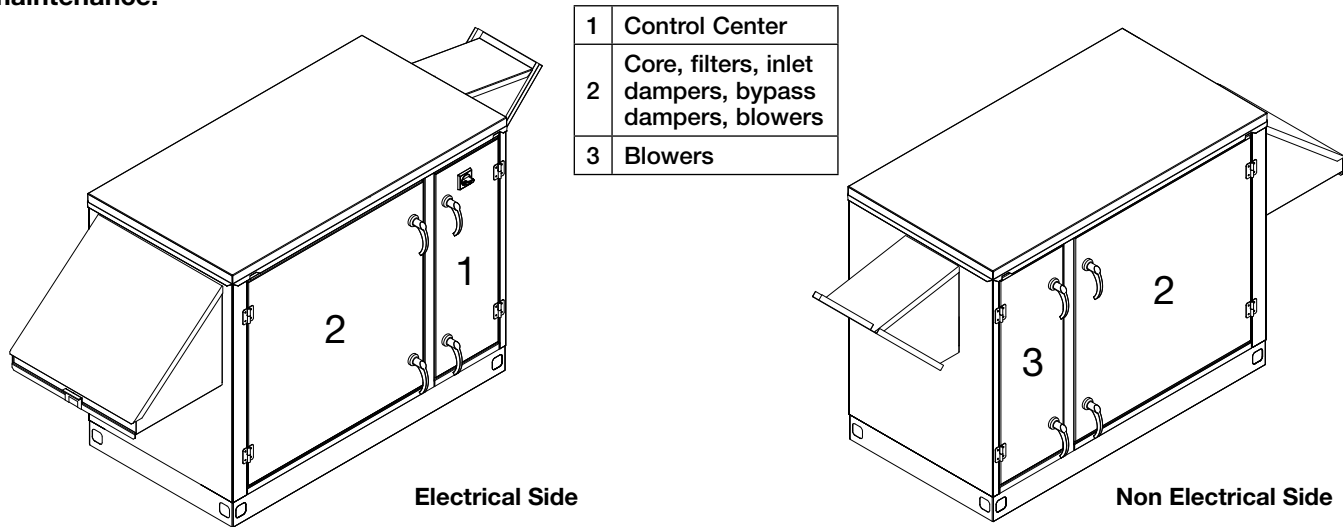
Lift-Off Access Service Clearance Requirements									
Unit Size	Electrical Side		Non-Electrical Side		Intake End			Discharge End	
	Recommended	Minimum	Recommended	Minimum	Weatherhood Yes	Weatherhood w/Preheater	Weatherhood No	Weatherhood Yes	Weatherhood No
ECV-10	24	20	24	No Access Required	33	39	No Access Required	24	No Access Required
ECV-20									
ECV-30									
ECV-40		20 (25 with bypass damper)							

All dimensions are in inches.

# Installation

## Access Panel Locations

The ECV is provided with access panels on both sides of the unit. **The non-electrical side can be placed against a wall. Clearance to the electrical side is essential to provide access to the control center and component maintenance.**



## Handling

While this unit was constructed with quality and dependability in mind, damage still may occur during handling of the unit for 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 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.

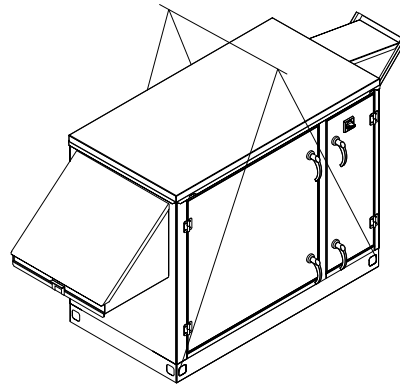
## Lifting

### WARNING

All factory provided lifting lugs must be used when lifting the unit. 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 shown under the Dimensional Data and Weights section.
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.
11. Do not use fork lifts for handling unit.



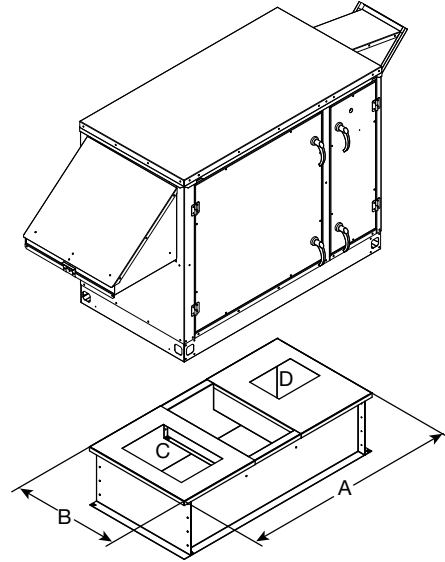
# Installation

## Roof Curb Mounting

Rooftop units require curbs to be mounted first. The duct connections must be located so they will be clear of structural members of the building.

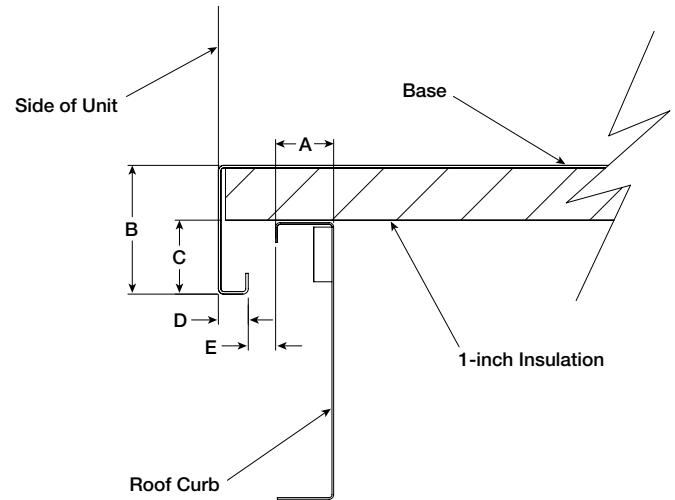
- 1. Factory Supplied Roof Curbs:** Roof curbs are Model GKD. The GKD ships in a knockdown kit (includes duct adapter) and requires field assembly (by others). Assembly instructions are included.
- 2. Install Curb:** Locate curb over roof opening and fasten in place. (Refer to Recommended Roof Openings). Check that the diagonal dimensions are within  $\pm 1/8$  inch of each other and adjust as necessary. For proper unit operation, it is important that the installation be level. Shim as required to level.
- 3. Install Ductwork:** Installation of all ducts should be done in accordance with SMACNA and AMCA guidelines. Duct adapter provided to support ducts prior to setting the unit.
- 4. Set the Unit:** Lift unit to a point directly above the curb and duct openings. Guide unit while lowering to align with duct openings. Roof curbs fit inside the unit base. Make sure the unit is properly seated on the curb and is level.
- 5. Fasten the Unit:** Fasten the unit to the curb/equipment support(s) using appropriate methods. The installer is responsible for determining appropriate support and fastening methods to ensure compliance with all applicable codes.

## Curb Outside Dimensions and Weights



Unit Size	A	B	C	D	Curb Weight (lbs.)
ECV-10	52.3	26.4	16.5 x 11.5	8.5 x 11.6	60
ECV-20	55.8	39.8	28 x 13.5	25.2 x 15.6	79
ECV-30	55.8	57.7	47.5 x 13.5	42.7 x 15.6	95
ECV-40	55.8	76.8	66.7 x 13.5	54 x 15.6	110

All dimensions are in inches. Weight is for 14-inch high model GKD curbs.



### Curb Cap Details for Factory-Supplied Roof Curbs

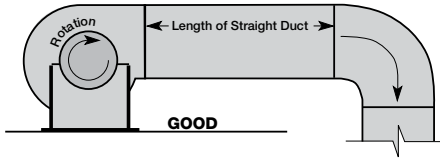
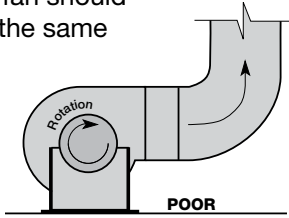
Unit Size	A	B	C	D	E
ECV-10	1.9	5.3	4.3	0.8	0.4
ECV-20	1.9	6.8	5.8	1.6	0.4
ECV-30	1.9	6.8	5.8	1.6	0.4
ECV-40	1.9	6.8	5.8	1.6	0.4

All dimensions are in inches.

# Installation

## 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.

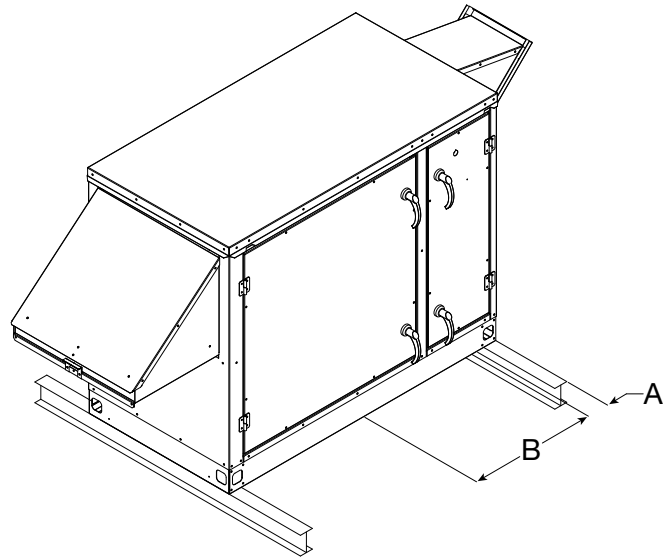


Recommended Discharge Duct Size and Length		
Unit Size	Duct Size (in.)	Straight Duct Length (ft.)
ECV-10	14 x 14	4
ECV-20	24.5 x 16	6
ECV-30	44 x 16	6
ECV-40	52 x 16	6

- 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.

## Rail Mounting / Layout

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



Unit Size	A	B
ECV-10	4.2	11.5
ECV-20	3.1	18.5
ECV-30	3.1	18.5
ECV-40	3.1	18.5

All dimensions are in inches.



## Electrical Information

The unit must be electrically grounded in accordance with the current National Electrical Code, ANSI/NFPA 70. In Canada, use current CSA Standard C22.1, Canadian Electrical Code, Part 1. In addition, the installer should be aware of any local ordinances or electrical company requirements that might apply. System power wiring must be properly fused and conform to the local and national electrical codes. System power wiring is to the unit main disconnect (door interlocking disconnect switch standard on most units) or distribution block and must be compatible with the ratings on the nameplate: supply power voltage, phase, and amperage (Minimum Circuit Amps - MCA, Maximum Overcurrent Protection - MOP). All wiring beyond this point has been done by the manufacturer and cannot be modified without affecting the unit's agency / safety certification.

If field installing an additional disconnect switch, it is recommended that there be 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.

If power supply is desired through bottom of unit, run the wiring through the curb, cut a hole in the cabinet bottom, and wire to the disconnect switch. Seal penetration in cabinet bottom to prevent leakage.

The electric supply to the unit must meet stringent requirements for the system to operate properly. Voltage supply and voltage imbalance between phases should be within the following tolerances. If the power is not within these voltage tolerances, contact the power company prior to operating the system.

**Voltage Supply:** See voltage use range on the rating plate. Measure and record each supply leg voltage at all line disconnect switches. Readings must fall within the allowable range on the rating plate.

**Key:** V1, V2, V3 = line voltages as measured

$$VA \text{ (average)} = (V1 + V2 + V3) / 3$$

VD = Line voltage (V1, V2 or V3) that deviates farthest from average (VA)

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

### CAUTION

If any of the original wire as supplied with the appliance must be replaced, it must be replaced with wiring material having a temperature rating of at least 105°C.

### WARNING

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

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 unit control center access door. The low voltage control circuit is 24 VAC and control wiring should not exceed 0.75 ohms.

Refer to Field Control Wiring Length/Gauge table for wire length maximums for a given wire gauge

Field Control Wiring Length/Gauge	
Total Wire Length	Minimum Wire Gauge
125 ft.	18
200 ft.	16
300 ft.	14
450 ft.	12

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.

If wire resistance exceeds 0.75 ohms, an industrial-style, plug-in 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 (located on the 24 VAC terminal strip under the Typical Control Center Components). 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.

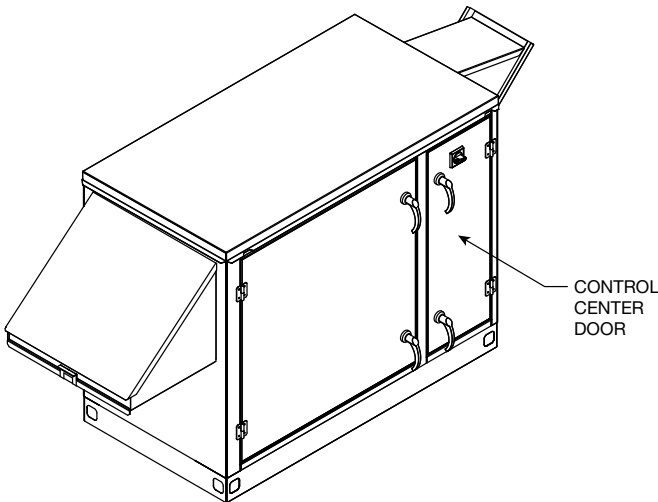
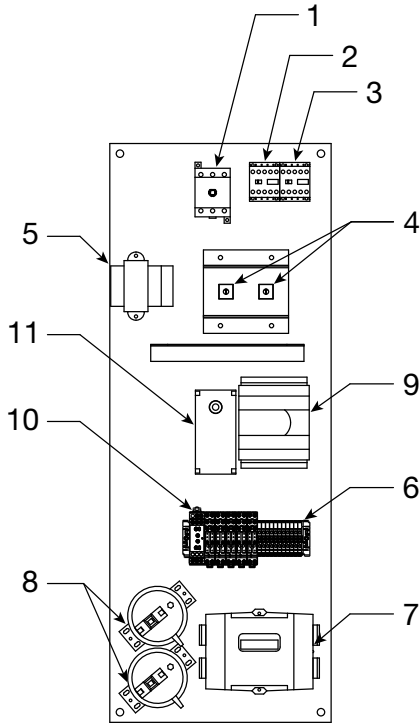
# Electrical Information

## Typical Control Center Components

1. Main Disconnect (nonfusible, lockable)
2. Motor Starter – Exhaust Air Fan
3. Motor Starter – Outdoor Air Fan
4. Speed Controllers/VFDs (Supply & Exhaust)
5. 24 VAC Control Transformer
6. 24 VAC Terminal Strip

## Optional Control Center Components

7. Economizer Controller
8. Dirty Filter Pressure Switches
9. Microprocessor
10. Frost Control Timer
11. Thermostat



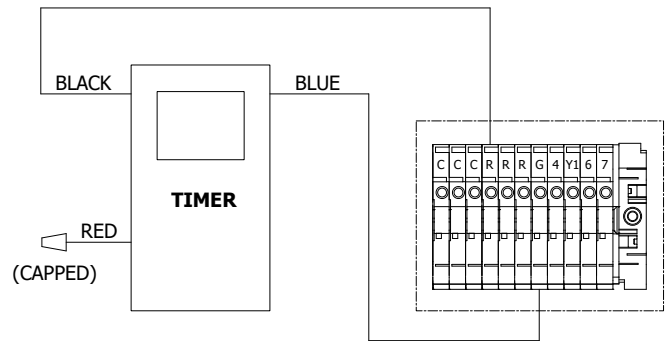
## Optional Accessory Wiring Schematics Remote Panel

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:

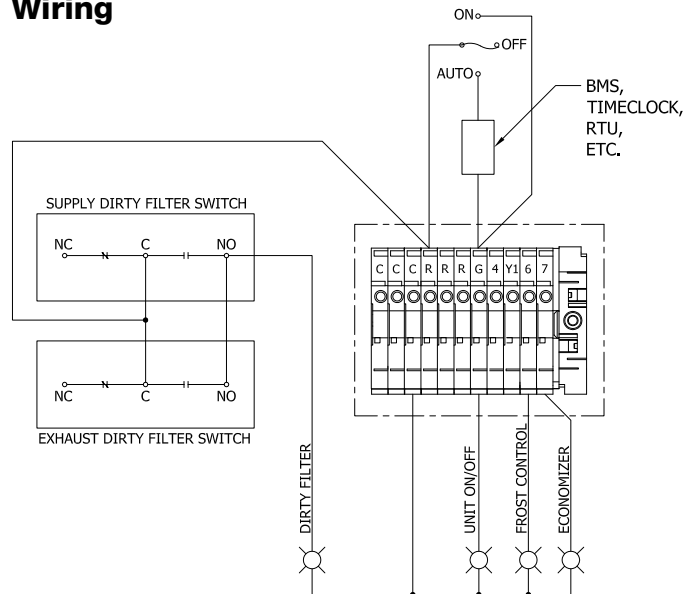
- Unit on/off switch
- Unit on/off light
- 7-day time clock
- Hand/off/auto switch
- Dirty filter light
- Economizer light
- Frost control light



## 7-Day Timer



## On/Off/Auto Switch & Indicator Light Wiring

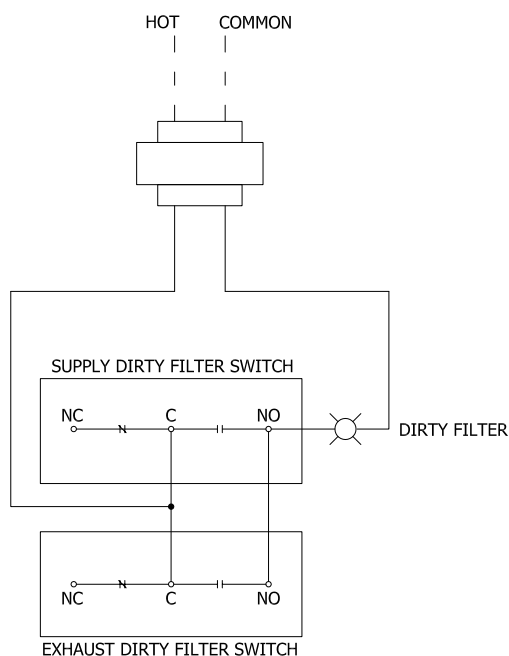


ON/OFF/AUTO SWITCH ALLOWS THREE MODES OF OPERATION  
 "ON" - UNIT IS TURNED ON MANUALLY  
 "OFF" - UNIT IS TURNED OFF MANUALLY  
 "AUTO" - UNIT IS CONTROLLED VIA SCHEDULER OF BMS, TIMECLOCK, TSAT, ETC.



## Electrical Information

### Dirty Filter Indicator (powered by others)



## Optional Component Overview

### Economizer

The energy core operation can be altered to take advantage of economizer operation (free cooling). Two control options are available:

1. Bypass damper
2. Exhaust only operation

**Bypass damper:** An integral bypass damper will cycle into a bypass condition allowing cool air to flow past the energy recovery core rather than flow through it. When outdoor air conditions are not suitable for economizer operation, the damper will remain closed. Economizer mode is initiated by temperature or enthalpy and dependent on the sensor. Energizing the bypass damper is accomplished one of two ways:

1. The outdoor air temperature is between 50°F (adj.) and 65°F (adj.).
2. The outdoor air temperature is between 50°F (adj.) and 65°F (adj.) or has an enthalpy >23.0 btu/lb. (adj.).

**Exhaust only operation:** The unit will have the capability to receive an external signal to power the supply fan on/off.

### Frost Control

Extremely cold outdoor air temperatures can cause moisture condensation and frosting on the energy recovery core. Timed exhaust and an electric preheater are optional frost control features that will prevent/control core frosting.

**Timed exhaust** frost control includes a timer as well as an adjustable thermostat (preset at 36°F) that is factory installed in the exhaust airstream. When timed exhaust frost control is initiated, the timer will turn the supply blower off. Timed exhaust uses a default timer setting that will shut down the supply fan for 5 minutes every 30 minutes to allow for the exhaust air to defrost the energy core.

**Electric preheat** comes standard as single-stage on/off control. Preheaters are single point wired at the factory. An adjustable thermostat (preset at 36°F) is mounted in the exhaust airstream to monitor the discharge air temperature and enable the preheater if required. If the temperature falls below the set point, the electric preheater will turn on. Access to the electric preheat is through the outdoor air filter access door.

Reference *Optional Start Up Components, Frost Control Test Procedure* for troubleshooting.

## Optional Component Overview

### Variable Frequency Drives (VFD)

VFDs 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

The factory-provided sensors can be set to reference a set point for on/off operation.

This accessory is often used in Demand Control Ventilation (DCV) applications. The factory-provided sensor can be set to reference a set point for multi-speed operation on the ECV-20, -30 and -40. The CO<sub>2</sub> sensor can also be used to output a 2-10 VDC signal to modulate the fan speed on all models.

The CO<sub>2</sub> sensor is either shipped loose to mount in the room space, ductwork, or is 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 unit control center.

### Airflow Monitor

A factory-wired, mounted, and powered airflow monitoring system is provided in the outdoor and/or exhaust air streams. The airflow control system offers the following functionality:

- Display of outdoor and/or exhaust airflow rate in actual cubic feet per minute (CFM) or actual liters per second (LPS) on a 16 character LCD display.
- Two configurable analog outputs for transmitting outdoor and/or exhaust airflow rate, outdoor air temperature, or a proportional-integral-derivative (PID) control signal based on an outdoor airflow set point.
- A configurable digital output that operates based on an airflow set point or range.

### Operation

Outdoor and/or exhaust airflow monitoring is accomplished using two thermal dispersion sensors that accurately measure airflow velocity down to zero feet per minute (fpm). The airflow controller takes the average measurement for two sensor configurations, and determines the outdoor airflow rate based on the effective intake area. Field calibration of the outdoor airflow monitoring device determines the effective intake area of the unit. Refer to GreenTrol® Automation Inc. GF-N2211 technical data sheet for further detail.

#### Important

For the airflow monitoring device to perform as intended, field calibration is required. Calibration of the airflow monitoring device requires an independent measurement of airflow and should be performed when the system undergoes test and balance.



# Start-Up

## 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.

Provided with Unit?

### Frost Control Application / Operation section:

			Setting	Factory Default
Yes	No	Frost Control thermostat		36°F
		Differential		2°F
		Timer		Refer to page 17

### Economizer Application / Operation section:

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

### Optional Accessories section:

### Operational

Yes	No	OA Dirty Filter Sensor	Yes	No	N/A
Yes	No	EA Dirty Filter Sensor	Yes	No	N/A
Yes	No	CO <sub>2</sub> Sensor	Yes	No	N/A
Yes	No	Remote Control Panel	Yes	No	N/A

### Variable Frequency Drives section:

### Operational

Yes	No	Blower VFDs	Yes	No	N/A
-----	----	-------------	-----	----	-----

### Damper section:

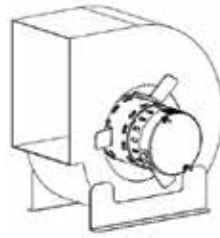
### Operational

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

## Start-Up Components

### Forward-Curved Fans

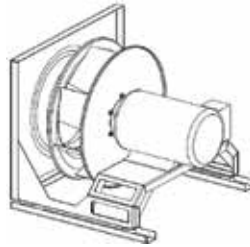
Model ECV-10 contains two, direct drive forward curved (1 supply and 1 exhaust) fans. These forward curved fans should be checked for free rotation. If any binding occurs, check for concealed damage and foreign objects in the fan housing.



Forward-Curved

### Plenum Fans

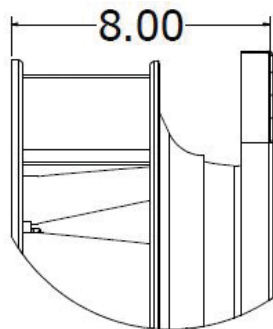
Model ECV-20 contains two, direct drive plenum (1 supply and 1 exhaust) fans. Model ECV-30 and ECV-40 contain four, direct drive plenum (2 supply and 2 exhaust) fans. Plenum fans are single width, single inlet fans. The impellers are unshrouded with blades that curve away from the direction of rotation. These fans throw the air radially outward, approximately 90 degrees from the inlet direction.



Plenum

### Plenum Fan Alignment

If necessary, adjust wheel position by loosening the wheel hub from the motor shaft. Adjust wheel position so the back edge of the plenum wheel is 8-inches from the inside face of the venturi panel.



### Fan Performance Modifications

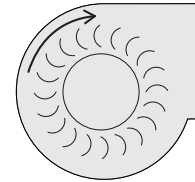
Start-up technician must check blower amperage to ensure that the amperage listed on the motor nameplate is not exceeded. Amperage to be tested with access doors closed and ductwork installed.

#### CAUTION

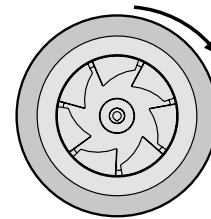
When operating conditions of the fan are to be changed (speed, pressure, temperature, etc.), consult Greenheck to determine if the unit can operate safely at the new conditions.

### 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 (see Rotation Direction figures). 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 or vibration. Refer to the Troubleshooting section of this manual if a problem develops.



Forward-Curved Fan Rotation



Plenum Rotation

(Always clockwise as viewed from inlet)

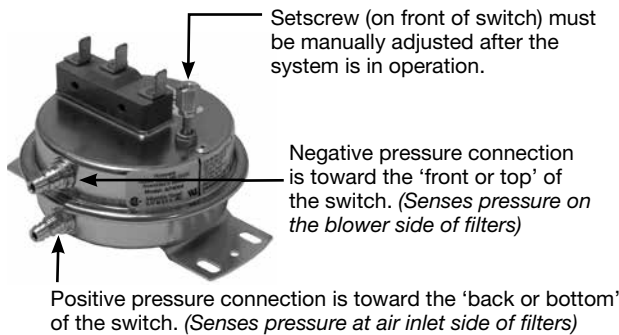
### Fan RPM

Supply fan(s) and exhaust fan(s) shall be preset at the factory to the customer specified RPM. 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. *Do not operate units with access doors open or without proper ductwork in place as the fan motors will overload.*

## 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.

### Economizer

#### Relevant Set Points

1. MAT SET The outdoor air temperature set point after the energy core. The control will open/close the bypass damper to maintain temperature as best as it can. (Set point menu, default 53°F)
2. LOW T LOCK The set point for the low temperature mechanical cooling lockout. (Set point menu, default 32°F)
3. DRYBLB SET The outdoor air set point to call for economizer. (Set point menu, default 63°F)
4. AUX1 O The controllers operating sequence structure. (Set point menu, default 'None')
5. ERV OAT SP The set point for low temperature economizer lockout. This is the low temperature set point when AUX1 O is set to ERV. (Set point menu, default 40°F)

#### Using the Keypad with Settings and Parameters

To use the keypad when working with set points, system and advanced settings, checkout tests, and alarms:

1. Navigate to the desired menu.
2. Press **↵** (enter) to display the first item in the currently displayed menu.
3. Use the **▲** and **▼** buttons to scroll to the desired parameter.
4. Press **↵** (enter) to display the value of the currently displayed item.
5. Press the **▲** button to increase (change) the displayed parameter value.\*
6. Press the **▼** button to increase (change) the displayed parameter value.\*
7. Press **↵** (enter) to accept the displayed value and store it in non-volatile RAM.
8. CHANGE STORED displays.
9. Press **↵** (enter) to return the current menu parameter.
10. Press **⏪** (escape) to return to the current menu parameter.

\*When values are displayed, pressing and holding the **▲** or **▼** button causes the display to automatically increment.

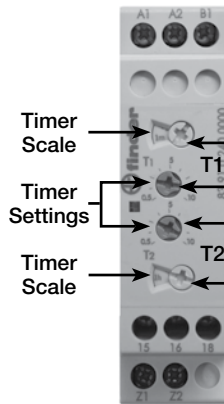


## Optional Start-Up Components

### Frost Control Test Procedure

#### Timed Exhaust

1. Remove power from unit.
2. Jumper the temperature indicating sensor in the unit control center. Thermostat controller has a pre-set temperature of 36°F.
3. Turn dial on the thermostat TS1 to highest temperature setting (130°F).
4. Add power to the unit. Blower should cycle on for 30 minutes, then turn off for 5 minutes.
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 blower off time.
  - **T2** timer setting set to **5** and timer scale set to **1h** for 30 minutes of blower on time.



#### Electric Preheat

1. Remove power from unit.
2. Place wire jumper between terminal R and G.
3. Turn dial on the thermostat TS1 to highest temperature setting.
4. Apply power to unit. Preheater should turn on.
5. Remove power from unit, if applicable remove wire jumper placed between R and terminal G, and turn dial on thermostat TS1 to factory setting (36°F).

### CO<sub>2</sub> Proportional Control

#### Speed Controller

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 ECV-10-VG carbon dioxide sensor is wired to the speed controller with default factory settings for proportional control of 500 PPM or less CO<sub>2</sub> = 50% fan speed and 1500 PPM or greater CO<sub>2</sub> = 100% fan speed. The blower's speed proportionally modulates between 500 and 1500 PPM CO<sub>2</sub>.

#### Variable Frequency Drive

The ECV-20, -30, and -40 are wired to the Variable Frequency Drive (VFD). Refer to the Variable Frequency Drive section for control sequence and programming.

### Vari-Green® Electronically Commutated (EC) Motor

#### Features

**Soft Start** – All motors feature soft-start technology which eliminates inrush current at start-up. The motors will reliably start at any speed setting.



**Overload Protection** – If the motor becomes overloaded, it will automatically reduce its speed until it is no longer overloaded. This means that the motor will never operate in the “service factor” which is possible with many AC motors.

**Locked Rotor Protection** – If the motor ever encounters a locked-rotor scenario, the motor will automatically shut itself down. It will try to restart up to 3 times and if after the 3rd time the motor will still not rotate, the motor will not attempt to start again until power is cycled.

**Thermal Protection** – The motors will have an internal thermal protection which electronically regulates the RPM limit until an acceptable temperature is met.

#### Operation and Wiring

These motors have the ability to accept a plug in potentiometer for speed adjustment AND the ability to accept a 0-10V signal for remote control.

**Motor Potentiometer** - Turn the dial with your fingers to adjust. To increase the speed, rotate the dial clockwise. To decrease the speed, rotate the dial counterclockwise. Turning the dial full counterclockwise will turn the motor off.

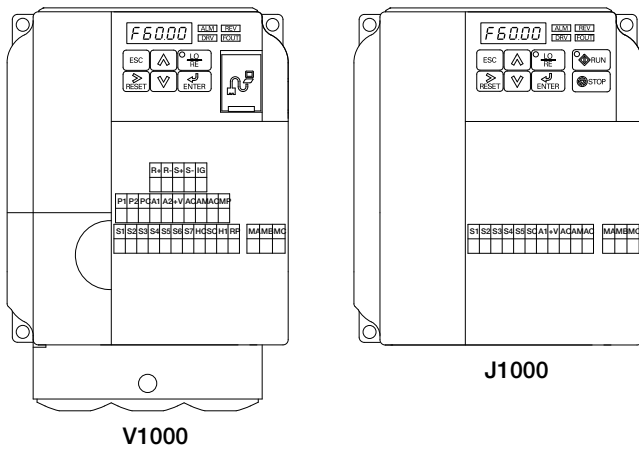
**0-10 VDC Signal** - From 0-1.9V, the motor will be off and will operate within the 2-10V range. This motor does not require 24V power for operation.

# Optional Start-Up Components

## Variable Frequency Drives

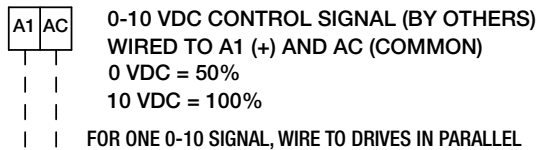
Optional factory installed, wired, and programmed variable frequency drives (VFDs) may have been provided for modulating or multi-speed control of the blowers. One VFD, either Yaskawa model V1000 or J1000, is provided for each blower (supply air and exhaust).

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).



### OPTION 1 - 0-10 VDC CONTROL

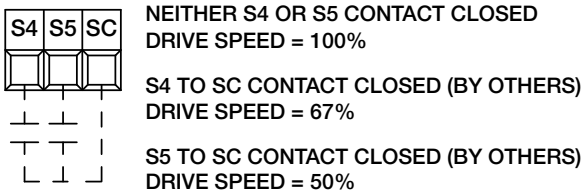
USER TO PROVIDE ISOLATION AS REQUIRED



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

## 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 the min and max Hz (Max. 90 Hz)
- **Multi-speed:** Digital contact closures by others command the VFD to run at multiple speed settings:
  - Open - Drive runs at 100%
  - SC to S4 - Drive runs at 67%
  - SC to S5 - Drive runs at 50%
- **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 to the settings programmed at Greenheck. This option is not available on the J1000.



## Optional Start-Up Components

### Outdoor Airflow Monitor

For additional information on how to navigate through the airflow controller menus, refer to technical manuals GF-2200A from GreenTrol® Automation Inc. at [www.greentrol.com](http://www.greentrol.com).

#### Field calibration procedure:

1. Turn off power to the unit using the power disconnect(s).
2. Remove the cover from the GreenTrol airflow monitoring controller.
3. Install a jumper wire between terminals R and G on the unit's terminal board if one isn't present.
4. When safe, turn the power back on to the unit using the power disconnect(s).

#### ***If no microprocessor controller, skip to step 8. Steps 5 thru 7 are for microprocessor only.***

5. Look at the unit's microprocessor controller screen and view the status of the unit. If the displayed status is "System Off" continue with step 6, otherwise go to step 7.
6. Adjust the unit on/off priorities on the unit's microprocessor controller so that the unit will run for calibration.
  - a. Push the "Prg" button on the microprocessor controller.
  - b. Use the up and down arrows to get to the "On/Off Unit" menu.
  - c. Push the enter button to view the current unit on/off priorities.
  - d. Push the down arrow to display the Unit ON/OFF Control screen.
  - e. Record the settings below so they can be changed back when calibration is complete.  
By digit input: \_\_\_\_\_  
By BMS: \_\_\_\_\_  
By Scheduler: \_\_\_\_\_
  - f. Use the enter button to navigate between the different settings on the page, use the up and down arrows to change the values so that "By digit input" is the only setting with "Yes".
7. Measure the supply airflow rate of the unit using an approved test and balance method.
8. Without making any changes to the system, calibrate the airflow monitoring controller so it reads the airflow measured in step 8 by using the Field Calibration Wizard.
  - a. The field calibration lasts for two minutes. Any significant changes in airflow will affect the accuracy of the reading.
  - b. To enter the Field Calibration Wizard, hold the Down and Enter buttons simultaneously on the airflow controller, then release the buttons.
  - c. Push the enter to enter to go Wizard 1
  - d. Push the enter button twice and change Wiz1 Enable to YES.
  - e. When asked for the number of calibration points (Cal Points), set the value to 1.
  - f. Push the enter button when the display says "Set Flow 1".
  - g. After completing the steps above, set the FLOW1 value to the airflow measured in step 8, then push the enter button to begin calibration.
9. After the calibration is completed, measure the supply airflow rate again and compare with the value on the airflow controller's display
  - a. If the values are within 5% of each other the device has been successfully calibrated.
  - b. If the values are not within 5% of each other repeat the field calibration process.
10. If you had to change the On/Off priorities on the microprocessor unit controller, change them back to the values that were written down in part 6.
11. Turn off power to the unit using the power disconnect(s) and wait one minute for the variable frequency drive(s) to lose backup power.
12. Replace the cover to the GreenTrol airflow monitoring station.
13. If you added a jumper between terminals R and G in step 3 remove it at this time. If a jumper was already in place, leave it in place.
14. When safe, turn the power back on to the unit using the power disconnect(s).
  - a. Recycling of the power resets the manual override values that were set during the calibration.

## Routine Maintenance

### 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

#### Motors

Check for cleanliness

#### Blower Wheel & Fasteners

Check for cleanliness

Check all fasteners for tightness

Check for fatigue, corrosion, wear

#### 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:

#### 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 Motors/Fans

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.

To access the fan motors on units with multiple supply and exhaust fans (ECV-30 and ECV-40). The fan closest to the outside of the unit can be accessed using the blower access door. The interior fans and motors will need to be accessed from inside the unit. First remove the energy cores and filters from the unit, next remove the core support that separates the supply and exhaust air streams on the blower panel. Next remove the intake cone panel that houses both the intake cones for the exhaust air stream (upper rectangular panel). Once this is removed, you should have access to the exhaust fan that is located on the control side of the housing. Reinstall intake cone panel and then remove the lower intake cone panel (lower rectangular panel). This will allow access to the supply blower that is located on the control side of the housing. Replace panel after service, reinstall core support that was removed, then reinstall cores and filters.

#### 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, motor base and accessories for tightness. A proper maintenance program will help preserve the performance and reliability designed into the fan.

#### External Filter Maintenance

Aluminum mesh, 2-inch deep filters are located in the supply weatherhood (if the weatherhood option was ordered). 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 will typically be 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®.

## Routine Maintenance

Pleated Filter Size and Quantities				
Unit Size	Supply		Exhaust	
	Size	Qty	Size	Qty
ECV-10	20 x 25	1	20 x 25	2
ECV-20	20 x 20	2	20 x 20	2
ECV-30	20 x 20	3	20 x 20	3
ECV-40	20 x 20	4	20 x 20	4

All dimensions in inches.

**Outdoor Air Filters:** Access to the outdoor air filters is through the door labeled as “Filter Access” on the sides of the unit.

**Exhaust Air Filters:** Access to the exhaust air filters is through the door labeled as “Filter Access” on the sides of the unit.

Refer to Access Panel Location section for additional information on filter locations.

### Door Seal Maintenance

A bulb seal is installed on the perimeter of the door frame. Inspect at least annually to ensure that the seal is still intact.

### Energy Recovery Core

The energy recovery core should be inspected and cleaned based on the application requirements and core type as outlined below.

#### WARNING

Do not wash, soak in water, or use detergents and/or cleaners on the fiber membrane core. This will result in a damaged core and will not be covered by the warranty.

#### WARNING

Energy core shall not be subjected to temperatures greater than 140°F. This will result in a damaged core and will not be covered by warranty

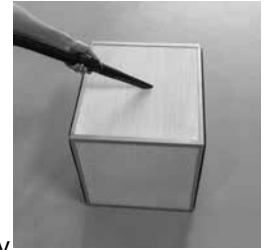
### Fiber Membrane

**Frequency of cleaning** - A regular cleaning cycle must be established for the energy recovery core in order to maintain optimum sensible and latent energy transfer. In reasonably clean environments such as schools, offices or retail stores, the energy recovery core should be inspected annually and cleaned as needed. Failure to follow a regular cleaning cycle for the energy recovery core can result in significant energy transfer performance losses.

**Accessing the energy recovery core** - Disconnect the power to the unit. Remove access panel.

**Removing the energy recovery core** - Once the energy core access doors are removed, the core can be pulled from the housing. To replace the core, reverse the procedure.

**Recommended cleaning procedure** - Once the core is removed, gently vacuum the surfaces of the core to remove the dirt and debris that has accumulated.



### Polymer Membrane

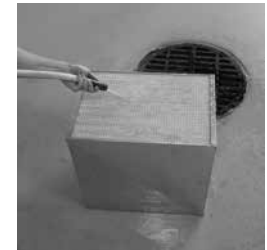
**Frequency of cleaning** - A regular cleaning cycle must be established for the energy recovery core in order to maintain optimum sensible and latent energy transfer. In reasonably clean environments such as schools, offices or retail stores, the energy recovery core should be inspected annually and cleaned as needed. Failure to follow a regular cleaning cycle for the energy recovery core can result in significant energy transfer performance losses.

**Accessing the energy recovery core** - Disconnect the power to the unit. Remove access panel.

**Removing the energy recovery core** - Once the energy core access doors are removed, the core can be pulled from the housing. To replace the core, reverse the procedure.

### Recommended cleaning

**procedure** - Once the core is removed, ensure that the plates are orientated in a way for proper draining. Use low pressure tap water to clean the core. If the core is extremely dirty, use a mild detergent such as Dawn® in a solution no less than 1:100 parts water to soap.



#### WARNING

Do not use a high pressure water source (pressure washer) or harsh, corrosive detergents. This will result in a damaged core and will not be covered by the warranty.

#### WARNING

Energy core shall not be subjected to temperatures greater than 140°F. This will result in a damaged core and will not be covered by warranty

## 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 starter overloaded.	Reset starter and check amps.
	Electrical.	Check for On/Off switches. Check for correct supply voltage.
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 which will turn unit on/off. Consult factory for relay information.
	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	CFM too high.	Check cfm.
	Static pressures are higher or lower than design.	If higher, ductwork should be improved. If lower, fan rpm should be lower.
	Blower rotation is incorrect.	Check rotation and reverse if necessary.
	Motor voltage incorrect.	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.
	Fan wheels are operating backwards.	For 3-phase, see Direction of Fan Wheel Rotation under Unit Start-Up section.
	Dirty filter or energy core.	Follow cleaning procedures in Routine Maintenance section.
	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 fan rpm. Decrease fan speed if necessary.
	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.
One or both blowers turn off intermittently and back on after about 2 minutes	Frost control sensors are tripping.	Adjust frost temperature sensor set point as needed.
Excessive noise or vibration	Fan wheel rubbing on inlet.	Adjust wheel and/or inlet cone. Tighten wheel hub on shaft.
	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, unit Start-Up Checklist, and Optional Accessories Checklist prior to requesting parts or service information.

# Troubleshooting - Economizer Alarms

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## Addressing Alarms

Alarms will signify a faulty sensor. When this occurs, verify all connections to the sensor and controller are secure. Press enter twice to clear the alarm. If the issue persists, consult the factory.

## Clearing Alarms

Once the alarm has been identified and the cause has been removed (e.g. replaced faulty sensor), the alarm can be cleared from the display.

To clear an alarm, perform the following:

1. Navigate to the desired alarm.
2. Press the **↵** (enter).
3. ERASE? displays.
4. Press **↵** (enter).
5. ALARM ERASED displays.
6. Press **⏏** (escape) to complete the action and return to the previous menu.

### NOTE

After clearing the alarm, it will redisplay after five seconds.

## Our Commitment

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

Product warranties can be found online at [Greenheck.com](http://Greenheck.com), either on the specific product page or in the literature section of the website at [Greenheck.com/Resources/Library/Literature](http://Greenheck.com/Resources/Library/Literature).

Greenheck's Energy Recovery Ventilators, Preconditioners, Models MiniVent, ERV, ERVe, MiniCore, ECV and ERM catalog 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).

