Supplement Microprocessor Controller

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.

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Overview

This document is to be used in conjunction with the Microprocessor Controller for Dedicated Outdoor Air System Installation, Operation and Maintenance Manual (IOM). All safety information provided in that IOM pertains to Heat-Cool Only controls also.

Heat-Cool Only Overview

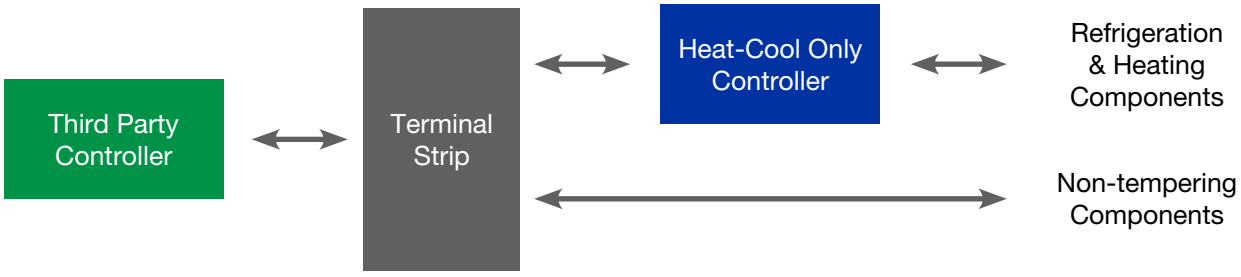
Heat-Cool Only is designed to allow third-party control of a packaged DX, or Heat Pump unit while maintaining the safeties of the refrigeration system and heating devices. To achieve this, the Heat-Cool Only controller is factory installed and factory commissioned. This controller is responsible for the operation of the refrigeration and heating components installed in the unit. The safety of the refrigeration system is assured by monitoring pressures and temperatures contained within the refrigeration circuit(s). The third party is required to control the following: supply and exhaust airflow, cooling or heating operation selection, dehumidification enable, temperature setpoints, and emergency shutdown.

Additionally, a third-party device that is field supplied and installed provides occupancy, temperature, and airflow monitoring. This third-party device interfaces to the Heat-Cool Only controller via a terminal strip in the control cabinet, as represented in the image below.

END DEVICES: End devices required for Heat-Cool Only operation are provided and installed in the unit for the sole purpose of operating the heat/cooling control system. Sensors required for the third-party controller operation are to be provided and installed by the third party. Additionally, the third-party control system may use additional end devices not provided by the factory. Please refer to the unit's submittal information for the exact unit configuration and selected options to determine factory provided end devices.

WARNING

Powering the third-party controller is the responsibility of the third party. The third party will supply and install a transformer to power their controller. This power cannot be taken from the control panel. The third-party device cannot be mounted in the electrical control panel of the unit.



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Third Party Responsibilities

Occupancy, temperature, airflow, and third-party device power with Heat-Cool Only are the responsibility of the third party through a third-party device. This control not only includes the timing of each occupied mode, but logic for enabling and modulating all non-refrigeration or heating components.

Occupancy

Scheduling and occupancy mode control are the responsibility of the third party.

Airflow

Maintaining the proper airflow by enabling and modulating the fans and dampers is the responsibility of the third-party controller.

During normal operation, airflow should continue over the unit's heat exchangers after removing the remote start command to the Heat-Cool Only controller. For units with variable speed compressors, the compressors may take up to two minutes to completely stop. Additionally, in heating mode, supply airflow should continue until the supply air temperatures drop below 80ºF to dissipate the heat remaining in the heating devices and prevent excessive component temperatures.

DAMPER POSITIONING: Dampers will need to be powered and a position signal provided, when the dampers are modulating. Prior to starting fans in the unit, the third party will ensure that there is an open path for airflow by confirming that the damper end switch is closed, when installed.

FAN MODULATION: The enable and modulation signals are the responsibility of the third-party controller.

- **Supply Fan:** Supply fan modulation will need to follow these guidelines. The end switch signal must be received prior to the start of any fans in the unit when installed.
  - **Cooling or Heat Pump Heating:** When the unit is operating in cooling mode or heat pump heating, the fan turndown must be limited to a minimum of 50% of the designed airflow to ensure the refrigeration system can adequately modulate to meet the desired temperature setpoints. Modulating below 50% of the designed airflow may result in loss of space temperature control and have a negative impact on the refrigeration and heating components.
  - **Electric Heat:** Supply fan modulation must be limited to the minimum airflow requirements of the electric heater manufacturer. The minimum air flow required through a duct heater depends on the KW per square foot of face area for the highest capacity ON-OFF stage. In general, 500 FPM is adequate in most applications. ***Please contact technical support to get more information regarding specific products.***

WARNING

When modulating the gas furnace heating capacity, it is recommended to maintain a maximum temperature rise and a minimum airflow for all units. The criteria must be met when controlling the staging and modulation of the gas furnaces in order to prevent improper combustion and damage to the unit.

Please see Appendix B – Heat-Cool Only Heating Limitations for minimum airflow specific to the unit size and furnace installed.

Please refer to the unit's submittal information for the exact gas furnace performance data.

  - **Gas Furnace Heat:** When the unit is heating with a gas furnace, limit turndown to the minimum airflow based on the unit size or 50.0% of design airflow, whichever value is greater.

    Please see Appendix B – Heat-Cool Only Heating Limitations for minimum airflow specific to the unit size and furnace installed.

- **Exhaust fan:** Exhaust fan modulation will need to maintain the building requirements.

Energy Recovery

Control of energy recovery equipment installed in the unit is the responsibility of the third party. A heat wheel with or without a VFD, a core with face/bypass dampers or a bypass only damper must be controlled to a third-party provided sensor.

ENERGY WHEEL BYPASS DAMPER: When provided, the energy wheel bypass damper needs to be opened when exceeding design outdoor airflow rate in economizer mode by turning off the energy recovery wheel.

ENERGY CORE DAMPERS: When selected, the energy core may have either face and bypass dampers or only a bypass damper.

- **Face/Bypass Dampers:** When face and bypass dampers are both installed, the signal to the actuator would be 2-10V that is the desired for energy recovery. The signal in this situation is controlling the face damper and the bypass is the inverse of the signal.
- **Bypass Only Damper:** When only a bypass damper is installed, the signal to the actuator would be 2-10V also. However, the signal is the opposite of the desired for energy recovery. If 80% energy recovery is desired, then the signal to the bypass damper should be 20% or 2 volts. The signal is controlling the bypass damper.

ENERGY RECOVERY DEFROST: Both forms of energy recovery must have a defrost sequence provided via the third-party controller.

- **Energy Recovery Wheel:** The third party will provide either an exhaust air temperature sensor or heat wheel pressure differential sensor/switch when pre-heat is not installed in the unit and the energy recovery device is used for exhaust air energy recovery. The exhaust air temperature must remain above 36°F or the differential pressure is less than 1.5"wc when the outside air temperature is below 10°F.
- **Energy Core:** The third party will provide an exhaust air temperature sensor when pre-heat is not installed in the unit and the energy recovery device is used for exhaust air energy recovery. The exhaust air temperature must remain above 36°F.
- **Electric Preheat:** When a preheat device is installed for energy recovery defrost, the third-party controller needs to ensure that the following conditions are met prior to enabling the preheat device.
    - Outside Air Damper >=30% open; AND
    - Supply Fan enabled; AND
    - Outdoor Air Temp < 10°F.

  NOTE: Please see manufacturer's information for suggested minimum cfm for pre-heat.

Temperature

Heat-Cool Only Control requires the third party to make decisions based on operating conditions and setpoints to heat, cool, dehumidify, or economize.
The third-party controller will communicate setpoints, via hard-wired 2-10 VDC signals, based on the operating mode:

- Cooling – Cooling Coil Setpoint
- Dehumidifying – Cooling Coil and Supply Air Setpoints
- Heat Pump Heating – Supply Air Setpoint
- Heating – Supply Air Setpoint

The third-party controller needs to control the amount of economizer and energy recovery capacity necessary to meet the current requirements, depending on the equipment installed in the unit. Analog output signals are sent via the terminal strip that interfaces with the controller or directly to the end devices.

Please refer to the unit wiring schematics or see Appendix A – Terminal Strip Wiring for further information regarding control input types and terminal strip wiring.

- **Cold Coil Temperature Control:** The third-party controller will send a signal to control the compressors in the unit. This setpoint will range between 50ºF and 75ºF in cooling and dehumidification modes of operation.
- **Supply Air Temperature Control:** When the unit has a HGRH coil or heating, there will be a Supply Air Temperature Setpoint input for the third-party controller. This setpoint will range between 50°F and 95°F in all modes of operation. The HGRH valve and heating devices will control to this setpoint.

  NOTE: A minimum setpoint of 60.0°F is advised in heating mode of a heat pump.
- **Supply Temperature Limits:** The heat-cool only controller also has high and low temperature limits. These limits are adjustable at the controller and will cause cooling or heating to be disabled. It is the responsibility of the third party to maintain the following conditions:
    - Minimum Low Supply Temp Limit: 35°F
    - Maximum High Supply Temp Limit: 120°F
- **Mode Switching – Cooling vs Heating:** When heating and cooling are both installed in the unit, the third party is responsible for determining which mode of operation is required at any given time. The Cooling/Heating Control Mode input will be open for cooling or closed for heating. When the input changes state, the unit will shut down the current operation of the cooling or heating devices and switch to the other mode of operation after the mode switch timer expires.
- **Mode Switching – Cooling vs Dehumidification:** When a hot gas reheat coil is installed in the unit, the third party is responsible for determining when the hot gas reheat will control to the Supply Air Temperature Setpoint. The Cooling/Dehumidification Control Mode input will be open for cooling only or closed when reheat is desired.

Digital Status

The Heat-Cool Only terminal strip provides the third-party controller with information from devices installed in the unit. The following information is available through those digital statuses.

OUTSIDE AIR DAMPER ACTUATOR END SWITCH: When installed, this status provides an indication that the outside air damper actuator has reached a specific open position.

CONDENSATE OVERFLOW SWITCH: This device, when installed, indicates when the condensate drain pan is full and further operation of the refrigeration system could cause an overflow of water in the pan.

ENERGY RECOVERY STATUS: When installed, the energy recovery device may have an indication back to the terminal strip that the device is rotating, or the bypass is open.

FILTER PRESSURE SWITCH: If a filter pressure switch or switches is installed, an indication back to the third-party indicates that the filters are dirty.

GLOBAL ALARM OUTPUT: The global alarm output is available on all Heat-Cool Only units. This status indicates that there is an alarm condition in the Heat-Cool Only controller.

Digital Commands

FIRE ALARM: This input is to integrate the building fire alarm into the unit operating system and will disable any airstream refrigerant leak detection system response. Only to be used for a fire alarm input. Overriding the leak detection system is only allowed during a fire alarm per ASHRAE 15. All heating or cooling operation will stop when this input is open. The shutdown of all other devices in the unit controlled directly by the third-party controller (i.e. fans, dampers, energy recovery) is responsibility of the third party and is not controlled by this unit. This input affects the Global Alarm status.

REMOTE START/STOP: This input is to remotely start or stop the refrigeration and heating control of the unit. This input will be closed for the unit to provide cooling or heating.

COOLING/DEHUMIDIFICATION CONTROL MODE: This input determines whether the unit is in cooling mode or dehumidification mode.

COOLING/HEATING CONTROL MODE: This input determines whether the unit is in cooling or heating mode.

A2L SYSTEM RESPONSE: This is a standard hardwired system for units with refrigeration that monitors for refrigerant leaks within the unit and will respond in two ways.

1. If the leak is detected in the air tunnel, the unit will override supply fan operation and damper operation to move stagnant refrigerant from within the unit, duct, and space, ensuring proper dilution. The system will also disable any ignition sources in the airstream zone and disable compressor operation. The supply fan will spin at the higher of the following: the minimum allowable CFM to allow heat operation or the UL-required minimum airflow to dilute the refrigerant. If recirculation dampers are present the unit will be forced into 100% recirculation mode. If the unit is selected as 100% outdoor air the damper will be forced into 100% outdoor air. Heat operation (electric post heat and indirect gas heat) is allowed during an airstream refrigerant detection alarm. The building is responsible for controlling the energy wheel speed and frost control as well as the exhaust fans.
2. If the leak is detected in the compressor section, the unit will disable the compressor operation and the indirect gas heat. The airstream fan will not be forced on. Heat operation will not be allowed. If the unit does not have an indirect gas heater there will not be a refrigerant sensor in the compressor section.

Alarm outputs are available for monitoring and external action requirements. These requirements include opening of zone dampers in the ductwork, disabling duct mounted electric resistance heaters, and/or enabling mechanical ventilation. These outputs are available to the building management system or through hardwire mitigation system contacts in the unit control section.

Verification of the mitigation system response must be performed at start-up by removing the A2L mitigation test jumper found in the control section of the unit. Additional testing may be required by local code.

The refrigerant sensors installed in the appliance will initiate a safety sequence if a leak is detected. Maintain the sensor to be free of any dust or other contaminants. The alarm status is available in the form of an electronic signal from the appliance controller and a relay dry contact suitable for building safety sequences. The end of life of the sensor will result in the appliance operating and displaying that there is a leak detected. Please reference the blink code on the bottom of the sensor and order a new sensor from the OEM. Sensor blink code status: Solid green = sensor power-up and self-test Blinking green = normal operation (heartbeat) Solid red = alarm state – gas detected Blinking red = sensor fault – replace sensor.

Operation of Unit

All Modes

The following conditions are required for the third party to enable the unit to operate in any mode:

- Remote Start Input: Closed
- Shutdown Input: Closed
- Damper Positioning: OAD/RAD End Switch Closed (when installed)**
- Supply Fan Status: Closed
- Supply Fan Control: Not below 50.0% of the full-load airflow for the unit**

**NOTE: These safety checks are the responsibility of the third-party controller and do NOT input to the controller.

Cooling

The following conditions are required for the third party to enable the unit and start compressors in cooling mode:

- Cooling/Dehumidification Control Input: Cooling mode (Open)
- Cooling/Heating Control Input: Cooling mode (Open)
- Outside Air Temperature: > Cooling Ambient Lockout (55.0°F) (adj.)
- Cooling Coil Leaving Air Temp: > Coil Low Temp Limit (42.0°F) (adj.)
- Refrigerant Pressure Switches: Closed (Both High and Low)
- Supply Air Temperature: > Minimum Low Supply Temp Limit (35.0°F)
- Cooling Coil Setpoint: 50 - 75°F scaled from 2-10vdc (Compressor staging)

Dehumidifying NOTE: Hot Gas Reheat must be installed in the unit to utilize this functionality.

The following conditions are required for the controller to enable a unit in dehumidification mode:

- Cooling/Dehumidification Control Input: Dehumidification mode (Closed)
- Cooling/Heating Control Input: Cooling mode (Open)
- Outside Air Temperature: > Cooling Ambient Lockout (55.0°F) (adj.)
- Cooling Coil Leaving Air Temp: > Coil Low Temp Limit (42.0°F) (adj.)
- Refrigerant Pressure Switches: Closed (High and Low)
- Supply Air Temperature: > Minimum Low Supply Temp Limit (35.0°F)
- Supply Air Setpoint: 50 - 95°F scaled from 2-10vdc (HGRH valve modulation)
- Cooling Coil Setpoint: 50 - 75°F scaled from 2-10vdc (Compressor staging)

Heating

The following conditions are required for the controller to enable a unit in heating mode:

- Heating/Cooling Control Mode: Heating mode (Closed)
- Outside Air Temperature: < Heating Ambient Lockout (80.0°F) (adj.)
- Supply Air Temperature: < Maximum High Supply Temp Limit (120.0°F)
- Supply Air Setpoint Request: 50 - 95°F scaled from 2-10vdc

Heating - Heat Pump

The following conditions are required for the controller to enable a unit and start compressors in heating mode.

- Heating/Cooling Control Mode: Heating mode (closed) (Heat Pumps Only)
- Outside Air Temperature: < Heating Ambient Lockout (80.0°F) (adj.)
- Outside Air Temperature: > ASHP Low Ambient Lockout (17°F) (adj.) (ASHP only)
- Refrigerant Pressure Switches: Closed (High and low)
- Supply Air Temperature: < Maximum High Supply Temp Limit (120.0°F)
- Supply Air Setpoint Request: 50-95°F scaled from 2-10vdc

Third-Party Wiring

The following table/diagram is the terminal strip wiring of the terminal strip for Heat-Cool Only operation. This terminal strip is the wiring point for the third-party control's device. Please refer to the unit schematics for additional information.

Terminal	Terminal Type	Description/Device	Third Party IO Type
50C (2)		Common	Common
501	0.0-10.0 VDC	Supply Fan Speed Input	Analog Command
502	0.0-10.0 VDC	Exhaust Fan Speed Input	Analog Command
503	0.0-10.0 VDC *	Energy Recovery Capacity Input *	Analog Command
51C		Common from Controller	
511	2.0-10.0 VDC	Cooling Coil Temperature Setpoint Input	Analog Command
512	2.0-10.0 VDC	Supply Air Temperature Setpoint Input	Analog Command
60C (2)		Common	Common
601	2.0-10.0 VDC	Outside/Recirc Air Damper Signal	Analog Command
602	24 VAC	Outside/Recirc Air Damper Actuator Power	Digital Command
603	24 VAC	Supply Fan Start	Digital Command
604	24 VAC	Exhaust Fan Start	Digital Command
605	24 VAC	Energy Recovery Wheel Start	Digital Command
606	24 VAC	Pre-Heater Enable	Digital Command
607	24 VAC	Return/Exhaust Damper Actuator Power	Digital Command
70P (2)		24 VAC power or 24 VAC common from unit	
701	24 VAC	Building Fire Alarm	Digital Command
702	24 VAC	Remote Start Input	Digital Command
703	24 VAC	Cooling(0)/Dehumidification(1) Control Mode	Digital Command
704	24 VAC	Cooling(0)/Heating(1) Control Mode	Digital Command
80C (3)		Common	Common
801		Global Alarm Output (Heat/Cool Alarms Only)	Digital Status
802		Outside Air Damper End Switch (100% OA Units)	Digital Status
803		Condensate Overflow Switch	Digital Status
804		Energy Recovery Status	Digital Status
805		Filter Pressure Switch	Digital Status
806		Return/Exhaust Damper End Switch	Digital Status
90C (2)		Common	Common
901 (2)	24 VAC	AFMS Power	24 VAC
902	0.0-10.0 VDC	Supply Airflow Measuring Station	Analog Feedback
903	0.0-10.0 VDC	Exhaust Airflow Measuring Station	Analog Feedback
904	0.0-10.0 VDC	Outdoor Airflow Measuring Station	Analog Feedback
71	R21 NC	Airstream Mitigation sequence active	Status - Alarm/off state is normal state
72	R21 Common	Airstream Mitigation sequence active	Common
73	R21 NO	Airstream Mitigation sequence active	Status - Alarm/off state is normal state
74	R23 NC	Indirect Gas Furnace lockout active	Status - Alarm/off state is normal state
74	R23 Common	Indirect Gas Furnace lockout active	Common
76	R23 NO	Indirect Gas Furnace lockout active	Status - Alarm/off state is normal state

* This terminal position is for any energy recovery device, heat wheel, core with face/bypass dampers, or core with bypass only damper. The voltage for either core option is 2.0-10.0VDC.

Appendix B: Gas Furnace Limitations

Supply fan modulation must be limited to the minimum airflow based on the unit size or 50% of design airflow, whichever value is greater. When modulating the gas furnace heating capacity, it is recommended to maintain a maximum temperature rise and a minimum airflow for all units.

WARNING

The following criteria must be met when controlling the staging and modulation of the gas furnaces to prevent improper combustion and damage to the unit. The airflow reduction is only allowed if the supply air temperature does not exceed the max temp rise listed below. The supply air temp must be monitored, and the furnace must be modulated to prevent over-firing of the furnace at low airflows.

1. In the table below, locate the unit casing size, the correct furnace MBH, and the airflow supply direction for the minimum airflow in CFM.
2. All gas furnaces must be limited to the greater of the following:
   a. minimum airflow in CFM; OR
   b. 50% of design airflow.
3. The third-party controls will send a 2-10VDC signal to control to a supply air temperature setpoint between 50.0°F (10.0°C) and 95.0°F (35.0°C) during all modes of operation.
4. The third-party controls must have a high supply temperature limit of 120.0°F (48.8°C) that shuts down all heating sources within the unit when the supply air temperature is greater than or equal to this high supply temp limit.
5. Minimum Temp Rise of 20.0°F for all furnaces.

Unit	Furnace	Bottom Discharge		Side Discharge	
Casing Size	**MBH**	**Max Temp Rise**	**Min Airflow CFM**	**Max Temp Rise**	**Min Airflow CFM**
RV-10 RVE-20	75	100.0°F	556	100.0°F	556
	100	100.0°F	741	100.0°F	741
	150	100.0°F	1,111	100.0°F	1,111
	200	100.0°F	1,481	100.0°F	1,481
RV-25 RVE-40 RVC-35	100	100.0°F	741	100.0°F	741
	200	100.0°F	1,481	100.0°F	1,481
	300	100.0°F	2,222	100.0°F	2,222
RV-45 RVE-85 RVC-65	300	100.0°F	2,222	100.0°F	2,222
	400	100.0°F	2,963	100.0°F	2,963
	600	100.0°F	3,704	100.0°F	3,704
RV-75 RVE-150	600	100.0°F	4,444	100.0°F	4,444
	800	100.0°F	5,926	100.0°F	5,926
	1000	100.0°F	7,407	100.0°F	7,407
	1200	100.0°F	8,889	100.0°F	8,889

Appendix C: Supply and Exhaust Airflow Calculations

If airflow monitoring for the outside air damper is installed it could be one of two types of airflow. Each type has their own calculations and/or setup.

Supply and Exhaust Fan Models

The following table shows the available models for the supply and exhaust fan blades installed in a unit and the corresponding K Factor for the fan blade. The third party needs to know the model number of the fan, how many fans are installed, and whether the airflow monitoring station was purchased with the supply and/or exhaust fans.

Supply and Exhaust Fan Models				
Manufacturer	**Model Number**	**Fan Blade Material**	**Fan Blade Diameter**	**K Factor**
Greenheck	PRM-450	Aluminum	450mm/18”	1899
Greenheck	PRM-560	Aluminum	560mm/22”	2975
Greenheck	PDL-355	Aluminum	355mm/14”	1160

Supply and Exhaust Fan Airflow Measurement

The third-party controller can use the transducer’s signal from the supply fan and/or from the exhaust fan and the airflow formula to determine the amount of current airflow.

FORMULA: $CFM = k * \sqrt{(\Delta P)}$

ΔP = Differential Pressure (0.0-30.0 in. wc scaled from 0.0 to 10.0 VDC reading from transducer)
k = K Factor (from table) * # of Fans
√= Square Root

NOTE: The supply and exhaust airflow will be calculated separately. Only include the fans of the same type in the calculation.

Appendix D: Greentrol Airflow Calculations

GreenTrol Airflow Monitoring

The GreenTrol® airflow monitoring station measures airflow using advanced thermal dispersion technology. An integral LCD display provides a local indication of airflow measurement and device configuration. The GreenTrol also accepts up to two airflow probes for averaging.

GreenTrol Airflow Monitor functions:

- LCD readout of measured airflow
- Dual airflow probe averaging

ANALOG OUTPUTS: The airflow monitoring controller has two configurable analog outputs that transmit airflow, temperature, or PID control. They can be configured for one of three analog output ranges: 0-10VDC, 0-5VDC, and 2-10VDC. The controller has been factory configured to use analog output 1 for transmitting outdoor airflow rate and analog output 2 for outdoor air temperature. The airflow monitoring output is wired to the customer terminal strip for Heat-Cool Only controls. See the technical manual for the airflow controller provided with the unit for instructions on configuring the analog outputs and using the Field Calibration Wizard.

FORMULA: Calculating airflow based on the analog output signal:

$$\text{Airflow} = (\text{Signal Voltage} - \text{Minimum Voltage}) \frac{\text{Full Scale Airflow}}{\text{Maximum Voltage} - \text{Minimum Voltage}}$$

Maintenance Log

Date ____________________Time ______________ AM/PM
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Our Commitment

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 within the product area tabs and in the Library under Warranties.

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.

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