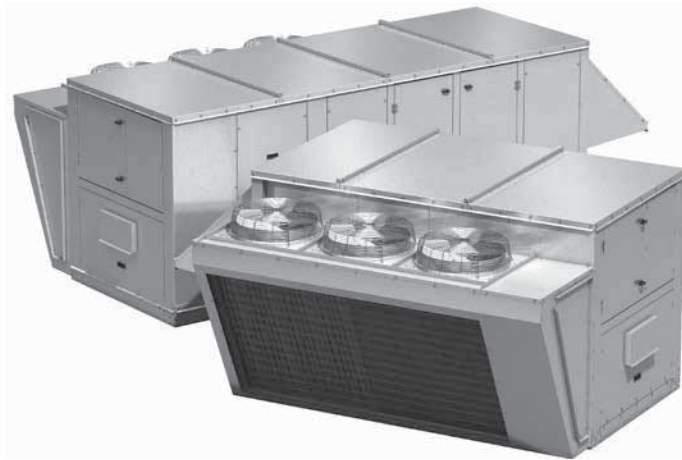


Installation, Operation and Maintenance Manual

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 instructions could result in personal injury and/or property damage!



General Safety Information

Only qualified personnel should install and maintain 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.

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 wheel faster than maximum cataloged fan RPM. Adjustments to fan speed significantly affect 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. Verify that the power source is compatible with the equipment.
6. Never open access doors to the unit while it is running.

WARNING

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

DANGER

- Always disconnect power before working on or near this equipment. Lock and tag the disconnect switch or breaker to prevent accidental power up.
- If this unit is equipped with optional gas accessories, turn off gas supply whenever power is disconnected.

CAUTION

This unit is equipped with a compressed refrigerant system. If a leak in the system should occur, immediately evacuate the area. An EPA Certified Technician must be engaged to make repairs or corrections. Refrigerant leaks may also cause bodily harm.

CAUTION

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

Receiving

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 of any damage detected. The customer will make a notation of damage (or shortage of items) on the delivery receipt and all copies of the bill of lading which is countersigned by the delivering carrier. If damaged, immediately contact your local representative. Any physical damage to the unit after acceptance is not the responsibility of manufacturer.

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.

Handling

Units are to be rigged and moved by the lifting brackets provided. This model is not designed for forklifting. Location and number of lifting points varies by model and size and all provided lifting brackets must be used to properly support the unit during handling. Handle each unit in such a way as to keep from scratching or chipping the coating. Damaged finish may reduce the ability of the unit to resist corrosion.

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 during storage. The manufacturer will not be responsible for damage during storage. These suggestions are provided solely as a convenience to the user.

Inspection and Maintenance During Storage

While in storage, inspect units once per month. Keep a record of inspection and maintenance performed. If moisture or dirt accumulations are found on the parts, the source should be located and eliminated. At each inspection, rotate all moving parts by hand ten to fifteen revolutions to distribute lubricant on motor and bearings. 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 preventative should be restored to good condition promptly if signs of rust occur. Immediately remove the original rust preventative coating with petroleum solvent and clean with lint-free cloths. Polish any remaining rust from the surface with

crocus cloth or fine emery paper and oil. Do not destroy the continuity of the surfaces. Wipe clean thoroughly with Tectyl® 506 (Ashland, Inc.) or the equivalent. For hard to reach internal surfaces or for occasional use, consider using Tectyl® 511M Rust Preventative or WD-40® or the equivalent.

Product Overview

A horizontally configured High Percentage Outdoor Air unit designed for installation either indoors or outdoors. Each unit has multiple options for cooling and/or heating. The unit is designed to replace air that is exhausted from the building and also heat and cool, as needed. The air volume produced by the unit is constant, but can be optionally modulated to provide a variable air volume (VAV) and recirculation is also offered as an option.

Cooling

Units have the following cooling options available:

- Packaged DX
- Split DX
- Chilled water coil

Units with packaged DX are shipped fully charged with refrigerant and are ready for operation upon arrival.

Heating

There are three different optional heat sources that can be ordered for this unit:

- Indirect gas-fired furnace with one or two sets of heat exchangers
- Electric heat with infinitely variable SCR control
- Hot water coil

Airflow Arrangement

The unit is capable of Constant Air Volume (CAV), Variable Air Volume (VAV), 100% Outdoor Air and have recirculating air options.

Safety Listing

Models are listed per ANSI/UL 1995, Heating and Cooling Equipment and are ETL Certified.

Models and Capacities

Model	Cooling Capacity
RV(E)-35	5 to 15 tons
RV(E)-50	10 to 25 tons
RV(E)-80	15 to 29 tons
RV(E)-120	20 to 43 tons

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Subassemblies

Blower - Either one or two plenum-type fans. All units are equipped with a plenum fan for Supply Air and a second may be selected for Exhaust (Relief) Air.

Coils - Evaporator coil (optional)
Condenser coil (optional, packaged DX only)
Water coil (optional)
Reheat coil (optional)

Compressors - Each unit having packaged DX will have either one, two or four refrigerant compressors. Optionally, one of the compressors may be a digital scroll type compressor.

Dampers - Motorized intake air damper, motorized recirculating damper. Optional return air damper. Optional gravity-type exhaust damper.

Optional Barometric Relief Damper - Used during economizer mode of the unit when building pressure increases, relief damper will open due to over pressurization.

Electric Heater - An SCR controlled electric heater (not shown) is available on the units. It requires a separate power supply and has its own control panel. See unit-specific wiring diagram.

Filters - Two-inch thick metal mesh filters in the outdoor weatherhood intake, 2-inch thick pleated paper MERV 8 (standard) or MERV 13 filters in the air stream. Optional 4-inch thick filter bank with a 2-inch thick MERV 8 and 2-inch thick MERV 13 or a 4-inch thick MERV 14 pleated paper supply filters.

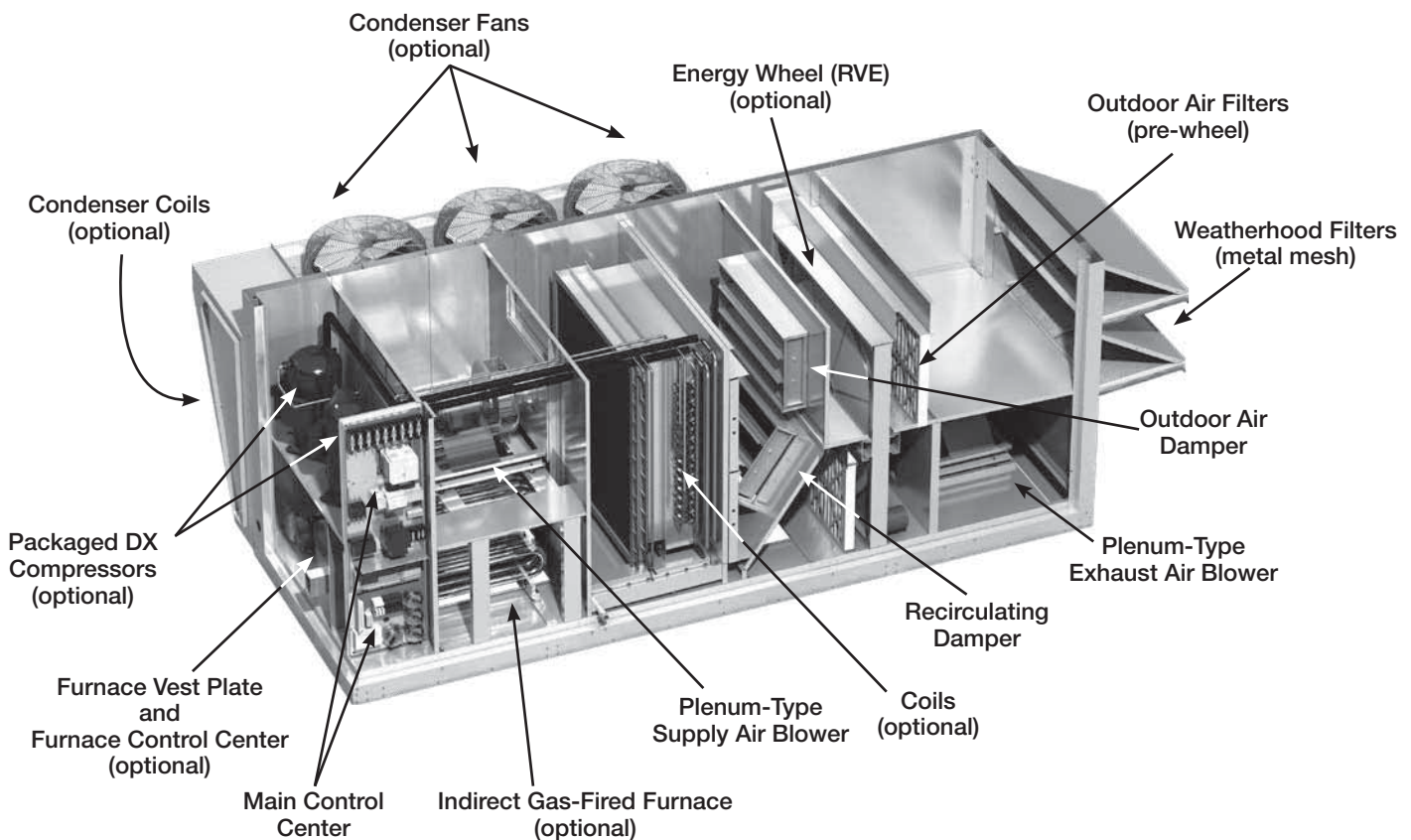
Indirect Gas-Fired Furnace - The optional model PVG furnace is available on housing sizes 35 and 50. Housing size 80 uses the optional model PVF furnace. Housing size 120 uses the optional PVF 200-600, HMA 700-800 furnace.

Packaged DX System - Any unit may be ordered with a packaged DX system. RV(E)-35, 50, 80 will include either one or two compressors; RV(E)-120 will include one, two or four compressors; a condenser coil(s) and evaporator coil(s) and all needed components. Units that have packaged DX are charged with R-410A refrigerant. Do not use tools or parts designed for other refrigerants on these units.

Split DX - The unit may be ordered with a split DX system for connection to a building cooling system.

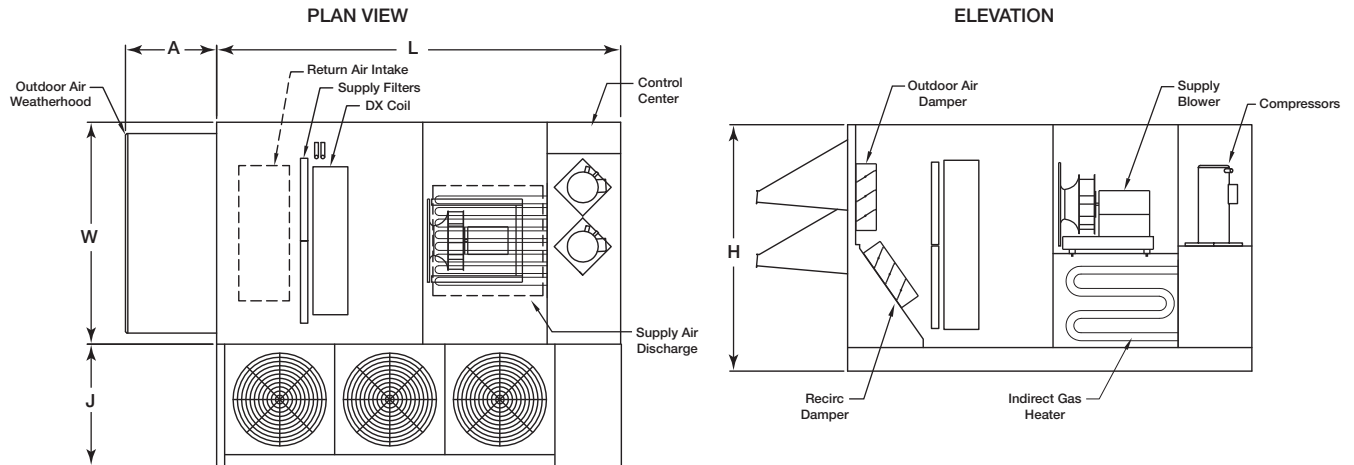
Vestibule - Some units may be ordered with a factory-assembled vestibule that is to be field-attached to the side of the unit. See lifting instructions.

Open view of Model RVE showing optional condenser coil, fans and energy recovery wheel.



Installation

Typical Unit Weights and Dimensions



Unit Size	A	L	W	J	H	Unit Weight	Outdoor Air Weatherhood (Aluminum Mesh)	Qty	Pre-Wheel Outdoor/Exhaust Filters*		Supply Final Filters (Pre-coil)**	
	Outdoor Air Weatherhood	Length	Width	Condensing Section	Height				Qty	Qty	Qty	Qty
RV-35	21.5	95.6	52.5	28.8	58.2	2,600	20x20x2	4	NA		20x20x2	4
RV-50	21.5	108.8	64	32	70.5	3,600	20x25x2				20x25x2	6
RV-80	26.5	117	68	30	82	4,500	25x25x2				20x25x2	6
RV-120	22	156	68	30	90	6,400	20x25x2	6	NA		16x20x2	12
RVE-35	21.5	147.5	52.5	28.8	58.2	3,000	20x20x2	4	20x25x2	2	20x20x2	4
RVE-50	21.5	163.1	64	32	70.5	4,100	20x25x2		20x25x2	3	20x25x2	6
RVE-80	26.5	178.3	68	30	82	5,100	25x25x2		16x20x2	7	20x25x2	6
RVE-120	22	224	68	30	90	8,300	20x25x2	6	16x20x2 [^]	7 [^]	16x20x2	12

All dimensions are shown in inches. Weight is shown in pounds.

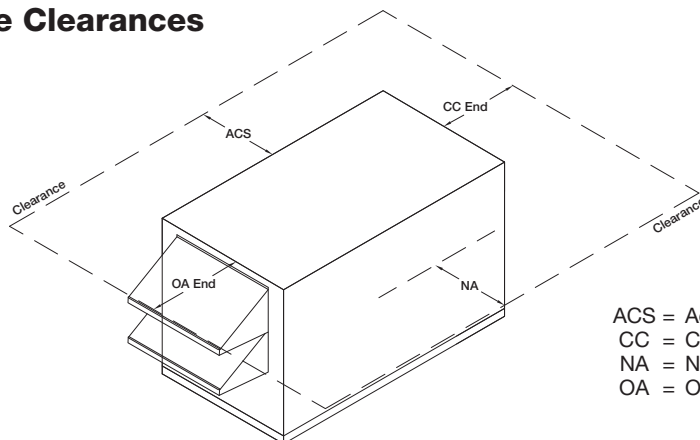
* Size and quantity is per airstream.

** Dimension based upon MERV 8 or 13 filters (MERV 14 filters are 4 in. thick).

[^] Based upon a 52 / 58 in. energy wheel (20x20x2, quantity of 8 for 72 in. energy wheel).

Note: If RV unit is ordered with optional exhaust (relief) fan, corresponding RVE dimensions will apply, excluding pre-wheel outdoor/exhaust filters.

Service Clearances



ACS = Access
 CC = Control Center
 NA = Non-Access
 OA = Outdoor Air Weatherhood

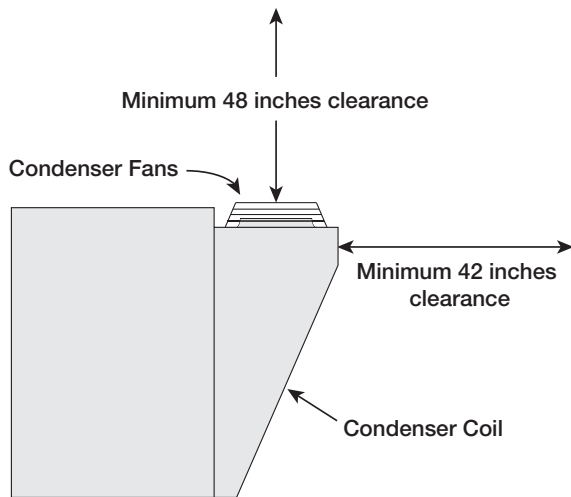
Unit Size	ACS	CC End	OA End	*NA from Unit	*NA from CS	*NA from Vest
RV(E)-35	36	36	42	24	42	30
RV(E)-50	36	36	42	24	42	30
RV(E)-80	36	36	52	24	42	30
RV(E)-120	36	36	52	24	42	30

All dimensions are shown in inches. *NA from Unit = no condensing section or piping vestibule

*NA from CS = condensing section, *NA from Vest = piping vestibule

Additional Clearances for Packaged DX Units

Packaged DX units require additional clearance because they must have unrestricted air movement around the condenser coil and condenser fans. Hot air is being discharged from the condenser fans during operation. Enough clearance must be provided to avoid recirculation or coil starvation. When equipped with condenser coils, the unit should never be placed under an overhang or inside a building. A minimum of 48 inches above the condenser fans is acceptable, but unobstructed is strongly recommended.



End view of rooftop unit with Packaged DX

Handling Concerns for Units with Packaged DX

Units having packaged DX have a system that is pressurized with refrigerant and if it is damaged, the refrigerant 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.

Before Lifting - Vestibule

Determine whether or not the unit has a vestibule that must be field-attached to the side of the unit. Vestibules are shipped assembled but detached from the unit. They have lifting lugs on them so they can also be lifted by crane, but the installed location of the unit may make it preferable to install the vestibule on the unit prior to lifting.

Before Lifting - Field Power Access

Determine where high voltage and low voltage wiring is to be brought into the cabinet. If wiring is to be brought into the cabinet through the floor, see Alternate Supply Entry Locations in this manual. If unit is to be installed on a roof, cut access openings in the roof deck as needed.

Lifting

1. Before lifting, be sure that all shipping materials have been removed from unit.
2. To assist in determining rigging requirements, weights are provided in the Unit Weights & Dimensions section of this manual.
3. Unit must be lifted by all lifting lugs provided at top of unit.
4. Spreader bars must span the unit to prevent damage to the cabinet by the lift cables.

WARNING

Spreader bars are required to prevent damage to the cabinet, failure to do so can result in damage that is the installer's responsibility.



5. Always test-lift the unit to check for proper balance and rigging before hoisting to desired location.
6. Never lift unit by weatherhood.
7. Never lift units in windy conditions.
8. Preparation of curb and roof openings should be completed prior to lifting unit to the roof.
9. Check to be sure that gasketing (supplied by others) has been applied to the top of the curb prior to lifting the unit and setting on the curb.
10. Do not use fork lifts for handling unit.

Roof Curb Mounting

Roof curb details, including duct locations and dimensions, are to be found in the roof curb assembly instructions.

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 which are shipped in a knockdown kit (includes duct adapters) and require field assembly (by others). Assembly instructions are included with the curb kit.

2. Install Curb

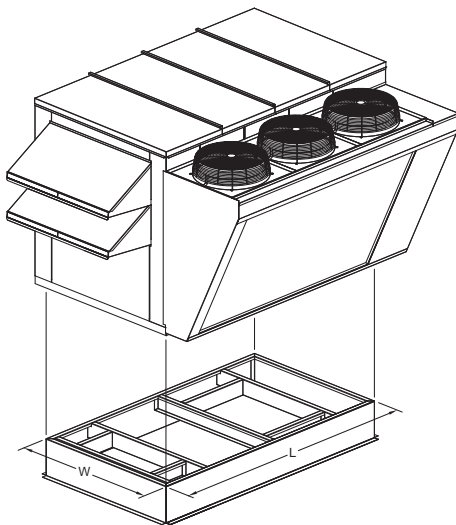
Locate curb over roof opening and fasten in place. Check that the diagonal dimensions are within $\pm 1/8$ inch of each other and adjust as necessary. For proper coil drainage and unit operation, it is important that the installation be level. Shim the curb as required to level. Install gasketing on top surface of curb (provided by others).

3. Install Ductwork

Installation of all ducts should be done in accordance with SMACNA and AMCA guidelines. Duct adapters are 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 level.



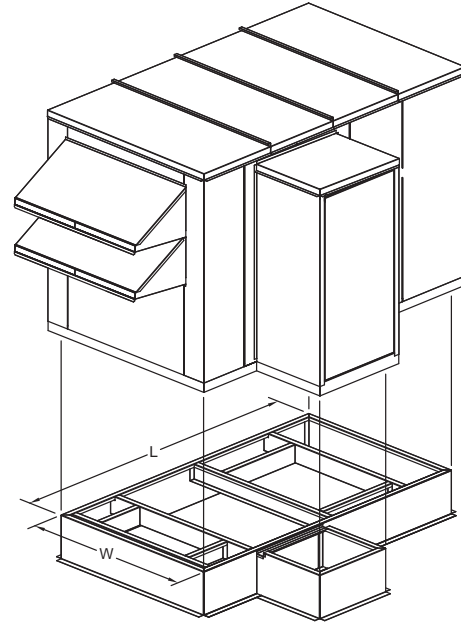
Typical Unit with Condensing Section and Factory-Supplied Curb Kit

5. Install Vestibule

If unit was ordered with a vestibule and it has not yet been attached to the unit, caulk and attach the vestibule at this time.

Optional Piping Vestibule

If the unit was ordered with the vestibule, the NA (Non-Access side) clearance dimension must be measured from the vestibule.

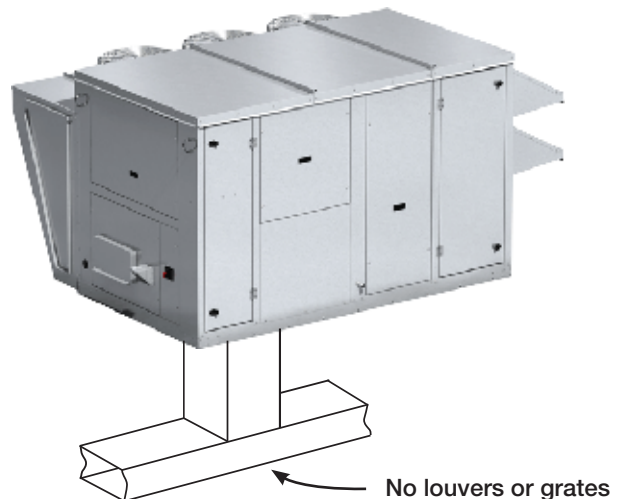


Typical Unit with Piping Vestibule and Factory-Supplied Curb Kit

Ductwork Configurations

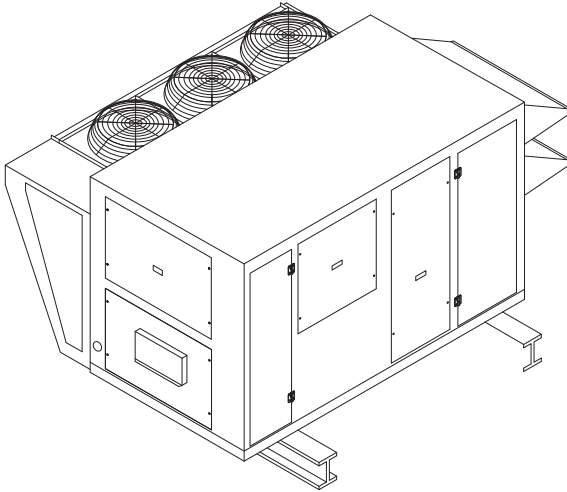
NOTE

Downblast Discharge Ductwork - whenever downblast discharge is used, the ductwork directly beneath the unit must be connected with either a "T" or an "L" configuration and the area directly beneath the heat source **must not have any openings** such as louvers or grates.



Rail Mounting and Layout

- The units may be installed on rails provided and installed by others. Ensure that rails are designed to handle the weight of the unit and provide proper load distribution on building supports.
- Make sure that rail positioning does not interfere with the openings on the unit.
- Rails should run the width of the unit and extend beyond the unit a minimum of 12 inches on each side.
- Set unit on rails.

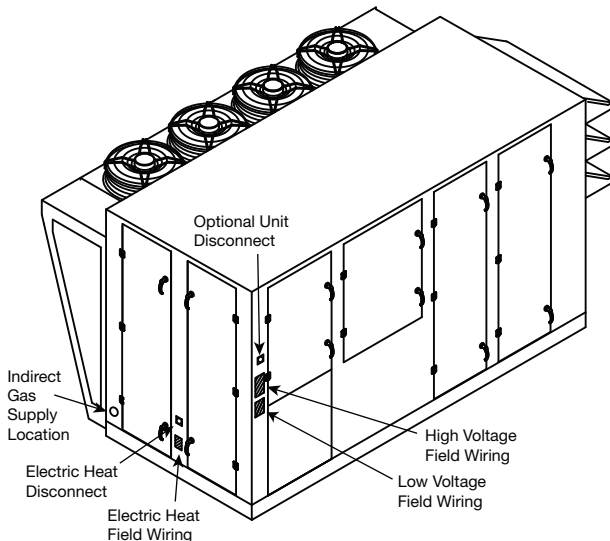


Typical Unit Installed on Rails Supplied by Others

Recommended Electrical and Gas Supply Entry Locations

Manufacturer recommends that electrical service and gas supply be brought into the cabinet through the end wall, as shown below. There are three penetrations into the cabinet that are required; one for high voltage supply wiring, one for low voltage control wiring and one for either gas supply or high voltage supply wiring for an electric heater.

Alternate Supply Entry Locations



Recommended Gas and Electric Supply Entry Locations

Each installation is unique and as a result, alternate entry locations may be field-located. Before using any alternate entry location, verify the suitability of the location and ensure the use of an alternate location does not interfere with unit wiring, components or functionality.

WARNING

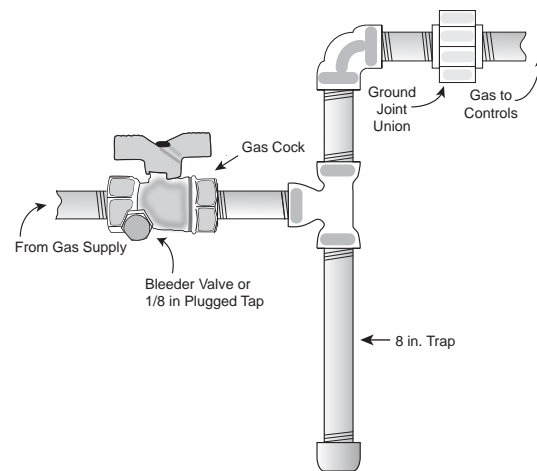
Never drill holes in the roof of the unit! There is high voltage wiring located between the inner and outer roof panels. Damage to the wiring could cause severe bodily harm or death.

Optional Gas Piping

Units with indirect gas-fired furnaces require field-supplied and installed gas supply piping. The unit gas connection is 3/4-inch NPT. The maximum allowable gas pressure is 14 in. wg.

Gas Connections

If this unit is equipped with an indirect gas-fired furnace, connection to an appropriate gas supply line will be required. For complete information on installation procedures for the optional gas furnace, refer the PVF/PVG Indirect Gas-Fired Heat Module Installation, Operation, and Maintenance Manual.



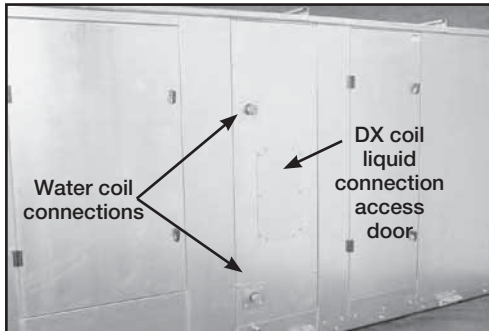
Typical Gas Supply Piping Connection

Piping Installation

Optional Coil Piping

Factory-installed cooling and heating components are mounted in the coil section of the unit. The coil section is downstream of the energy wheel on the supply air side of the unit. Note the coil connection locations on the picture. Coil connections are located external to the unit as shown.

Note: DX coil liquid connection is internal to units.



Water Coils

1. Piping should be in accordance with accepted industry standards. Pipework should be supported independently of the coils. When installing couplings, do not apply undue stress to the connection extending through the unit. Use a backup pipe wrench to avoid breaking the weld between coil connection and header.
2. Connect the water supply to the bottom connection on the air leaving side and the water return to the top connection on the air entering side. Connecting the supply and/or return in any other manner will result in very poor performance. Be sure to replace factory-installed grommets around coil connections if removed for piping. Failure to replace grommets will result in water leakage into the unit and altered performance.
3. Water coils are not normally recommended for use with entering air temperatures below 40°F. No control system can be depended on to be 100% safe against freeze-up with water coils. Glycol solutions or brines are the only safe media for operation of water coils with low entering air conditions. If glycol or brine solutions are not used, coils must be drained when freezing conditions are expected. **If required, vent and drain connections must be field-piped, external to the unit.**
4. Pipe sizes for the system must be selected on the basis of the head (pressure) available from the circulation pump. The velocity should not exceed 6 feet per second and the friction loss should be approximately 3 feet of water column per 100 feet of pipe.
5. For chilled water coils, the condensate drain pipe should be sized adequately to ensure the condensate drains properly. Refer to Drain Trap section.

Direct Expansion (DX) Coils (Split DX)

1. Piping should be in accordance with accepted industry standards. Pipework should be supported independently of the coils. Undue stress should not be applied at the connection to coil headers.
2. The condensate drain pipe should be sized adequately to ensure the condensate drains properly. Refer to Condensate Drain Trap section.
3. When connecting suction and liquid connections make sure the coil is free from all foreign material. Make sure all joints are tight and free of leakage. Be sure to replace factory-installed grommets around coil connections if removed for piping.
4. Manufacturer does not supply compressor or condensing units with standard models. For further instruction on DX coil installation and operation contact your compressor and/or condenser manufacturer.

Condensate Drain Trap

This unit is equipped with a stainless steel condensate pan with a stainless steel 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 and to prevent migration of sewer gas back into the unit.

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.

Condensate Overflow switch

This unit is equipped with an optional factory-mounted condensate overflow switch. In the event that a high level of condensate is detected, a dry contact will be powered (24 VAC). This dry contact can be used for field monitoring of condensate levels. All monitoring and control shall be provided by others.

Electrical Information

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 Electric 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.

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.

Determine the Size of Electric Heater Wiring

An optional electric heater may require a separate power supply. The power connection should be made to the factory-provided electric heater disconnect and must be compatible with the ratings on the nameplate, supply power voltage, phase and amperage. Consult ANSI/NFPA 70 and CSA C22.1 for proper conductor sizing.

Provide the Opening(s) for the Electrical Connections

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

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.

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.

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.

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

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.

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. 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.

Control Center Components

Main Control Center Components

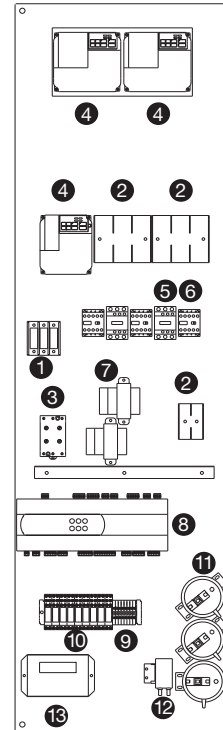
This is a typical installation. Components and their locations will vary.

High Voltage Side

1. Power distribution block; high voltage supply is terminated here.
2. Fuse holders
3. Phase monitor
4. VFD
5. Compressor motor contactors
6. Condensing fan motor contactors
7. Transformer

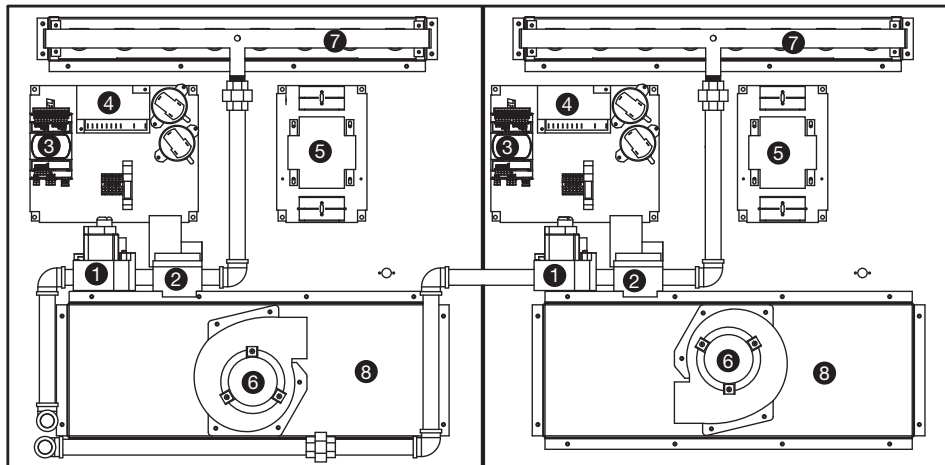
Low Voltage Side

8. Microprocessor controller
9. Low voltage terminal strip
10. Relays
11. Dirty filter switch
12. Wheel pressure switch
13. Outdoor airflow monitor



Optional Indirect Gas-Fired Furnace

Note: In some models, two furnaces are installed to provide greater output. When two furnaces are installed, they are in parallel and both will operate at the same time and the same output. Both furnaces will have identical controls.



Dual furnaces shown. Available on housing 80 and 120 with furnace capacities 500 MBH or higher.

1. Single-stage valve
2. Modulating valve
3. PCOE expansion board
4. Ignition controller
5. Transformer
6. Combustion blower
7. Burner manifold
8. Collector box

For further information on the optional furnace and its control center, see the Indirect Gas-Fired Heat IOM shipped with the unit.

Component Operation

Phase Monitor

The unit control circuitry includes a phase monitor that constantly checks for phase reversal, phase imbalance, loss of phase or a power brownout. When it detects a fault, it cuts off the 24 VAC that goes to the low voltage terminal strip, thereby shutting off all motors.



Typical Phase Monitor

Variable Frequency Drive (VFD)

If a VFD was provided and installed at the factory, it has been pre-set to control the speed of the blower motor for optimum performance. The motor speed needs to be verified during test and balance of the unit.

If the system was configured for Constant Air Volume (CAV), the VFD will operate in an ON / OFF fashion and the speed of the motor will not change. If the system was configured for Variable Air Volume (VAV), the microprocessor controller will constantly monitor operating conditions and provide a signal to the VFD, changing the VFD output as needed.



Typical Variable Frequency Drive (VFD)

The VFD may alternatively be connected to an external signal such as provided by a BMS and be operated by a 2-10 VDC or a 4-20 mA input.

Supply Fan VFD Sequence

Optional Room CO2 Sensor: The microprocessor controller will modulate the supply fan based on a comparison of the CO2 setpoint to the actual CO2 levels reported from the sensor. Mechanical high static protection cutoffs must be installed by others to protect the system and equipment from over-pressurization.

Optional Duct Static Pressure Sensor: The microprocessor controller will modulate the supply fan based on a comparison of the duct static pressure set point to the actual duct static pressure level reported from the sensor. Mechanical high static protection cutoffs must be installed by others to protect the system and equipment from over-pressurization. The manufacturer does not assume responsibility for this.

Optional Building Static Pressure Sensor: The supply fan is modulated based upon the signal from a building static pressure sensor. The microprocessor controller will modulate the supply fan based on a comparison of the building static pressure set point to the actual building static pressure level reported from the sensor.

Optional Single Zone VAV: The microprocessor will use a space mounted temperature sensor to vary heating and cooling capacity and the airflow delivered by the fan to maintain room-air temperature at a desired set point.

Optional 0-10 VDC by others to VFD: The supply fan is modulated by a 0-10 VDC provided by others in the field.

Optional Exhaust Fan VFD Sequence

Optional Building Static Pressure Sensor: The exhaust fan is modulated based upon the signal from a building static pressure sensor. The microprocessor controller will modulate the exhaust fan based upon a comparison of the building static pressure level reported from the sensor.

Optional Outdoor Air Damper Tracking: The microprocessor controller will proportionally modulate the exhaust fan based upon the outdoor air damper position.

Optional Supply Tracking: The microprocessor controller will proportionally modulate the exhaust fan based upon the supply fan.

Optional 0-10 VDC by Others to VFD: The supply fan is modulated by a 0-10 VDC provided by others in the field.

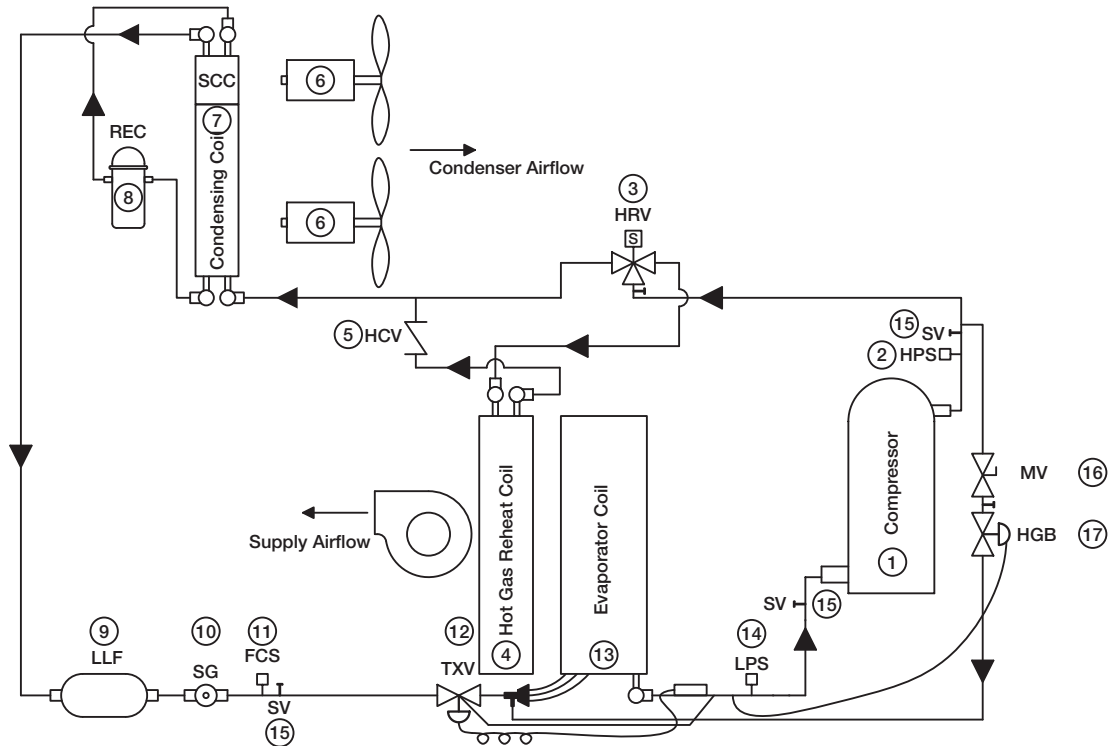
Optional Outdoor Air and Recirculated (Recirc) Air Damper Sequence

Optional Room CO2 Sensor: The controller will proportionally modulate the OA/RA dampers based upon a comparison of the CO2 set point to the actual CO2 level reported from the sensor. As the CO2 level rises, the controller will proportionally modulate the outdoor air damper open, between the minimum and maximum OA position.

Optional Building Pressure: The OA/RA dampers will modulate based upon the signal from a building static pressure sensor. The controller will modulate the dampers, between the minimum and maximum OA positions, based upon a comparison of the building static pressure set point to the actual building static pressure level reported from the sensor.

Factory-Installed Refrigeration System Components

Packaged DX Cooling with Three Way Hot Gas Reheat and Hot Gas Bypass



1. Compressor

2. High Limit Pressure Switch

The switch opens when refrigerant pressure increases above the set point in the discharge line. A manual reset is then required.

3. Hot Gas Reheat Valve (optional)

Units equipped with a reheat coil use a three-way valve with actuator to control the supply air discharge temperature of the unit during dehumidification mode. The unit controller provides a 0-10 VDC signal to control the amount of reheat to meet the supply temperature set point

4. Hot Gas Reheat Coil (Optional)

5. Hot Gas Reheat Check Valve (Optional)

6. Condenser Fans

7. Condensing Coil

8. Liquid Receiver (Optional)

9. Liquid Line Filter Drier

10. Sight Glass

11. Fan Cycle Switch(es)

The switch(es) open or close based on liquid refrigerant pressure to control the condensing fans to maintain liquid pressure.

12. Thermostatic Expansion Valve (TXV)

Each unit is equipped with a TXV on each refrigerant circuit. The valve controls the flow of liquid refrigerant entering the evaporator coil by maintaining a constant, factory-set superheat of 10°F. The valve is adjustable and is located on the

side of the evaporator coil and can be accessed through the coil access panel.

13. Evaporative Coil

14. Low Limit Pressure Switch

The switch is installed on the suction line and disables the DX system when the suction pressure drops below the set point. The switch will auto reset when the pressure rises above the auto-reset set point.

15. Service Access Ports

16. Hot Gas Bypass Manual Shut Off Valve (Optional)

Used to disable hot gas bypass for service and troubleshooting procedures.

17. Hot Gas Bypass Valve (Optional)

On units equipped with hot gas bypass, hot gas from the compressor is injected into the liquid line of the evaporator coil after the TXV.

Valve Adjustment - To adjust the valve, connect a pressure gauge to the suction line and block the entering air to the evaporator coil. The valve should begin to open when the suction pressure drops to approximately 115 PSIG for R-410A (the valve will feel warm to the touch). Adjustments are made by first removing the cap on the bottom of the valve and then turning the adjusting stem clockwise to increase the setting pressure (counterclockwise to decrease). Allow several minutes between adjustments for the system to stabilize. When adjustment is complete, replace the cap on the valve.

Start-Up Unit

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 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.

WARNING

- Unit was factory tested. All blowers, fans, and compressors are set-up to run correctly when supplied power. If any one fan is running backwards or the compressor is making loud noises, immediately turn off the power. Switch two leads on the incoming power to the disconnect. This will ensure proper operation of the unit. Failure to comply may damage the compressors and void the warranty.
- Do not jumper any safety devices when operating the unit. This may damage components within or cause serious injury or death.
- Do not operate compressor when the outdoor temperature is below 40°F.
- Do not short-cycle the compressor. Allow 5 minutes between “on” cycles to prevent compressor damage.
- DX system is charged with refrigerant. Start-up must be performed by EPA Certified Technician.

WARNING

Prior to starting up the unit, power must be energized for 24 hours without a call for cool to allow the compressor crankcase heaters time to boil off any liquid refrigerant present in the compressor.

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 No. _____

Unit Serial No. _____

Energy Wheel Date Code _____

Compressor 1 Model No. _____

Compressor 2 Model No. _____

Compressor 3 Model No. _____

Compressor 4 Model No. _____

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 unit.
- Check all fasteners, set-screws, and locking collars on the fans, bearings, drives, motor bases and accessories for tightness.
- Rotate the fan wheels and energy recovery wheels by hand and ensure no parts are rubbing.
- Filters can load up with dirt during building construction. Replace any dirty pleated filters and clean the aluminum mesh filters in the intake hood.
- Verify that non-motorized dampers open and close properly.
- Check the tightness of all factory wiring connections.
- Verify control wire gauge.
- Verify diameter seal settings on the energy recovery wheel.
- Verify proper drain trap installation.
- Check condensing fans for any damage or misalignment. Spin the blades and make sure they don't contact any parts and are free turning without any resistance.
- Look over the piping system.
- Inspect all coils within the unit. Fins may get damaged in transit or during construction. Carefully straighten fins with a fin comb.
- If there is an indirect gas-fired furnace in this unit, refer to the manual provided with this unit for Pre-Start-Up information.
- This unit contains a crankcase heater for each compressor which needs power supplied to it 24 hours prior to start-up. If start-up is scheduled in 24 hours, unlock the disconnect power and energize unit.

SPECIAL TOOLS REQUIRED

- Voltage Meter (with wire probes)
- Amperage Meter
- Pressure Gauges – (refrigerant)
- Tachometer
- Thermometer
- 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.

- Make sure Pre-Start-Up checklist is complete.
- Jumper R to G, R to Y1, and R to Y2 (if applicable) on the control board.
- Turn the disconnect on. After 3 minutes compressors will come on. Make sure all fans and compressors are rotating the correct direction.
- Allow the unit to run until the refrigerant system stabilizes. Approximately 1-2 minutes.

Voltage Imbalance

In a 3-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 x (VA-VD)] /VA

Start-Up Checklist

Line Voltage. Check at unit disconnect.

L1-L2 _____ Volts L2-L3 _____ Volts L1-L3 _____ Volts

Motor Amp Draw

Supply Motor 1 Amps	L1	_____ Amps	L2	_____ Amps	L3	_____ Amps
Supply Motor 2 Amps	L1	_____ Amps	L2	_____ Amps	L3	_____ Amps
Exhaust Motor 1 Amps	L1	_____ Amps	L2	_____ Amps	L3	_____ Amps
Exhaust Motor 2 Amps	L1	_____ Amps	L2	_____ Amps	L3	_____ Amps

Fan RPM

Correct fan rotation direction?

Supply Fan RPM	_____	Supply Fan	Yes / No
Exhaust Fan RPM	_____	Exhaust Fan	Yes / No

Energy Wheel Motor

L1 _____ Amps L2 _____ Amps L3 _____ Amps

Condensing Fans

Condensing Fan 1	L1	_____ Amps	L2	_____ Amps	L3	_____ Amps
Condensing Fan 2	L1	_____ Amps	L2	_____ Amps	L3	_____ Amps
Condensing Fan 3	L1	_____ Amps	L2	_____ Amps	L3	_____ Amps
Condensing Fan 4	L1	_____ Amps	L2	_____ Amps	L3	_____ Amps

Compressors

Outdoor Air Temperature	_____ Deg F	Outdoor Air Relative Humidity	_____ % RH
Return Air Temperature	_____ Deg F	Return Air Relative Humidity	_____ % RH

	Compressor 1	Compressor 2	Compressor 3	Compressor 4
L1	Amps	Amps	Amps	Amps
L2	Amps	Amps	Amps	Amps
L3	Amps	Amps	Amps	Amps
Crankcase Heater	Amps	Amps	Amps	Amps
Superheat <i>Should be between 8° and 12°F</i>	Deg. F	Deg. F	Deg. F	Deg. F
Subcooling <i>Should be between 12° and 17°F</i>	Deg. F	Deg. F	Deg. F	Deg. F
Discharge Pressure <i>Should be between 300 and 500 PSIG</i>	PSIG	PSIG	PSIG	PSIG
Suction Line Pressure <i>Should be between 100 and 135 PSIG</i>	PSIG	PSIG	PSIG	PSIG
Liquid Line Temp.	Deg. F	Deg. F	Deg. F	Deg. F
Suction Line Temp.	Deg. F	Deg. F	Deg. F	Deg. F
Moisture Indicating Sight Glass				
Liquid Visible	Yes / No	Yes / No	Yes / No	Yes / No
Color of Center Dot	Green / Yellow	Green / Yellow	Green / Yellow	Green / Yellow
Hot Gas Bypass Operational	Yes / No	Yes / No	Yes / No	Yes / No



Start-Up Components

Fan

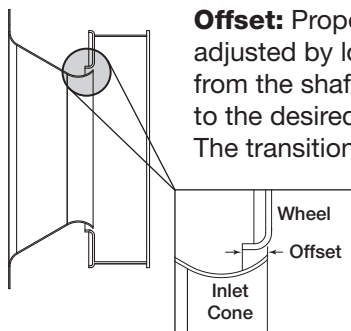
The fan should be checked for free rotation. If any binding occurs, check for concealed damage and foreign objects in the fan housing.

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.

Supply Fan (Plenum Type)

The unit contains one plenum supply fan located on the end of the unit opposite the outdoor air intake and may optionally have a relief air blower which is referred to as an exhaust blower in this document. Efficient fan performance can be maintained by having the correct offset.



Offset: Proper offset, or overlap, is adjusted by loosening the wheel hub from the shaft and moving the wheel to the desired position along the shaft. The transition between the inlet cone and the wheel should be as shown; there is a smooth feel to the profile when moving one component to the other.

Unit Size	Fan	Offset (inches)	Tolerance (inches)
RV(E)-35	Supply	5/32	± 1/32
	Exhaust	5/32	± 1/32
RV(E)-50	Supply	3/8	± 1/16
	Exhaust	3/8	± 1/16
RV(E)-80	Supply	3/8	± 1/16
	Exhaust	3/8	± 1/16
RV(E)-120	Supply	5/32	± 1/32
	Exhaust	5/32	± 1/32

Refer to the respective Installation, Operation and Maintenance Manual shipped with this unit for additional start-up and maintenance information regarding the plenum fan.

Fan Wheel Rotation Direction

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 the bearings. Refer to the Troubleshooting portion of this manual if a problem develops.

Supply/Exhaust Fan

The optional exhaust fan is a direct-drive plenum type. Fan speed is controlled by a VFD which, in turn, is controlled by the DDC controller or by an external signal. Motor speed will be set on the VFD during the unit Test and Balance, but after that, the VFD will not normally be changed. Always check the motor amperage rating shown on the motor nameplate when changing the fan RPM. All access doors must be installed except the control center door.

Vibration

Vibration Causes

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

Excessive vibration may be experienced during initial start-up. Left unchecked, excessive vibration can cause a multitude of problems,

including structural and/or component failure. The most common sources of vibration are listed.

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.

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

Discharge Air Temperature Sensor

Units are supplied with a Discharge Air Temperature Sensor that is to be field-installed prior to unit start-up. The sensor is to be installed at least three duct diameters downstream of the heat exchanger. The sensor must be connected directly to the microprocessor controller. All other sensors and low voltage devices are to be connected to the low voltage terminal strip in the control center. The discharge air sensor is shipped loose and can be found in the unit's control center. See the unit-specific wiring diagram for connection locations.

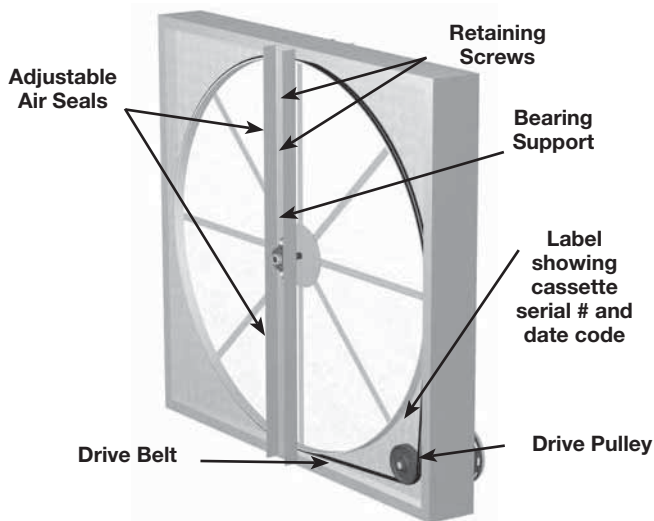


Typical Discharge Air Temperature Sensor

Optional Energy Wheel

Start-Up

If selected, the energy wheel is installed in the unit's airstream with one half of the wheel in the intake airstream and one half in the exhaust airstream. Air leakage between the two airstreams has to be kept to a minimum and the wheel has air seals that must be adjusted for that purpose. The seals must be adjusted at time of start-up.



Drive Belt

Inspect the drive belt. Make sure the belt rides smoothly in the pulley and around the outside of the wheel. Note the directional arrow and data information shown in the image.

Adjust the Air Seals

Make sure the unit power supply is locked out. Disconnect the wiring to the wheel module and pull the wheel cassette out of the cabinet on its tracks. Large cassettes are not removable. Then slowly rotate the wheel by hand to make sure there is no binding or misalignment.

There is a perimeter seal located around the outside of the wheel and a diameter seal across the face of the wheel on both sides. Check to make sure that all air seals are secure and in good condition.

Adjust the air seals by loosening all the air seal retaining screws on the bearing support. Using a piece of paper as a feeler gauge, adjust the seals so they almost touch the face of the wheel while tugging slightly on the paper. When the wheel is rotated, there should be a slight tug on the paper. Tighten the screws, repeat the steps on the other set of seals.

Push the wheel cassette back into the unit and plug in the power connector. Turn the main power supply back on and then observe the operation of the wheel by opening the wheel access door slightly. Remove filters if necessary to observe the wheel.

Sequence of Operation

Optional Economizer - The economizer will be locked out when: the outside air is $<40^{\circ}\text{F}$ (-2°F hysteresis, adjustable); the unit is operating in dehumidification mode; or there is a call for heating.

- **Stop Wheel:** When economizer mode is enabled and there is a signal for cooling, the wheel will stop rotating to allow free cooling.
- **Idle Wheel:** When economizer mode is enabled and there is a signal for cooling, the wheel will rotate at a minimum speed to prevent particle build up on the wheel.
- **Modulate Wheel:** When economizer mode is enabled and there is a signal for cooling, the wheel VFD modulates wheel speed to maintain the discharge temperature set point.

Optional Frost Control - The microprocessor controller will output a signal when wheel frosting is occurring which is determined by a temperature set point (OA $<5^{\circ}\text{F}$ - 2°F hysteresis, adjustable) and wheel pressure drop increase.

- **Preheat:** When frosting is occurring, the preheater is energized to defrost the wheel. Once the pressure drop decreases below the set point, the preheater is de-energized.
- **Timed Exhaust:** When frosting is occurring, the supply blower is cycled off. The exhaust blower shall continue to run, allowing the warm exhaust air to defrost the wheel. After the 10 minute cycle, the supply fan is re-energized to continue normal operation.
- **Modulating Wheel:** Includes a VFD in addition to the thermostat and pressure sensor. When modulating wheel frost control is initiated, the VFD will reduce the speed of the wheel, which keeps the exhaust air condition from reaching saturation, thus, eliminating condensation and frosting. If the outdoor air temperature is greater than the frost threshold temperature OR the pressure differential is less than the set point, the wheel will run at full speed. If the outdoor air temperature is less than the frost threshold temperature AND the pressure differential is greater than the set point, the wheel will run at reduced speed until the pressure differential falls below the set point. The temperature and pressure differential set points are set at the factory, but are field-adjustable. The VFD will be fully programmed at the factory.

Alarm Indication - Microprocessor shall have one digital output for remote indication of an alarm condition. Possible alarms include:

- **Wheel Rotation Alarm:** Monitors wheel rotation, and sends a signal to controller (after a 15 second time delay with no rotation) that signals the microprocessor to activate an alarm.

Optional Energy Wheel - Maintenance

WARNING

Whenever performing maintenance or inspections, always disconnect the power source.

Inspection

The wheel should be inspected semiannually in accordance with the maintenance schedule. Maintenance of the wheel consists mainly of inspecting the wheel for cleanliness and then checking the drive motor, belt, and pulley for wear. If the wheel layers appear dirty, the wheel should be disassembled and cleaned.

The wheel rotates through the two airstreams which are moving in opposite directions, the wheel is self-cleaning, up to a point. If the wheel media becomes blocked by dirt or dust, or if the media collects a layer of smoke residue or an oily film, the energy transfer efficiency drops.

The main factor in the frequency of cleaning is the cleanliness of the air. If air filters are not changed frequently, the wheel will collect contaminants and will then have to be cleaned.

Wheel Disassembly

Wheels are part of a cassette that may be pulled from the unit for easy access. There may be a small damper assembly or other component that blocks removal of the cassette. Before sliding out the cassette or any other component, disconnect any power supply cord and secure it so it cannot jam or otherwise get damaged.

Each wheel has removable segments that hold the coated layers of media and each segment is held in place with two retaining clips located on the outer rim of the wheel. When removing more than one segment, remove them in sequence from opposite sides of the wheel (180 degrees apart) to reduce the imbalance. Secure the wheel against rotation. Carefully release the two retaining clips and swing them fully open. The segment can now be removed by pushing the face of the segment close to the outer rim of the wheel. Wheel segments are built to close tolerances and the segment may have to be jiggled to remove it. Do not use a hammer or otherwise force the segment because these are high value items and are not built to withstand abuse.

Whenever retaining clips are opened, they should be closed as soon as possible. If the wheel should rotate when a clip is open, the clip will jam against the bearing support bar and could cause damage.



Energy Wheel Cassette



Segment Retaining Clip

Cleaning

Maintenance or cleaning of the wheel segments should be done with the segments removed from the wheel cassette to avoid splashing liquids or cleaning agents inside the cabinet. If the energy wheel appears excessively dirty, it should be cleaned to ensure maximum operating efficiency. Only excessive buildup of foreign materials needs to be removed.

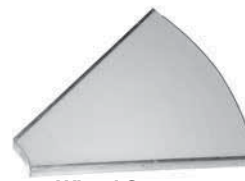
DISCOLORATION AND STAINING OF ENERGY RECOVERY WHEEL DOES NOT AFFECT ITS PERFORMANCE.

Thoroughly spray the wheel matrix with a household cleaner such as Fantastik™ or the equivalent. Gently rinse with warm water and use a soft brush to remove any heavy accumulations. A detergent/water solution can also be used. Avoid aggressive organic solvents, such as acetone. Wheel segments can be soaked in the above solution overnight for removal of stubborn dirt or accumulations.

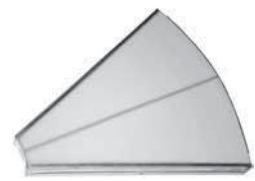
After cleaning is complete, shake excess water from the wheel or segments. Dry the wheel or segments before putting them back into the cassette.

Reassembly

When reinstalling the segments, be sure to install them with the correct face toward the motor side of the cassette. Note that one face of each segment is smooth and the other face has a reinforcing channel or support cut into the surface.



Wheel Segment (Pulley Side)



Wheel Segment (Motor Side)

Energy Recovery Wheel Belt

Inspect belts each time filters are replaced. Belts that look chewed up or are leaving belt dust near the motor pulley may indicate a problem with the wheel. Be sure to inspect wheel for smooth and unrestricted rotation. If a belt requires replacement, contact the local manufacturer representative. Instructions for replacement will ship with the new belt.

Energy Recovery Wheel Bearing

In the unlikely event that a wheel bearing fails, the bearing is behind a removable plate on the wheel support beam (slide cassette halfway out of cabinet to access). Contact the local manufacturers representative for detailed instructions on how to replace the bearing.

Optional Energy Wheel – Troubleshooting

Symptom	Possible Cause	Corrective Action
Energy wheel does NOT turn	Air seals are too tight.	Refer to Adjust the Air Seals in the Optional Energy Wheel Start-Up section.
	Broken belt.	Replace.
	No power to wheel motor.	Make sure wheel drive is plugged in. Verify power is available.
Energy wheel runs intermittently	Wheel motor overloads are tripping due to rubbing between wheel and air seals.	Recheck air seals, make sure they are not too tight. See Adjust the Air Seals in the Optional Energy Wheel Start-Up section.

Troubleshooting – Alarms

Several of the electronic controls in the unit monitor the system for faults and will go into alarm, shutting down the unit or a single function within the unit.

Microprocessor Controller

Check the screen on the microprocessor for an alarm condition. If the microprocessor is in an alarm condition, a message will show on the screen.

The microprocessor is located in the main control center. If the microprocessor is in alarm condition, the Alarm button will blink red. Press the Alarm button to see the specific condition or to reset the microprocessor. Refer to the microprocessor IOM for detailed information on fault codes and see the unit-specific wiring diagram.

Phase Monitor

The phase monitor has two LED indicator lights, one red and one green. Green indicates proper operational status, red indicates the unit has detected a fault and is in alarm condition. The alarm LED will blink to show the specific fault and there is a chart printed on the monitor that shows the code for the blinking light. The phase monitor is self-resetting once the alarm condition is corrected. It is located in the main control center.

Variable Frequency Drive (VFD)

Variable frequency drives have a display screen that will show an alarm condition. If a fault such as a voltage spike occurs, the VFD will go into alarm and will not reset until a hard restart is performed. See the unit-specific manufacturer's manual supplied with the unit. VFDs are located in the main control center.

Optional Digital Scroll Compressor Controller

Present only if packaged DX with digital scroll option is selected. The controller has three LED indicator lights.

One is green, indicating that it has power, one is an alarm indicator that will flash a code for various alarm conditions and the third indicates whether the compressor is operating in a loaded or unloaded condition. See the manufacturer's unit-specific manual for further information.



See the Fault Code chart below. The Fault Code chart is also printed on the back of the controller. Note that if the controller generates either a Code 2 or a Code 4 Lockout, a manual reset must be performed. Manual Reset is accomplished by shutting off main power to the unit and then turning it back on.

Digital Scroll Compressor Controller Fault Codes			
Alert Code	System Condition	Diagnostic Alert Light	Action
Code 2*	High Discharge Temperature Trip	Blinks 2 Times	Lockout
Code 3	Compressor Protector Trip	Blinks 3 Times	Lockout
Code 4*	Locked Rotor	Blinks 4 Times	Lockout
Code 5	Demand Signal Loss	Blinks 5 Times	Lockout
Code 6	Discharge Thermistor Fault	Blinks 6 Times	Reduce Capacity
Code 7	Future	N/A	N/A
Code 8	Welded Contactor	Blinks 8 Times	Unload Compressor
Code 9	Low Voltage	Blinks 9 Times	Trip Compressor

*Protective faults that require manual reset.

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.
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.

Troubleshooting – Refrigeration Circuit

TROUBLESHOOTING NOTE

Before any components are changed on the refrigeration system, the cause of the failure must be identified. Further problems will exist unless the true cause or problem is identified and corrected.

IMPORTANT

Do not release refrigerant to the atmosphere! If required service procedures include the adding or removing of refrigerant, the service technician must comply with all federal, state and local laws. The procedures discussed in this manual should only be performed by a qualified EPA Certified Technician.

NOTE: Unit is equipped with a phase loss/phase reversal control. If system does not start, check phase of electrical supply.

The first step in troubleshooting a refrigeration circuit is to examine the microprocessor controller and digital scroll compressor controller (if present) and see if there is a fault code. The next step is to check airflow conditions (e.g. improper ductwork, atypical wet bulb / dry bulb, etc.). After these steps have been eliminated, proceed with troubleshooting by following this guide.

Symptom	Possible Cause	Corrective Action
Compressor will not run or does not start	Open disconnect switch or circuit breaker.	Close switch and/or breaker.
	Compressor contactor not closing.	Check voltage to contactor coil, transformer, slave relay, system. Replace parts as necessary.
	Blown fuse or tripped breaker.	Check for reason and repair. Replace fuse after correcting problem.
	Low line voltage.	Check line voltage. If more than 10% from compressor marking, correcting is necessary.
	Compressor motor protector open.	Motor thermal protector automatically resets. Allow time (2 hours) for compressor to cool down so protector will reset. Restart and check for reason overheat occurred.
	Compressor defective.	Check motor for open circuit, short circuit, grounded windings, or burn out. Compressor may be seized; check refrigerant. If necessary, replace compressor.
	High pressure switch open or defective.	If manual reset (high pressure), reset switch. (Switch opens at 600 psi and will not reset above 420 psi for R-410A). Replace if defective.
	Low pressure switch open or defective.	Switch will open at 50 psi and auto-close at 90 psi. Replace if defective.
	Open room thermostat or control. (No cooling required).	Check room temperature. If temperature is proper, wait for thermostat to close.
Loose wiring.	Check all wire terminals and tighten as necessary.	
Compressor starts but cuts out on low pressure <i>Low pressure switch activates at 50 PSIG</i>	Low or loss of refrigerant charge.	Check refrigerant pressures and temperatures (subcooling.)
	Airflow restricted.	Check for dirty evaporator coil, dirty filters, dampers closed, iced evaporator coil, improper belt, check motor amps, check duct design.
	Restriction in refrigerant line.	Check refrigerant pressures, look for frosted tubing and components indicating a restriction. Check pressure drop across the filter drier.
	Defective low pressure switch.	Replace.

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Troubleshooting – Refrigeration Circuit

Symptom	Possible Cause	Corrective Action
Compressor starts but cuts out on high pressure switch <i>High pressure activates at 600 PSIG</i>	Refrigerant overcharge.	Check pressures, charge by subcooling.
	Condenser fan motor defective.	Check fan motor.
	Condenser coil inlet obstructed or dirty.	Check coil and clearances. Clean coil if necessary.
	Air or non-condensables in system.	Check high side equalized pressures, check thermal expansion valves.
	Defective high pressure switch.	Replace.
	Restriction in discharge or liquid line.	Check refrigerant line pressures, check thermal expansion valves, replace any defective component.
	Condensing fan relay not pulling in.	Replace.
Compressor cuts out on thermal overload	Low voltage.	Check voltage.
	Sustained high discharge pressure.	Check running amperage and conditions described under “low suction pressure” symptoms.
	High suction and discharge pressures.	Check thermal expansion valve setting, check for air in system. Check air conditions and cfm.
	Defective compressor overload.	If compressor is hot, allow compressor to cool for two hours. Recheck for open circuit.
	Improper refrigerant charge.	Check subcooling.
	Improperly wired.	Review wiring schematics.
	Loose wiring.	Check all connections.
	Defective start relay.	Replace relay.
	Motor windings damaged.	Verify amp draw.
Compressor hums, but will not start	Improperly wired.	Review wiring schematics.
	Low line voltage.	Check voltage.
	Loose wiring.	Check all connections.
	Defective start relay.	Replace relay.
	Motor winding damaged.	Verify amp draws. Replace compressor if necessary.
	Internal compressor mechanical damage.	Replace.
Compressor noisy or vibrating	Refrigerant overcharge.	Check pressures and subcooling.
	Liquid floodback.	Check thermal expansion valve setting. Check for refrigerant overcharge.
	Tubing rattle.	Dampen tubing vibration by taping or clamping. Carefully bend tubing away from contact where possible.
	Scroll compressor rotating in reverse. (3-phase)	Check high and low side pressures during operation to confirm. Rewire for opposite rotation.
	Damaged compressor.	Replace the compressor.
	Improper mounting on unit base.	Check that compressor is properly isolated and mounting bolts are tight.

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Troubleshooting – Refrigeration Circuit

Symptom	Possible Cause	Corrective Action
High suction pressure	Excessive load on evaporator coil.	Check for high entering wet bulb temperature, check for excessive air flow.
	Compressor is unloaded. (digital scroll)	Check digital scroll controller signal and solenoid valve.
	Expansion valve sensing bulb not secured to suction line.	Check the thermal expansion valve, ensure bulb is insulated. Check superheat. If superheat is high, then valve is choking refrigerant flow. <ul style="list-style-type: none"> • Check bulb for contact. • Adjust valve for superheat ~10°F. • Replace valve power head or valve.
	Thermostatic expansion valve. Overfeeding.	Check bulb location and clamping. Adjust superheat. Replace expansion valve power head.
	Room load too large.	Reduce the load or add more equipment.
	Overcharged.	Check pressures and subcooling.
High discharge pressure	Thermal expansion valve setting.	Check thermal expansion setting and calibrate superheat / subcooling.
	Air inlet to condenser dirty or obstructed.	Check for proper clearances and possible air recirculating. Clean coil.
	Condenser fan motor defective.	Check condenser fan motor.
	Too much refrigerant.	Check subcooling. Remove excess refrigerant.
	Non-condensable in system.	Remove non-condensable from system.
	Dirty condenser coil.	Clean condenser coil.
	Condenser fan not running or running backwards.	Check electrical circuit and fuse. Check fan cycling controls.
	High load conditions.	Add more equipment or reduce load.
Low suction pressure	Refrigerant undercharge/loss of refrigerant charge.	Check pressures and subcooling.
	Blower running backward.	Confirm blower rotation. If reversed, interchange any two wires from 3-phase disconnect.
	Low entering air temperature. (Low load conditions).	Check entering air wet bulb conditions.
	Refrigerant leak.	Check system for leaks. Repair leaks and add refrigerant.
	Evaporator dirty or iced-up, or airflow restricted.	Clean the coil. Check fan operation. Check airflow.
	Plugged liquid line filter-drier.	Replace filter-drier, check psi across filter.
	Improper hot gas bypass setting.	Check setting and correct as required.
	Expansion valve defective, superheat too high or valve too small.	Adjust valve for proper superheat or replace the expansion valve if too small or defective.
Moisture in system, check sight glass.	Reclaim refrigerant, check for leaks, recharge.	

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Troubleshooting – Refrigeration Circuit

Symptom	Possible Cause	Corrective Action
Low discharge pressure	Insufficient refrigerant charge.	Check subcooling, check for leak. Repair leak and add refrigerant.
	Defective or improperly adjusted expansion valve.	Check superheating and adjust thermal expansion valve.
	Low suction pressure.	See “low suction pressure”.
	Faulty condenser temperature controls. (Condensing fan cycle switch).	Check condenser controls and reset to obtain desired condensing temperature.
Compressor short cycles	Thermostat location or controls malfunction.	Check thermostat, check heat anticipator setting.
	Improper refrigerant charge.	Check subcooling, verify superheat.
	Defective high or low pressure control.	Check high or low pressure switch.
	Poor air distribution.	Check ductwork for recirculating.
	High discharge pressure.	See “high discharge pressure”.
	Low airflow at evaporator(s).	Check blower operation and airstream restrictions.
	Incorrect unit selection (oversized).	Contact factory.
Compressor loses oil	Refrigerant leak.	Check system for leaks. Repair leaks and add refrigerant.
	Short cycling.	Check low pressure control settings.
	Refrigerant flood back.	Check thermal expansion valve setting. Check for refrigerant overcharge. Check crankcase heater operation.
	Reheat flush cycle inadequate.	Contact factory.
Not enough cooling or lack of cooling	Refrigeration undercharged.	Check subcooling. Adjust charge, if necessary.
	Dirty filter or evaporator coil.	Check filter, coil and airflow.
	Dirty or clogged condenser coil.	Check coil and airflow.
	Air or other non-condensables in system.	Check equalized high side pressure with equivalent outdoor temperature.
	Restriction in suction and liquid line.	Check for restrictions in refrigerant circuit.
	Control contacts stuck.	Check wiring.
	Excessive load.	Add more equipment or reduce room load.
Liquid line is frosted or wet	Restriction in liquid line.	Clear restriction upstream of point of frosting.
Suction line is frosting	Insufficient evaporator airflow.	Check airflow, check filters, check VFD control signal for proper operation.
	Malfunctioning or defective expansion valve.	Check bulb of thermal expansion valve.
Frost on evaporator coil	Hot gas bypass valve not functioning properly.	Check valve. If defective, replace.
	Manual hot gas bypass valve closed.	Open valve.
	Low load or airflow.	Increase airflow, check filters.

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

Routine Maintenance

DANGER

Electric shock hazard. Can cause injury or death. Before attempting to perform any service or maintenance, turn the electrical power to the 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.

This unit requires minimal maintenance to operate properly. Maintenance requirements for this model vary for each installation and depend greatly on how much the system is used and the cleanliness of the air. Proper maintenance will both increase the life of the system and maintain its efficiency. Maintenance must be performed by experienced technicians and in the case of refrigeration systems, must be done by an EPA certified technician.

Maintenance frequency is based on a presumed nominal use of the system. If the system is being run constantly, the frequency should be adjusted accordingly. If there is seasonal debris in the air which can be drawn into the filters and the coils, they should be checked more frequently. If the system is being used for only a few hours per day, the frequency may be reduced. Use the maintenance log at the end of this manual to record each maintenance session and observations and then establish a maintenance schedule that is appropriate for the installation. The following is provided as a guideline:

Maintenance Frequency:

Monthly

1. External Filter
Clean metal mesh filters
2. Internal Filters
Replace MERV 8 filters monthly.
Adjust replacement schedule for MERV 13 and MERV 14 or other filters as inspection requires.

Semiannually

1. Check motor and motor bearings
Check for excessive heat, vibration or noise.
Lubricate bearings in accordance with the motor manufacturer's recommendations.
2. Condensate Drain (if applicable)
Inspect and clean – refill with water
3. Condenser Coils
Inspect for cleanliness – clean as required

Annually

It is recommended that the annual inspection and maintenance occur at the start of the cooling season. After completing the checklist, follow the unit start-up checklist provided in the manual to ensure the refrigeration system operates in the intended matter.

1. Lubrication
Apply lubricant where required
2. Dampers
Check for unobstructed operation
3. Blower Wheel and Fasteners
Check for cleanliness
Check all fasteners for tightness
Check for fatigue, corrosion, wear
4. Door Seal
Check if intact and pliable
5. Wiring Connections
Check all connections for tightness
6. Cabinet
Check entire cabinet, inside and out, for dirt buildup or corrosion. Remove accumulated dirt, remove any surface corrosion and coat the area with appropriate finish.

Units with Packaged DX:

Semiannually

1. Evaporator Coil Maintenance
Check for cleanliness - clean if required
2. Condenser Coil Maintenance
Check for cleanliness - clean if required
3. Condensate Drain
Inspect and clean - refill with water
4. Condensing Fan Blades and Motors
Check for cleanliness
Check all fasteners for tightness
Check for fatigue, corrosion and wear

Maintenance Procedures:

Lubrication - Check all moving components for proper lubrication. Apply lubricant 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.

Gas Furnace - Maintain furnace in accordance with instructions in the Indirect Gas-Fired Heat IOM shipped with this unit.

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 cooling. Never wash-down the motor with high pressure spray. Greasing of motors is only intended when fittings are provided. Fan motors typically have two grease fittings. Each motor manufacturer has different lubrication schedules for different models. Go to the motor manufacturer's website and download their maintenance requirements. **Do not over-lubricate motors or use an incompatible grease.** Many fractional motors are permanently lubricated for life and require no further lubrication.

Fan Wheel and 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.

Internal Filter Maintenance - The unit will typically be provided with 2-inch thick pleated paper filters in the airstream. These filters should be checked according to a routine maintenance schedule and replaced as necessary to ensure proper airflow through the unit. Replacement filters shall be of same performance and quality as factory installed filters. Filter must be pleated design with integral metal grid. Two acceptable filter replacements are Aerostat Series 400 or Farr 30/30®.

Filters upstream of the coil should be checked regularly. If the filters are dirty, they should be cleaned or replaced. It is important the filters stay clean to maintain desired airflow.

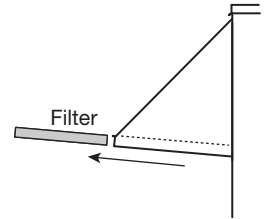
WARNING

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.

External Filter Maintenance - Aluminum mesh, 2-inch thick filters are located in the supply weatherhood (if the weatherhood option was purchased). These 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 by rinsing with a mild detergent in warm water prior to start-up.



Outdoor Air Intake Hood
Mesh Filter Access

Coil Maintenance - Coils must be cleaned to maintain maximum performance. Check coils once per year under normal operating conditions and if dirty, brush or vacuum clean. Soiled fins reduce the capacity of the coil, demand more energy from the fan and create an environment for odor and bacteria to grow and spread through the conditioned zone. High pressure water (700 psi or less) may be used to clean coils with a fin thickness over 0.0095 inches thick. **TEST THE SPRAY PRESSURE** over a small corner of the coil to determine if the fins will withstand the spray pressure. For coils with fragile fins or high fin density, foaming chemical sprays and washes are available. Many coil cleaners use harsh chemicals, so they must be used with caution by qualified personnel only. Care must be taken not to damage the coils, including the fins, while cleaning. **Caution: Fin edges are sharp!**

WARNING

Biological hazard. May cause disease. Cleaning should be performed by qualified personnel.

Drain pans in any air conditioning unit will have some moisture in them, therefore, algae and other organisms will grow due to airborne spores and bacteria. Periodic cleaning is necessary to prevent this buildup from plugging the drain and causing the drain pan to overflow. Inspect twice a year to avoid the possibility of overflow. Also, drain pans should be kept clean to prevent the spread of disease. Cleaning should be performed by qualified personnel.

Maintenance Log

Date _____ Time _____ AM/PM

Notes: _____

Date _____ Time _____ AM/PM

Notes: _____

Date _____ Time _____ AM/PM

Notes: _____

Date _____ Time _____ AM/PM

Notes: _____

Date _____ Time _____ AM/PM

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Date _____ Time _____ AM/PM

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Date _____ Time _____ AM/PM

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Date _____ Time _____ AM/PM

Notes: _____

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.

Greenheck's Model RV and RVE 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.

