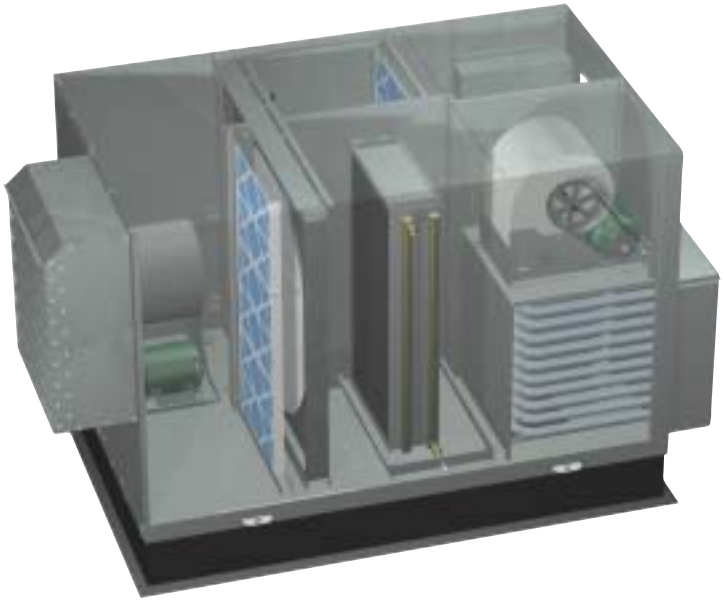
MODEL PVF

INDIRECT GAS FIRED FURNACES FOR ENERGY RECOVERY UNITS

Installation, Operation and Maintenance Manual



Refer to Part Number 460945 for any unit information other than that pertaining to the Indirect Fired Furnace.

WARNING!!!

Improper installation, adjustment, alteration, service or maintenance can cause injury or death. Read the installation, operating and maintenance instructions thoroughly before installing or servicing this equipment.

CAUTION!!!

Units are designed for outdoor installation only. DO NOT locate units indoors.

Indirect Fired Gas Unit Installations

Units are listed for installation in the United States and Canada

- Installation of gas fired duct furnaces must conform with local building codes. In the absence of local codes, installation must conform to the National Fuel Gas code, ANSI Z223.1 or in Canada, CAN/CGA-B149 installation codes.
- All electrical wiring must be in accordance with the regulation of the National Electric Code, ANSI/NFPA No. 70.
- Unit is approved for installation downstream from refrigeration units. In these conditions, condensate could form in the duct furnace and provision must be made to dispose of the condensate.

Shipping

Check the unit for shipping damage. If any shipping damage is found, it should be reported to the last carrier and your local Greenheck representative.

GREENHECK

The Solution Company.

Location Recommendations

1. Do not install units in locations where flue products can be drawn into adjacent building openings such as windows, fresh air intakes, etc. Distance from vent terminal to adjacent public walkways, adjacent buildings, operable windows, and building openings shall conform with the local codes. In the absence of local codes, installation shall conform with the National Fuel Gas Code, ANSI Z223.1, or the CAN/CGA B-149 Installation Codes.
2. Building materials that will be affected by flue gases should be protected.
3. Avoid locating in an area where deep snow is likely to accumulate. During the winter months, keep snow clear on the access side of the unit to prevent any blockage of combustion air inlet or flue exhaust openings.
4. Maintain minimum horizontal clearance of 4 feet from electric meters, gas meters, regulators, and relief equipment. In Canada, the minimum clearance is 6 feet.
5. Local codes may supercede any of the above provisions.
6. Be sure that the minimum clearances to combustible materials are maintained.

Unit Clearances to Combustible Materials

Combustion blower discharge must be located 42 in. from any combustible materials.

Venting

1. Do not modify or obstruct the combustion air inlet cover or the combustion blower weatherhood.
2. During the winter months, periodically clear snow from access side of unit to prevent blockage of the inlet and exhaust openings.
3. Do not add any vents other than those supplied by the manufacturer.

Gas Connection

Gas Supply Pressure Requirements
Natural: 6 to 14 in. wg
LP: 11 to 14 in. wg

1. Single furnaces (furnace input 100 to 400 MBH) have a single ¾ inch connection. Double furnaces (furnace input 500 to 800 MBH) have two ¾ inch connections, and triple furnaces (furnace input 1050 to 1200 MBH have three ¾ inch connections.
2. When connecting the gas supply, the length of the run must be considered in determining the pipe size to avoid excessive pressure drop. Refer to a Gas Engineer's Handbook for gas pipe capacities.
3. A drip leg should be installed in the pipe run to the unit.
4. Install an easily accessible ground joint union and a manual shut off valve (these are required by some local codes) for emergency shut off and easy servicing of the controls.
5. A ⅛ inch NPT plugged tap shall be installed immediately ahead of the gas supply connection to the furnace.
6. After gas piping is completed, carefully check all piping connections for gas leaks. Use soap solution or equivalent for testing. DO NOT use a flame or other source of ignition to check for gas leaks.
7. When leak testing pressures above 14 in. wg (½ psi), close the field installed shutoff valve, disconnect the furnace and its gas train from the gas supply line, and plug the supply line before testing.
8. When leak testing at pressures equal to or less than 14 in. wg (½ psi) close the field-installed shutoff valve to isolate the unit from the gas supply line before testing.

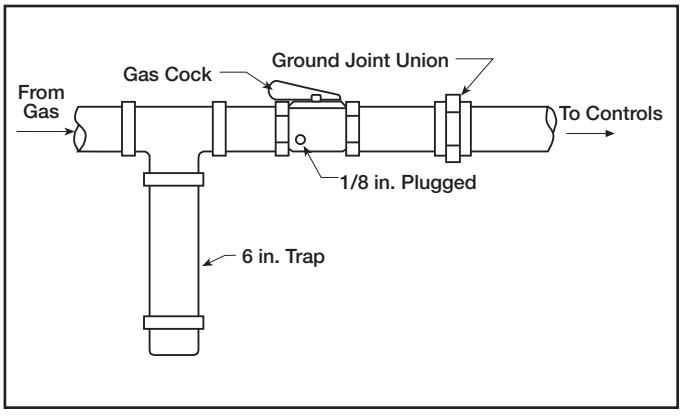


Figure 1: Recommended Piping to Controls

Electrical Connections

WARNING!!!

- Disconnect power supply before making wiring connections to prevent electrical shock and equipment damage.
- All appliances must be wired strictly in accordance with wiring diagram furnished with the unit. Any wiring different from the diagram could result in a hazard to persons and property.
- Any original factory wiring that requires replacement must be replaced with wiring material having a temperature rating of at least 105°C.

1. Installation of wiring must conform with local building codes. In the absence of local codes, installation must conform to the National Electric Code ANSI/NFPA 70-Latest Edition. Unit must be electrically grounded in conformance with this code. In Canada, wiring must comply with CSA C22.1, Canadian Electrical Code.
2. All furnaces are provided with a wiring diagram located on the inside of the access panel. Refer to this wiring diagram for all wiring connections.
3. The combustion blower motor will not run unless the furnace is turned on and the gas controls are calling for heat.

Control Center Layout

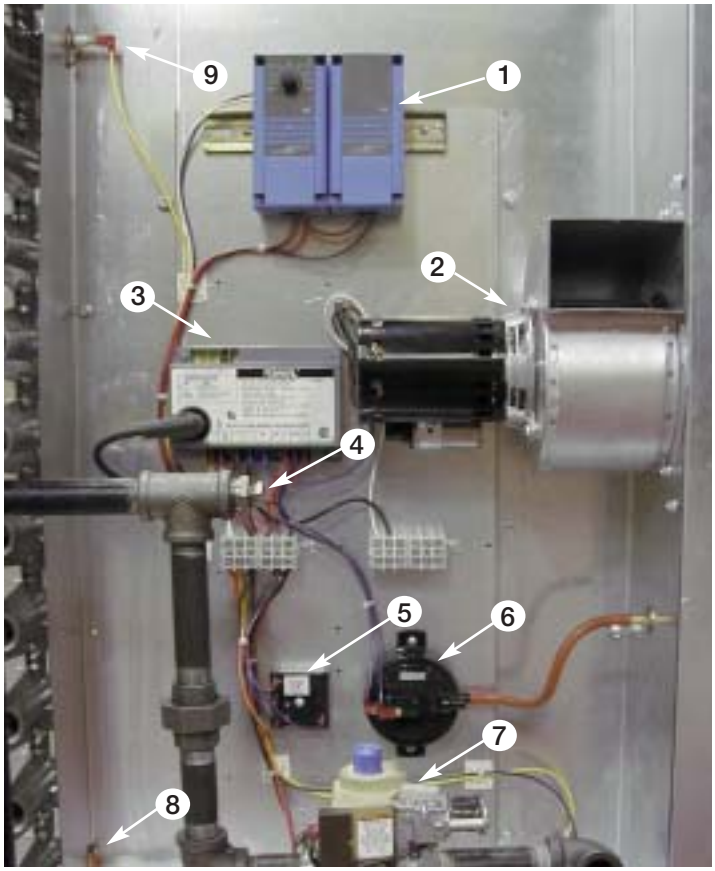


Figure 2: Furnace Control Center

1. **Two-stage temperature controls** - Controls the furnace stages based on the unit discharge temperature.
2. **Combustion blower** - Exhausts the products of combustion from the furnace tubes.
3. **Ignition controller** - Continually monitors, analyzes, and controls the proper operation of the gas burner.
4. **Manifold pressure test port** - Used for checking the manifold gas pressure.
5. **Time Delay relay** - Allows burner to stay at high fire for 10 seconds upon being lit.
6. **Air pressure switch** - Tests to ensure the combustion blower is operating.
7. **Two-stage gas valve** - Contains main pressure regulator, safety shut-off valves, and manual shut off knob. It controls the furnace to 50% or 100% fire.
8. **Ignitor** - Provides spark for burner ignition.
9. **Flame Sensor** - Ensures that each burner has ignited.

Start-Up Procedure

1. Turn off power to the unit at the disconnect switch. Close all manual gas valves.
2. Check that all gas and electrical connections are weatherized.
3. Make sure that the combustion air inlet and the combustion blower discharge are free from obstructions.
4. Inspect the unit to make sure that no damage has occurred during installation.
5. With the furnace control center access panel removed, connect a "U" tube manometer to the manifold pressure test port as shown in Figure 2. This will be used for checking the manifold gas pressure.
6. Set the thermostat or discharge temperature controls to lowest setting.
7. Open all manual gas valves including the combination gas valve and turn power on.
8. Call for heat with the thermostat or discharge temperature controls and allow the burner to light. Greenheck duct furnaces are equipped with an automatic spark ignition system which automatically lights the burner. DO NOT attempt to light the burners manually.
9. After the burner is lit, check to make sure that the supply blower is operating.
10. Verify that the gas controls sequence properly (see **Sequence of Operation** below).
11. Check the manifold gas pressure (see **Burner Adjustments** on pages 5 and 6).

Sequence of Operation

Power-up/Standby

After power is supplied to the unit:

1. The ignition control will reset and perform a self-check routine.
2. The diagnostic LED will flash for up to four seconds.
3. The ignition control will begin scanning the thermostats.

Heat Mode

When the thermostat or discharge temperature controls call for heat:

1. The ignition control will check that the pressure switch for the combustion blower is open.
2. The combustion blower will be energized and the 15-second pre-purge begins.
3. The gas valve is energized and the igniter will spark for up to 10 seconds.

   Natural Gas - If a flame is not sensed during the trial for ignition, two additional trials will be attempted before going into lockout for one hour.

   LP Gas - If a flame is not sensed during the trial for ignition, the control will go into lockout for one hour.
4. When a flame is sensed, sparking stops immediately. The gas valve and combustion blower remain energized.

5a. Two-stage control: The burner will light at 100% fire and remain there for 10 seconds. The thermostat will then operate the burners at high or low fire, depending on the demand for heat.

5b. Electronic Modulation - The burner will light at 100% fire and remain there for 10 seconds. The main burner gas valve will then modulate from 100% down to 50% as needed. If the burner remains on low fire for an extended period of time, the burner will shut off and re-light as necessary.

6. The ignition control constantly monitors the thermostat, pressure switch, and burner flame to assure proper operation.
7. When the thermostat or discharge temperature controls are satisfied, the main valve is de-energized and the combustion blower shuts off following a 30-second post-purge period.

Recovery from Lockout

The ignition control will automatically reset after 1 hour if the thermostat is still calling for heat. Prior to 1 hour, a manual reset (cycle power to unit) is required. The thermostat may be reset or the power interrupted for a period of 5 seconds. See page 7 for **Ignition Control Diagnostics**.

Performance Data

Model Number	Input (MBH)	Output (MBH)	Air Temperature Rise Through Unit (°F)															
			20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
			CFM																
PVF 100	100	80	3704	2963	2469	2116	1852	1646	1481	1347	1235	1140	1058	988	926	871	823	780	741
PVF 150	150	120	5556	4444	3704	3175	2778	2469	2222	2020	1852	1709	1587	1481	1389	1307	1235	1170	1111
PVF 200	200	160	7407	5926	4938	4233	3704	3292	2963	2694	2469	2279	2116	1975	1852	1743	1646	1559	1481
PVF 250	250	200	9259	7407	6173	5291	4630	4115	3704	3367	3086	2849	2646	2469	2315	2179	2058	1949	1852
PVF 300	300	240	11111	8889	7407	6349	5556	4938	4444	4040	3704	3419	3175	2963	2778	2614	2469	2339	2222
PVF 350	350	280	12963	10370	8642	7407	6481	5761	5185	4714	4321	3989	3704	3457	3241	3050	2881	2729	2593
PVF 400	400	320	14815	11852	9877	8466	7407	6584	5926	5387	4938	4558	4233	3951	3704	3486	3292	3119	2963

Ratings shown are for elevations up to 2000 ft. For higher elevations, the input should be reduced by 4% per 1000 ft. of elevation above sea level. In Canada, from 2000 to 4500 ft in elevation, the unit must be derated to 90% of the input listed above. The unit shall also be used in accordance with standard CGA 2.17.

Furnace Controls

Staged Temperature Controls

For Energy Recovery Units without Temperature Control Package

The furnace stage controls are located in the furnace control center. One control is provided for each stage of heating. The discharge temperature setting is located on the control furthest to the left. The offset and differential settings for each stage are preset at the factory; however, field-adjustments may be made to get the best control for your application. See the literature provided with the controls for further information.

Figure 3: Staged Controls

For Energy Recovery Units with Temperature Control Package

If two-stage control is ordered with a Temperature Control Package, the controller in the unit's main control center will control the stages of heating. The temperature set point may be adjusted on the controller (See Temperature Controller IOM).

Staged Burner Adjustments

Setting Manifold Pressure for Two Stage Gas Control

1. Set the unit to high fire by setting the discharge temperature control or thermostat to its maximum setting. If the ambient temperature is warm, the unit may not stay at high fire.
2. Measure the burner manifold pressure at the manifold pressure test port (see **Control Center Layout** on page 3) using a "U" tube manometer. The pressure on high fire should be 3.5 in. wg for natural gas and 10 in. wg for LP gas. To change the pressure, adjust the regulator adjustment screw on the combination gas valve.
3. Set the unit to low fire by removing the wire from the high fire terminal on the combination gas valve.
4. The manifold pressure on low fire for natural gas should be 0.88 in. wg and 2.5 in. wg for LP gas. To change the pressure, use the low fire adjustment screw on the combination gas valve.

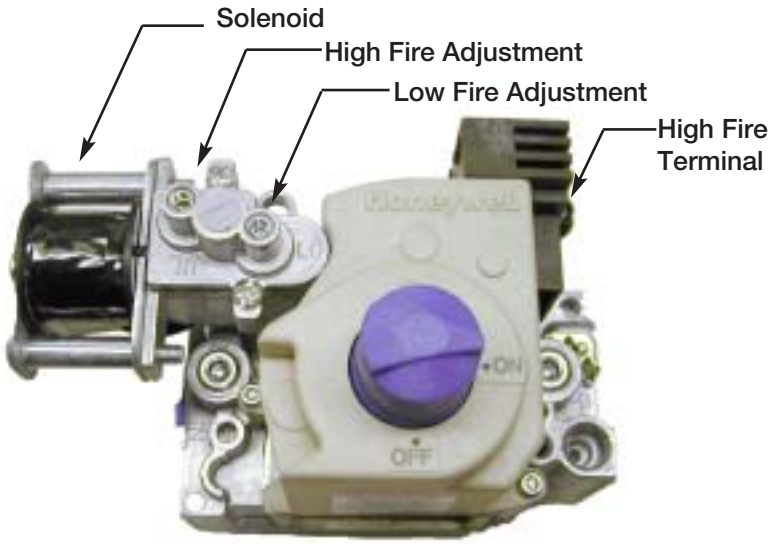


Figure 4: Combination Gas Valve

Electronic Modulation Temperature Controls

For Energy Recovery Units without Temperature Control Package
A Discharge Temperature Dial is used for temperature control for electronic modulation. The temperature dial will be located in the furnace control center.

For Energy Recovery Units with Temperature Control Package
The Temperature Controller in the unit's main control center will provide the electronic modulation control.

High and Low Fire Settings for Electronic Modulation

Check the high and low gas pressures on initial start up per the instructions below. These settings are pre-set at the factory, but should be adjusted in the field if necessary. Set the high fire first and the low fire second. The low fire must always be checked if the high fire is changed.

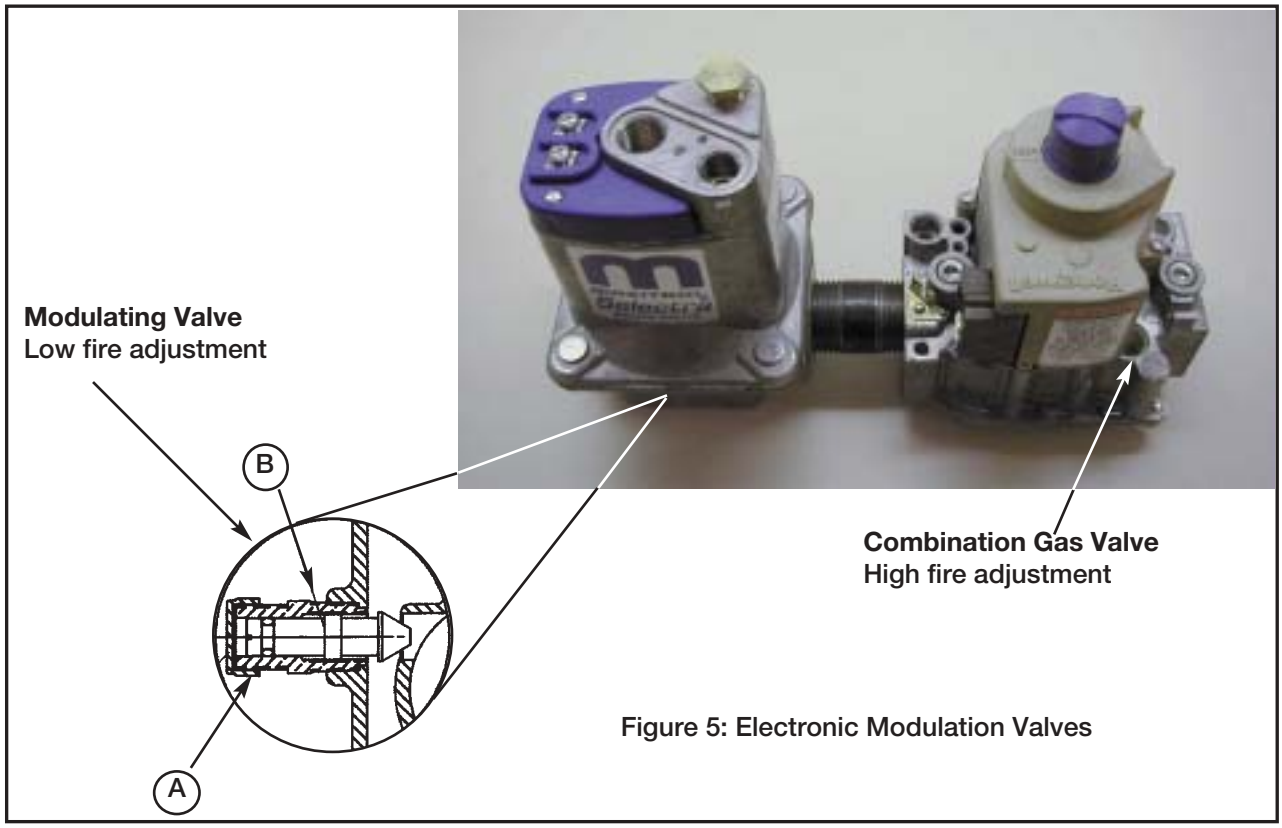


Figure 5: Electronic Modulation Valves

1. Set the unit to high fire by placing a jumper between terminals 7 and 8 on the Maxitrol amplifier.
2. Measure the burner manifold pressure at each furnace at the pressure test port (see Figure 2) using a high quality manometer that can measure low gas pressures. The pressure at high fire should be 3.5 in. wg for natural gas and 10.0 in. wg for LP Gas. To change the pressure, adjust the high fire screw on the combination gas valve.
3. To get the unit to low fire: Remove the wire from terminal 3 on the amplifier and isolate it from touching anything. Set the discharge temperature selector to the highest setting. If there is a room override thermostat, turn the dial to the highest setting.
4. Measure the manifold pressure on low fire, it should be 0.88 in. wg for natural gas and 2.5 in. wg for LP gas.
5. To adjust the low fire, remove the bypass cap (A) and turn screw (B) as shown in diagram. Adjust the screw indicated in Figure 5 on the modulating valve.
6. Reconnect wire to terminal 3.
7. Remove jumper and place all wires back to where they were and plug the manifold pressure port.

Troubleshooting

Ignition Control Diagnostic LED

During normal operation, the LED is shut off. The LED will be on or flashing during a fault condition. If a fault condition is occurring, turn the unit off and on again. If the LED is still flashing, refer to the following troubleshooting section.

LED Indication	Error Mode
Steady on	Internal control failure
1 flash	Air flow fault
2 flashes	Flame with no call for heat
3 flashes	Ignition lockout

Airflow Fault (1 Flash)

An airflow fault may occur for the following reasons:

- An airflow switch continually monitors the combustion airflow during an ignition sequence. During the initial call for heat, if the pressure switch contacts are in the closed position for 30 seconds without an output to the combustion blower, an airflow fault will be declared. The control will remain in this mode with the combustion blower off.
- After the combustion blower output (L1 and IND) is energized and the airflow switch remains open for more than 30 seconds, an airflow fault will be declared. The control will stay in this mode with the combustion blower on, waiting for the airflow switch to close.
- If the airflow signal is lost while the burner is firing, the control will immediately de-energize the gas valve and the combustion blower will remain on. If the call for heat remains, the control will wait for proper airflow to return. If proper airflow is not detected after 30 seconds, an airflow fault will be declared. If proper airflow is detected at any time, a normal ignition sequence will begin.

Once proper airflow is detected, the normal Sequence Of Operation for ignition will follow (see page 4).

Flame Fault (2 Flashes)

If the main valve fails to close completely and maintains a flame, the full-time flame sense circuit will detect it and energize the combustion blower. Should the main valve later close completely and remove the flame signal, the combustion blower will be de-energized.

Ignition Lockout (3 Flashes)

Possible Cause	Solution
Manual gas valve not open	Open manual valve
Air in the gas line	Bleed gas line
Supply gas pressure too high or too low	Check that supply pressure is between 6 in. wg and 14 in. wg for natural gas and 11 in. wg and 14 in. wg for LP.
Loose wire connections	Check for tight wire connections.
No spark: a. Transformer failure b. Spark electrode c. Spark cable shorted to ground d. Ignition controller not grounded	 a. Check primary and secondary voltages of transformer. Replace if necessary. b. Ensure spark gap is ⅛ in. and ceramic insulator is not cracked. Replace if necessary. Electrode is NOT field-adjustable. c. Replace spark cable d. Check that the ignition controller is grounded to the furnace control center.
High limit control tripped	Check unit airflow and manifold pressure.
Faulty combination gas valve	If 24 volts is measured between terminals MV and common, but valve remains closed, replace valve.
Faulty ignition control	Check diagnostic LED for steady on and for voltage between V1 and V2. If no voltage is present, replace ignition control.

Routine Maintenance

CAUTION!!!

Turn off all gas and electrical power to the unit before performing any maintenance or service operations to this unit.

Combustion Blower Motor

Motor maintenance is generally limited to cleaning. Cleaning should be limited to exterior surfaces only. Removing dust and grease build-up on the motor housing assures proper motor cooling. Use caution and do not allow water or solvents to enter the motor or bearings. Under no circumstances should motors or bearings be sprayed with steam, water or solvents. The motor bearings are pre-lubricated and sealed, requiring no further lubrication.

Burners and Orifices

Before each heating season, examine the burners and gas orifices to make sure they are clear of any debris such as spider webs, etc. Clean burner as follows:

- Turn off both electrical and gas supplies to the unit.
- Disconnect union between manifold and gas valve.
- Remove manifold and burner assembly.
- Inspect and clean orifices and burners as necessary. Avoid using any hard or sharp instruments which could cause damage to the orifices or burners.
    - Remove any soot deposits from the burner with a wire brush.
    - Clean the ports with an aerosol degreaser or compressed air.
    - Wipe the inside of the burner clean. Cleaning the burner with a degreaser will slow the future buildup of dirt.
- Before reinstalling the burner assembly, look down the heat exchanger tubes to make sure they are clear of any debris.
- Reinstall manifold and burner assembly, reconnect wire leads, and gas supply piping.
- Turn on the electrical power and gas supply.
- Follow the start-up procedure to light the burners and verify proper operation.

Heat Exchanger

The heat exchanger should be checked annually for cracks and discoloration of the tubes. If a crack is detected, the heat exchanger should be replaced before the unit is put back into operation. If the tubes are dark gray, airflow across the heat exchanger should be checked to make sure the blower is operating properly.

Flue Collector Box

The flue passageway and flue collector box should be inspected prior to each heating season and cleared of any debris.

Electrical Wiring

The electrical wiring should be checked annually for loose connections or wiring deterioration.

Replacement Parts

When ordering replacement parts, include the complete unit model number and serial number listed on the unit rating plate.

Warranty

Greenheck warrants this equipment to be free from defects in material and workmanship for a period of one year from the purchase date. Any units or parts which prove to be defective during the warranty period will be repaired or replaced at our option.

The motor is warranted by the motor manufacturer for a period of one year. Should the motor prove defective during this period, it should be returned to an authorized motor service station.

Greenheck will not be responsible for any installation or removal costs.