

# Modular In-Direct Fired Heaters and Inserts Installation, Operation, and Maintenance Manual

---



**Modular In-Direct Fired Heater**



**In-Direct Fired Module**



**In-Direct Fired Furnace**

## **FOR YOUR SAFETY**

If you smell gas:

1. Open windows.
2. Don't touch electrical switches.
3. Extinguish any open flames.
4. Immediately call your gas supplier.

## **FOR YOUR SAFETY**

The use and storage of gasoline or other flammable vapors and liquids in open containers in the vicinity of this appliance is hazardous.

## **RECEIVING AND INSPECTION**

Upon receiving unit, check for any interior and exterior damage, and if found, report it immediately to the carrier. Also check that all accessory items are accounted for and are damage free. Turn the blower wheel by hand to verify free rotation and check the damper (if supplied) for free operation.

## **WARNING!!**

Improper installation, adjustment, alteration, service or maintenance can cause property damage, injury or death. Read the installation, operating and maintenance instructions thoroughly before installing or servicing this equipment. ALWAYS disconnect power and gas prior to working on heater.

**Save these instructions.** This document is the property of the owner of this equipment and is required for future maintenance. Leave this document with the owner when installation or service is complete.

## TABLE OF CONTENTS

WARRANTY.....	3
INSTALLATION.....	4
Mechanical.....	4
Site Preparation .....	4
Assembly .....	4
Curb and Ductwork .....	4
Roof Mount Installation.....	5
Installation with Exhaust Fan .....	5
In-Direct Fired Module Installation .....	6
Indoor (INLINE) Installation .....	6
Indoor Flue Venting.....	7
Gas.....	8
Electrical .....	9
Motorized Intake Damper .....	9
Remote Control Panel .....	10
Fan to Building Wiring Connection.....	10
OPERATION.....	11
Start Up.....	11
Special Tools Required .....	11
Start Up Procedure .....	11
Pilot Adjustment .....	11
Main Burner Adjustment.....	12
Furnace Start Up Summary.....	13
Final Start Up Procedure.....	14
Pulley Adjustment .....	15
Pulley Alignment .....	15
Proper Belt Tension .....	15
Pulley Combination Chart.....	16
Sequence of Operation.....	16
Modulating Gas System .....	16
Flame Safety Control.....	17
Operation Summary .....	17
Optional Remote Panel Circuit .....	18
Components.....	19
Remote Panel Option .....	20
Troubleshooting .....	21
Airflow Troubleshooting Chart .....	21
Furnace Troubleshooting Chart.....	22
Remote Panel Troubleshooting Chart.....	23
Troubleshooting Flowcharts.....	24
MAINTENANCE .....	25
General Maintenance .....	25
2 weeks after startup .....	26
Every 3 months .....	26
Filter Quantity Chart .....	26
Yearly.....	26
Orifice and Gas Consumption Chart .....	27
Start-Up and Maintenance Documentation .....	28
Job Information .....	28
Heater Information .....	28
Maintenance Record .....	28
Factory Service Department.....	28

## **WARRANTY**

This equipment is warranted to be free from defects in materials and workmanship, under normal use and service, for a period of 12 months from date of shipment. This warranty shall not apply if:

1. The equipment is not installed by a qualified installer per the MANUFACTURER'S installation instructions shipped with the product,
2. The equipment is not installed in accordance with federal, state and local codes and regulations,
3. The equipment is misused or neglected,
4. The equipment is not operated within its published capacity,
5. The invoice is not paid within the terms of the sales agreement.

The MANUFACTURER shall not be liable for incidental and consequential losses and damages potentially attributable to malfunctioning equipment. Should any part of the equipment prove to be defective in material or workmanship within the 12-month warranty period, upon examination by the MANUFACTURER, such part will be repaired or replaced by MANUFACTURER at no charge. The BUYER shall pay all labor costs incurred in connection with such repair or replacement. Equipment shall not be returned without MANUFACTURER'S prior authorization and all returned equipment shall be shipped by the BUYER, freight prepaid to a destination determined by the MANUFACTURER.

# INSTALLATION

It is imperative that this unit is installed and operated with the designed airflow, gas, and electrical supply in accordance with this manual. If there are any questions about any items, please call the service department at **1-866-784-6900** for warranty and technical support issues.

## Mechanical

**WARNING: DO NOT RAISE VENTILATOR BY THE INTAKE HOOD, BLOWER OR MOTOR SHAFT, OR BEARINGS – USE LIFTING LUGS PROVIDED OR A SLING**

## Site Preparation

1. Provide clearance around installation site to safely rig and lift equipment into its final position. Supports must adequately support equipment. Refer to manufacturer's estimated weights.
2. Consider general service and installation space when locating unit.
3. Locate unit close to the space it will serve to reduce long, twisted duct runs.
4. Do not allow air intake to face prevailing winds. Support unit above ground or at roof level high enough to prevent precipitation from being drawn into its inlet. The inlet must also be located at least 10 feet away from any exhaust vents. The heater inlet shall be located in accordance with the applicable building code provisions for ventilation air.

### **CLEARANCES**

The top, back, and front surfaces of this heater may not be installed less than 6" from combustible materials. The heater base may be installed on combustible surfaces. Allow 24" minimum service clearance on both sides of this heater.

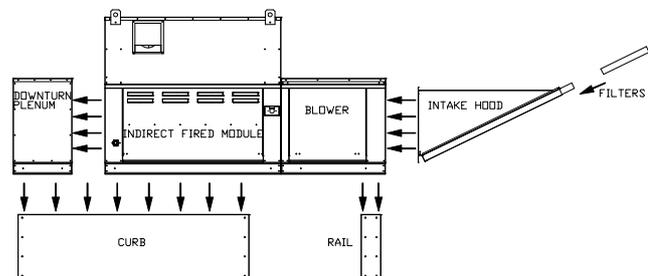
### **IMPORTANT**

To prevent premature heat exchanger failure, do not locate any gas fired unit in areas where chlorinated, halogenated, or acid vapors are present in the atmosphere.

## Assembly

Intakes, curbs and downturn plenums are shipped unassembled. Upon unit arrival, follow the following procedure to assemble the intake and downturn plenum (if down discharge) to the heater.

1. Apply silicone or weather-proof gasket on the back side of the flanges of the intake hood or v-bank intake.
2. Screw the flanges of the intake hood or v-bank to the unit with the supplied sheet metal screws. If the unit is a modular unit with a v-bank or evaporative cooler section, the v-bank or evaporative cooler will bolt to the heater with the bolts provided. Place caulk on the outside of the screws to prevent water leaks.
3. If the unit is a down discharge unit, bolt the downturn plenum to the indirect fired module with the provided bolts. The doors of the indirect fired module provide access to install the bolts into the downturn plenum. Ensure that seal closes properly.



## Curb and Ductwork

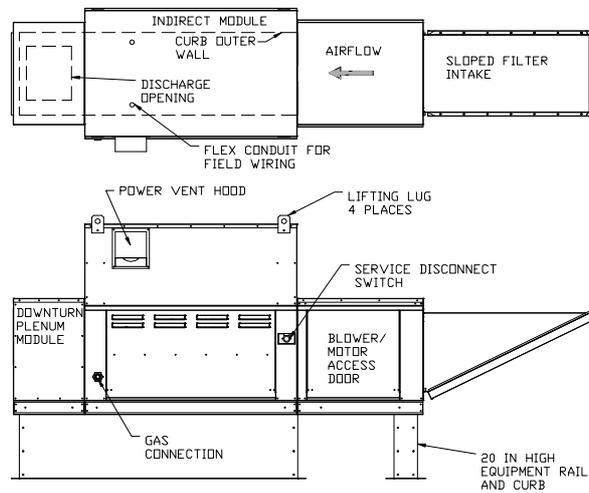
This fan was specified for a specific CFM and static pressure. The ductwork attached to this unit will significantly affect the airflow performance. Flexible ductwork and square elbows should not be used. Also, transitions and turns in ductwork near the fan outlet will cause system effect and will

drastically increase the static pressure and reduce airflow. The chart below shows the minimum fan outlet duct sizes and straight lengths recommended for optimal fan performance. **Follow SMACNA guides and recommendations for the remaining duct run.** Fans designed for rooftop installation should be installed on a prefabricated or factory built roof curb. Follow curb manufacturer's instructions for proper curb installation. The unit should be installed on a curb and/or rail elevated not less than 20" above any surface. Be sure duct connection and fan outlet are properly aligned and sealed. Secure fan to curb through vertical portion of the ventilator base assembly flange using a minimum of eight (8) lug screws, anchor bolts, or other suitable fasteners (not furnished). Shims may be required depending upon curb installation and roofing material. Check all fasteners for tightness. The diagrams below show different mechanical installation configurations.

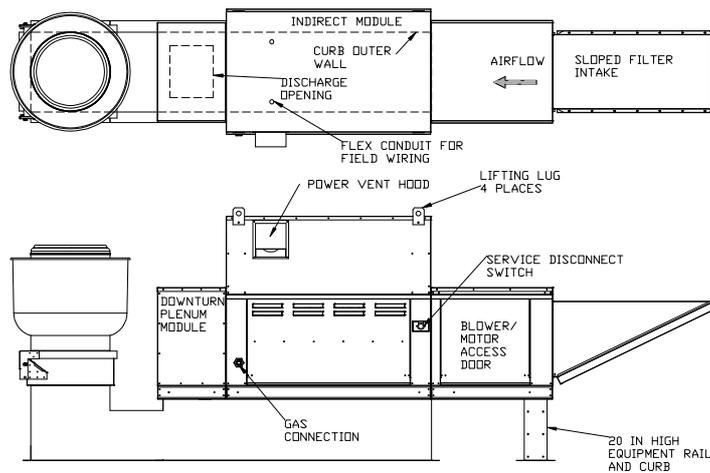
### Recommended Supply Ductwork Sizes

Blower Size	Straight Duct Length
10	48 in.
15	72 in.
18	86 in.

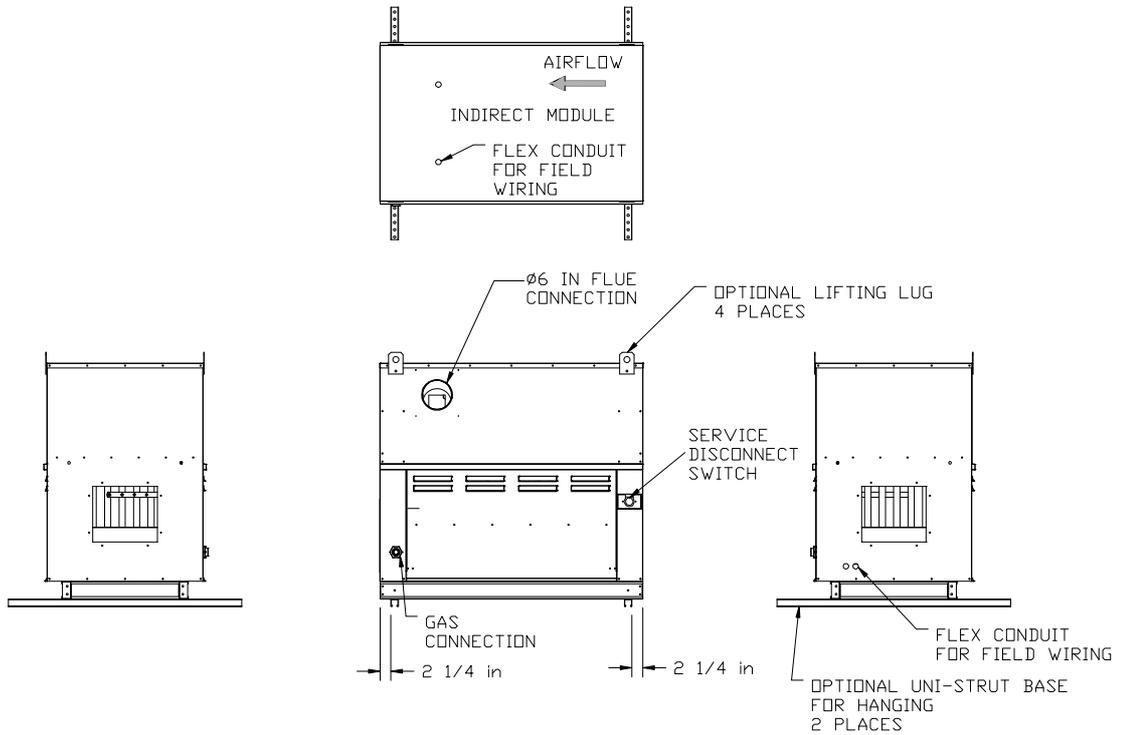
### Roof Mount Installation



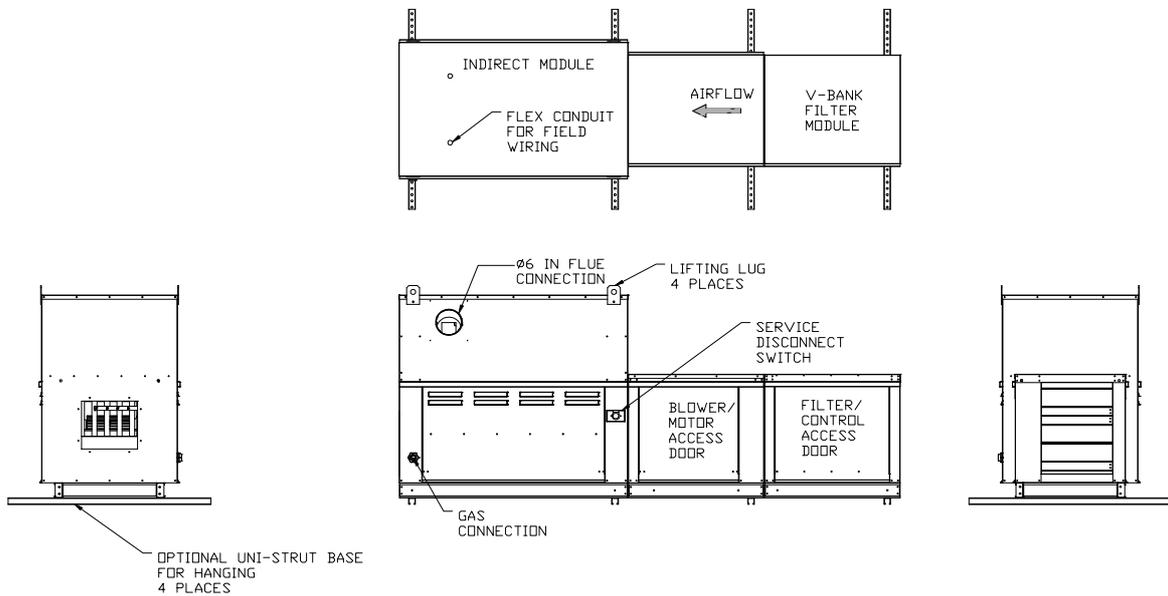
### Installation with Exhaust Fan



## In-Direct Fired Module Installation



## Indoor (INLINE) Installation



## Indoor Flue Venting

Indoor gas fired heating equipment must be vented. **Do not operate un-vented.** Gas fired heating equipment which has been improperly vented, or which experiences a blocked vent condition may emit flue gases into heated spaces.

1. Installation of venting must conform with local building codes, or in the absence of local codes, with the National Fuel Gas Code.
2. Do not use a vent pipe smaller than the size of the outlet on the heater.
3. Reference Table 2.1. Length of horizontal vent pipe should not exceed the values given in this chart based on Model size. Install with a minimum upward slope from unit of ¼ inch per foot and suspend from overhead structure at points no greater than 3 feet apart. For best venting, put as much vertical vent as close to the unit as possible.

Figure 2.1 Typical Power Exhauster Installation

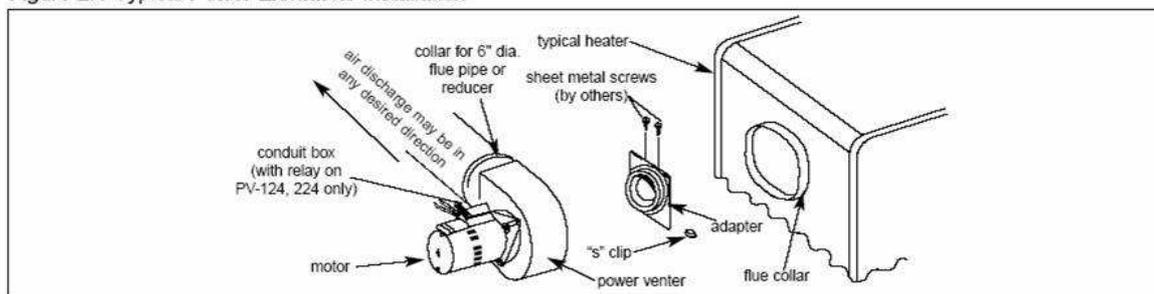


Table 2.1 PD/BD - Allowable Horizontal Vent Pipe Lengths for Modine Power Exhausts

Negative Pressure in a Building, Inches H <sub>2</sub> O		.00	.05	.10	.15	.20	.25	.30	.35	.40	.45	.50	.55	.60
Model Size	Adapter Part No.	Vent Pipe Ø Diameter — Inches		Length of Pipe in Feet										
30	3H602696C1	4	*	*	*	*	*	*	23	—	—	—	—	—
		5	*	*	*	*	*	*	60	—	—	—	—	—
50	3H602696C12	4	*	*	*	*	*	*	*	25	—	—	—	—
		5	*	*	*	*	*	*	*	65	—	—	—	—
75	3H602696C2	4	*	*	*	*	*	*	85	53	21	—	—	—
		5	*	*	*	*	*	*	*	56	—	—	—	—
100	3H602696C3	4	85	68	52	36	19	—	—	—	—	—	—	—
125	3H602696C14	4	*	*	92	78	63	49	34	20	5	—	—	—
		5	*	*	*	*	*	*	90	52	14	—	—	—
150	3H602696C4	4	76	69	62	55	48	41	34	27	19	12	—	—
		5	*	*	*	*	*	*	89	70	51	32	—	—
175	3H602696C4	4	77	69	61	52	44	36	28	20	11	3	—	—
		5	*	*	*	*	*	*	95	73	52	30	9	—
200	3H602696C15	4	61	55	48	44	38	32	26	17	14	11	8	0
		5	182	155	148	130	113	96	79	68	43	34	25	15
250	3H602696C11	4	47	43	39	35	32	28	24	20	17	13	—	—
		5	*	*	*	93	83	73	63	53	43	33	—	—
300	3H602696C6	6	*	*	96	79	63	47	31	15	—	—	—	—
350	3H602696C7	6	*	93	83	72	62	52	42	32	—	—	—	—
400	3H602696C7	6	*	66	57	47	38	29	19	10	0	—	—	—

4. Fasten individual lengths of vent together with at least three corrosion resistant sheet metal screws.
5. Vent pipes should be fitted with a tee with a drip leg and clean out tap at the low point in the vent run. This should be inspected and cleaned out periodically during the heating season.
6. Do NOT use dampers or other devices in the vent or combustion air pipes.
7. Use a vent terminal to reduce downdrafts and moisture in the vent line.
8. When venting into a common vent, the individual vents should enter at different levels. The area of the common vent should be equal to or greater than the area of the largest vent plus 50% of the area of all additional vents.

## Gas

Installation of gas piping must conform with local building codes, or in the absence of local codes, with the National Fuel Gas Code, ANSI Z223.1 (NFPA 54) – latest edition. In Canada, installation must be in accordance with CAN/CGA-B149.1 for natural gas units and CAN/CGA-B149.2 for propane units.

**WARNING: INLET GAS PRESSURE MUST NOT EXCEED 14 IN. W.C. SEE UNIT RATING PLATE FOR PROPER GAS SUPPLY PRESSURE AND GAS TYPE.**

1. Always **disconnect power** before working on or near a heater. Lock and tag the disconnect switch or breaker to prevent accidental power up.
2. Piping to the unit should conform with local and national requirements for type and volume of gas handled, and pressure drop allowed in the line. Refer to the Gas Engineer's Handbook for gas line capacities.
3. The incoming pipe near the heater should be sized to match the connection on the outside of the unit. Unit inlet sizes are shown in the table to the right. Avoid multiple taps in the gas supply so the unit has a steady supply of gas at all times.
4. Install a ground joint union with brass seat and a manual shut-off valve external to the unit casing, as shown below, adjacent to the unit for emergency shut-off and easy servicing of controls.
5. Provide a sediment trap, as shown below, before each unit and where low spots in the pipe line cannot be avoided.
6. Blow out the gas line to remove debris before making connections. Purge line to remove air before attempting to start unit. Purging of air from gas lines should be performed as described in ANSI Z223.1-latest edition "National Fuel Gas Code", or in Canada in CAN/CGA-B149.
7. All field gas piping must be pressure/leak tested prior to unit operation. Use a non-corrosive bubble forming solution or equivalent for leak testing. The heater and its individual shut-off valve must be disconnected from the gas supply piping system during any pressure testing of that system at test pressures in excess of ½ psi. The heater must be isolated from the gas supply piping system by closing its individual manual shutoff valve during any pressure testing of the gas supply piping system at test pressures equal to or less than ½ psi. **This must be performed on an annual basis.**
8. This unit requires a constant **7 in. w.c. minimum natural gas supply, (LP should be 11 in. w.c. minimum)** when the unit is operating at maximum gas flow. If the gas supply exceeds **14 in. w.c.** it will damage the internal valve components, and if it is below 7 in. w.c., the heater may not perform to specifications.

**Gas Connection Sizes**

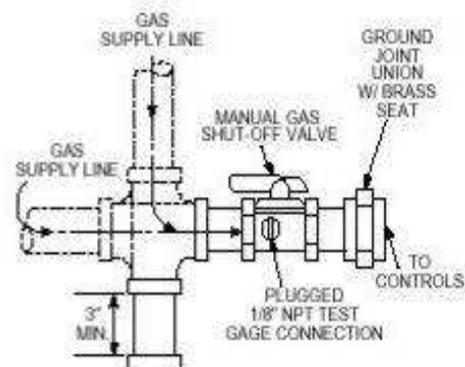
Unit Size	Gas Pipe Size (NPT)
Size 1	¾"
Size 2	1"
Size 3	1"

**Gas Pressure Table**

Gas Pressure Type	Gas Pressure
Inlet Pressure - Natural Gas	7 in. w.c. – 14 in. w.c.
Inlet Pressure - Propane	11 in. w.c. – 14 in. w.c.
Max. Manifold Pressure - Natural Gas	3.5 in. w.c. maximum
Max. Manifold Pressure - Propane	10 in. w.c. maximum
Min. Manifold Pressure - Natural Gas	0.56 in. w.c. maximum
Min. Manifold Pressure - Propane	1.6 in. w.c. maximum

**NOTICE**  
Refer to the heater rating plate for determining the minimum gas supply pressure for obtaining the maximum gas capacity for which this heater is specified.

**Gas Connection Diagram**



## Electrical

Before connecting power to the heater, read and understand this entire section of this document. As-built wiring diagrams are furnished with each fan by the factory, and are attached to the door of the unit.

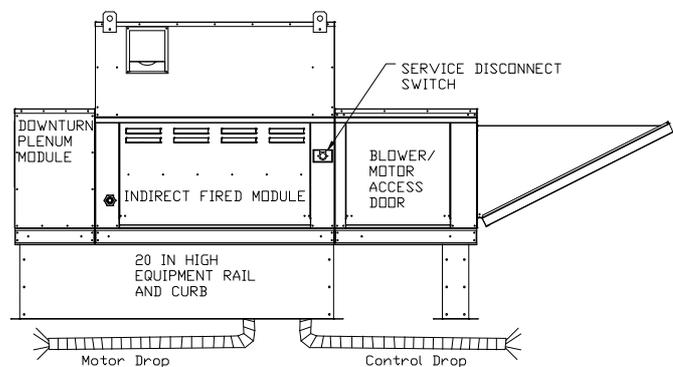
Electrical wiring and connections should be done in accordance with local ordinances and the National Electric Code, ANSI/NFPA70. Be sure the voltage and phase of the power supply and the wire amperage capacity is in accordance with the motor nameplate. For additional safety information refer to AMCA publication 410-96, *Recommended Safety Practices for Users and Installers of Industrial and Commercial Fans*.

**WARNING!!**  
**Disconnect power before installing or servicing fan. High voltage electrical input is needed for this equipment. This work should be performed by a qualified electrician.**

1. Always **disconnect power** before working on or near a heater. Lock and tag the disconnect switch or breaker to prevent accidental power up.
2. An electrical drop containing the motor power wiring is shipped with every fan. The electrical drop should be brought through one of the conduit openings located in the base of the unit, run through the curb, and connected to a junction box inside the building.
3. A dedicated branch circuit should supply the motor circuit with short circuit protection according to the National Electric Code. This dedicated branch should be run to the junction box mentioned above and connected as shown in a following illustration labeled "Fan to Building Wiring Connection".
4. Make certain that the power source is compatible with the requirements of your equipment. The heater nameplate identifies the **proper phase and voltage** of the motor.
5. Units shipped with an optional remote panel have two electrical circuit drops. It is important to run the motor wires in a separate conduit from the remote control wiring. The DC wires from the unit temperature controller, located in the control drop, should either be shielded cable or be run in a separate conduit.
6. Before connecting heater to the building power source, verify power line wiring is de-energized.
7. Secure the power cables to prevent contact with sharp objects.
8. Do not kink power cable and never allow the cable to come in contact with oil, grease, hot surfaces or chemicals.
9. Before powering up the heater, check fan wheel for free rotation and make sure that the interior of the heater is free of loose debris or shipping materials.
10. If any of the original wire supplied with the heater must be replaced, it must be replaced with type THHN wire or equivalent.

### Copper Wire Ampacity

Wire Size AWG	Maximum Amps
14	15
12	20
10	30
8	50
6	65

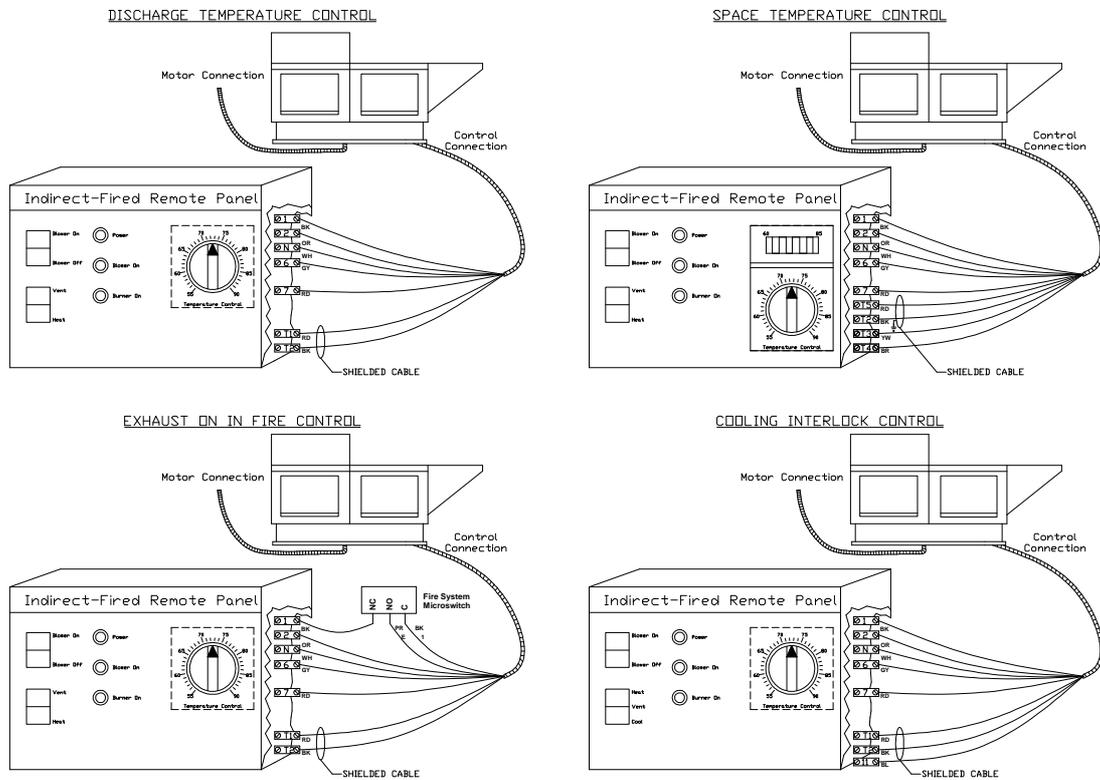


## Motorized Intake Damper

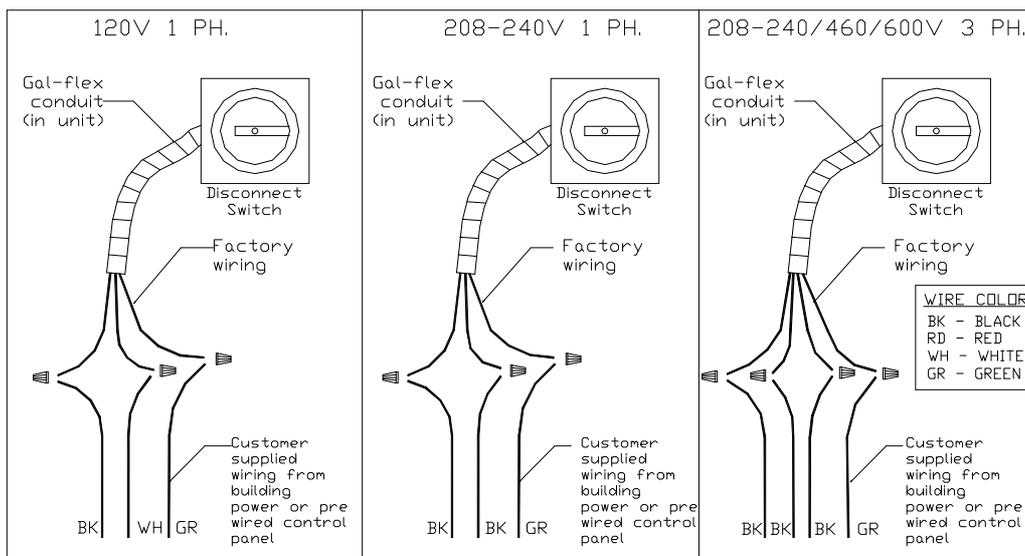
On units shipped with the optional motorized intake damper, a power transformer is supplied with the unit if the main incoming voltage is greater than 120V. The damper motor is automatically energized when the main disconnect switch is in the ON position. **No external wiring to the damper motor is required.**

## Remote Control Panel

On units shipped with the optional remote control panel, an electrical drop containing the panel wiring is provided with the heater. There is a terminal strip inside the remote panel that matches the terminals in the heater unit. The remote panel should be wired as shown below.



## Fan to Building Wiring Connection



## OPERATION

Prior to starting up or operating the heater, check all fasteners for tightness. In particular, check the set screw in the wheel hub, bearings and the fan sheaves (pulleys). With power and gas to the heater OFF or prior to connecting ventilator to power, turn the fan wheel by hand to be sure it is not striking the inlet or any obstacles. Re-center if necessary.

### Start Up

#### Special Tools Required

- AC Voltage Meter
- Tachometer
- Standard hand Tools
- Amperage Meter
- Manometer
- Thermometer

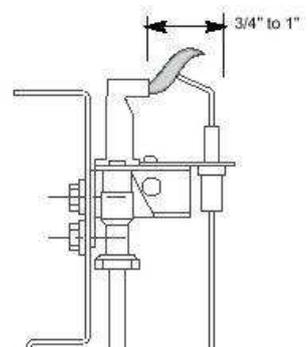
#### Start Up Procedure

1. Check all electrical connections for tightness and continuity.
2. Check pulley alignment and belt tension as described below.
3. Inspect the condition of the intake damper and damper linkage, if provided.
4. Inspect the air-stream for obstructions and install intake filters if missing.
5. Compare the supplied **motor voltage** with the fan's nameplate motor voltage. If this does not match, correct the problem.
6. Start the fan up, by turning the external disconnect to the **ON** position, and shut it **OFF** immediately to **check rotation of the wheel** with the directional arrow on the blower scroll. Reversed rotation will result in poor air performance, motor overloading and possible burnout. For units equipped with a single-phase motor check the motor wiring diagram to change rotation. For 3-phase motors, any two power leads can be interchanged to reverse motor direction.
7. When the fan is started up, observe the operation and check for any unusual noises.

#### Pilot Adjustment

1. Restart the fan and check the gas supply pressure at the inlet gas tap upstream of all electronic valves. The inlet pressure should be **7 in. - 14 in. w.c. on natural gas and 11 in. – 14 in. w.c. on propane gas**. If the inlet pressure is too high, install an additional pressure regulator external to the unit.
2. Open the field installed manual gas shut-off valve and the manual main gas valve on the combination gas control valve.
3. Call for heat with the thermostat (turn set-point to temperature above outside air) and allow the pilot to light. If the pilot does not light, purge the pilot line. If air purging is required, disconnect the pilot line at the outlet of the pilot valve. In no case should the gas line be purged into the heat exchanger.
4. Check the **pilot flame** length and adjust according the correct pilot flame diagram. Remove the burner access panel, (located on the bottom of the furnace behind the valves) to access the burner and pilot assembly. A short pilot flame can be caused by low gas pressure, or a dirty pilot orifice. To adjust the pilot flame, remove the cap from the pilot adjustment screw on the combination gas valve. Adjust the pilot length longer by turning the screw counter-clockwise. Shorten the pilot flame by turning the screw clockwise. The pilot flame should be 3/4" to 1" long and encompass 3/8" to 1/2" of the tip of the flame sensing rod.
5. Once the pilot has been established, replace the burner access panel and open the main manual gas shut-off valve downstream of the electronic valves. Check to make sure that the main gas valve opens, and gas flows to the burner.

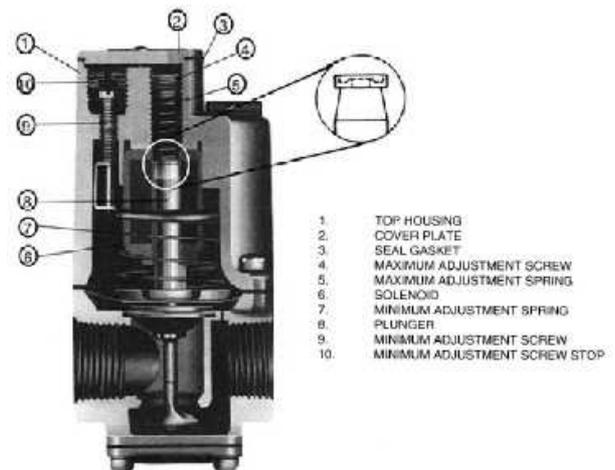
#### Correct Pilot Flame



## Main Burner Adjustment

- Once the pilot has been properly established, the manifold gas pressure should be adjusted to jobsite conditions. The gas pressure regulator (integral to the combination gas control) is adjusted at the factory for average gas conditions. It is important that the gas be supplied to the furnace in accordance with the input rating on the rating plate.
- Create a high fire call for heat. This should be done with the blower on and all gas controls on. High fire can be achieved by removing the wire at terminal #3 from the Maxitrol amplifier (0 VDC to modulating valve).
- The manifold pressure should be checked at the pressure tap downstream of the modulating valve. For natural gas systems, the high fire manifold pressure should be set at **3.5 in. w.c.** For propane gas, the high fire manifold pressure should be set to **10 in. w.c.**
- Remove the cap of the modulating valve. Using the maximum adjustment screw, adjust the high fire manifold pressure to 3.5 in. w.c. for natural gas and 10 in. w.c. for propane gas. If the high fire screw is at the end of its adjustment and more pressure is needed, then adjust the main gas pressure regulator spring (on the combination valve) to achieve the proper manifold pressure. Turning the regulator screw clockwise will increase pressure and counter-clockwise will decrease pressure.
- Reconnect the wire on the Maxitrol amplifier at terminal #3.
- The low fire manifold pressure must now be set. This is done by first moving the wire from terminal #11 on the Maxitrol amplifier to terminal #10. The temperature set-point should be set to its minimum set-point. Place a jumper wire between terminal #3 and terminal #4 on the Maxitrol amplifier.
- Using the minimum adjusting screw, adjust low the low fire manifold pressure to **0.56 in. w.c.** for natural gas and **1.6 in. w.c.** for propane gas. Replace the cap to the Maxitrol valve and restore all of the original wiring on the Maxitrol amplifier and gas components.
- The main burner flame can be viewed after loosening and pushing aside the gas designation disc on the side of the burner box. The appearance of the flame can be adjusted by changing the manifold air shutters. To increase primary air, loosen the air shutter set screws and move the air shutters closer to the manifold. To decrease primary air, move the air shutters away from the manifolds. Retighten set screws after adjustment. Proper operation provides a soft blue flame with a well-defined inner core. A lack of primary air will produce soft, yellow tipped flames. Excess primary air produces short, well-defined flames with a tendency to lift off the burner ports.
- A final gas leak check shall be performed to verify the gas-tightness of the heater's components and piping under normal operating conditions.

### Maxitrol Modulating Valve



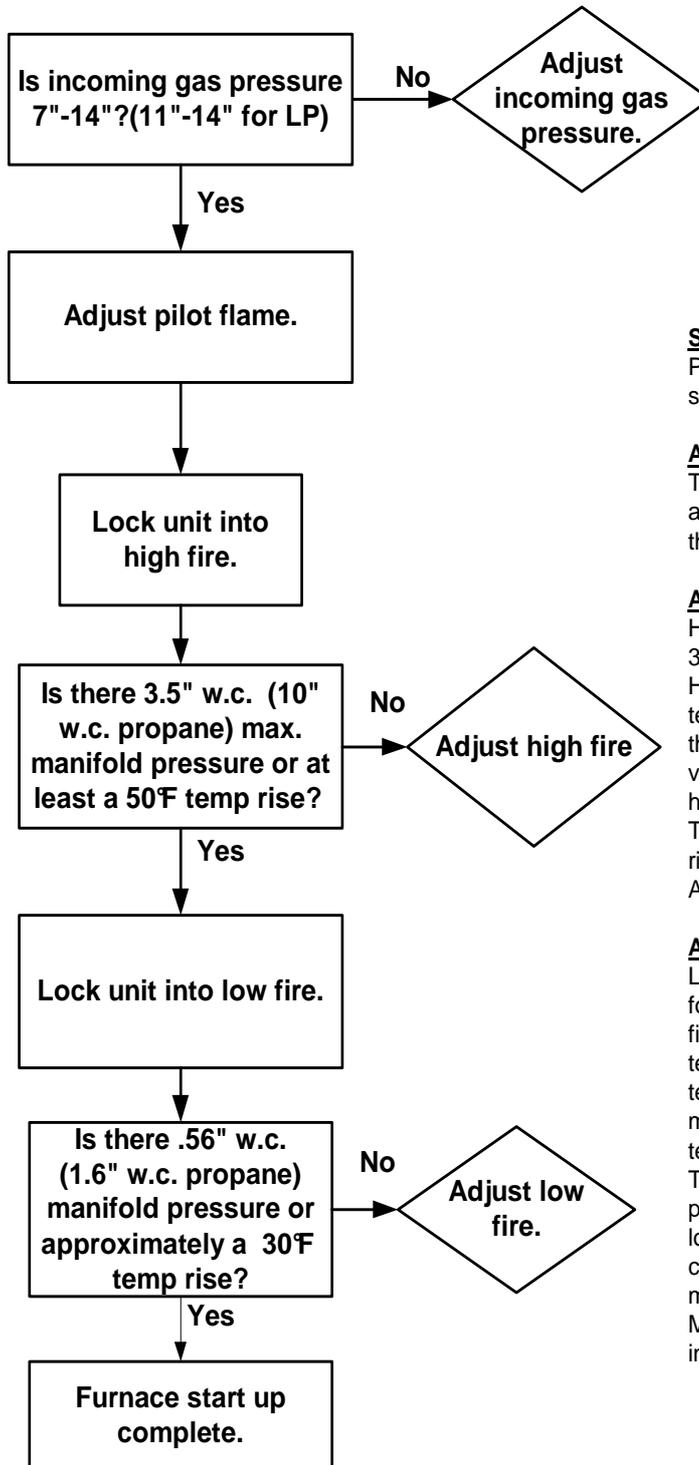
### Mod Valve Voltage Summary

Volts DC	Firing Mode
0 to 2 VDC	High Fire
2 to 14 VDC	Modulation
14 to 20 VDC	Low Fire

### Orifice and Gas Consumption Chart

Furnace Size	No. of Orifices	Natural Gas Orifice Drill Size	Propane Gas Orifice Drill Size	Natural Gas CFH	Propane Gas CFH
200	3	23	40	192.3	80
350	6	27	43	336.5	140
400	6	23	40	384.6	160

## Furnace Start Up Summary



**Setting incoming pressure:**

Pressure must be measured at first "T" in supply gas line before the first gas valve.

**Adjusting the pilot:**

The pilot flame should be 3/4" to 1" long and encompass 3/8" to 1/2" of the tip of the flame sensing rod.

**Adjusting high fire:**

High fire manifold pressure should be 3.5" for natural gas and 10" for propane. High fire should produce at least a 50°F temperature rise. Remove wire #3 from the Maxitrol amplifier. This will drive the valve into its full open position. Adjust high fire with the regulator inside the unit. Turn clockwise to increase temperature rise. Replace wire #3 on the Maxitrol Amplifier.

**Adjusting low fire:**

Low fire manifold pressure should be .56" for natural gas and 1.6" for propane. Low fire should produce about a 30°F temperature rise. Move wire from terminal #11 to terminal #10 on the maxitrol amplifier. Place jumper between terminals #3 and #4 on the amplifier. This will drive the valve into its lowest position. Adjust the low fire by turning the low fire bypass screw (small screw under cap on Maxitrol Valve) on the top of the modulating valve. Refer to the included Maxitrol literature for more detailed information.

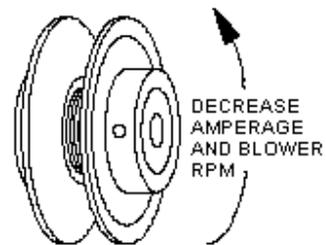
## Final Start Up Procedure

1. With the air and burner systems in full operation and all ducts attached, measure the system airflow. Motor sheave (pulley) is variable pitch, and allows for an increase or decrease of the fan RPM to adjust the airflow, as shown in the illustration below. For your convenience, a RPM chart is included in the following pages.
2. Once the proper airflow is achieved, measure and record the fan speed with a reliable tachometer. **Caution - Excessive speed will result in motor overloading or bearing failure. Do not set fan RPMs higher than specified in the maximum RPM chart.** See the troubleshooting guide for more information.
3. Measure and record the **voltage** and **amperage** to the motor and compare with the motor nameplate to determine if the motor is operating under safe load condition.
4. Once the rpm of the ventilator has been properly set, disconnect power and recheck belt tension and pulley alignment as described below.

**Maximum RPM and HP Chart**

Blower Size	Maximum RPM	Maximum HP
10"	1800	2
15"	1400	5
18"	1200	5 (10 on 918)

**Pulley Adjustment Illustration**



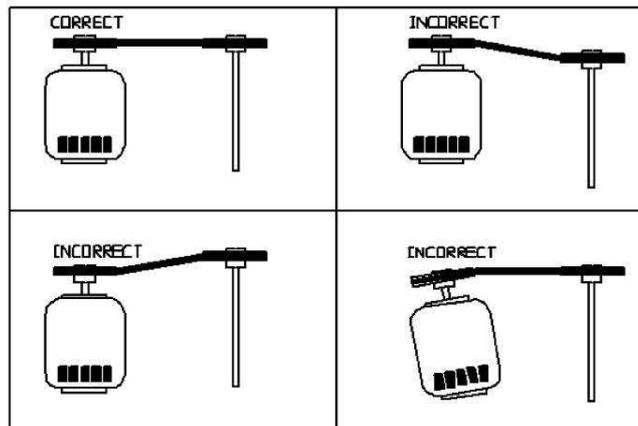
## Pulley Adjustment

The adjustable motor pulley is factory set for the RPM specified. Speed can be increased by closing or decreased by opening the adjustable motor sheave. Two groove variable pitch pulleys must be adjusted an equal number of turns open or closed. Any increase in speed represents a substantial increase in horsepower required by the unit. Motor amperage should always be checked to avoid serious damage to the motor when the speed is varied. Always torque setscrews according to the setscrew torque chart.

## Pulley Setscrew Torque

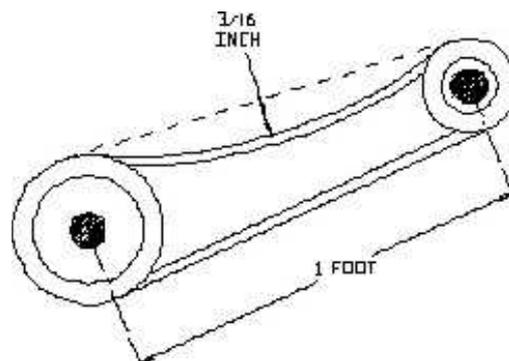
Thread Size	Torque (IN/Lb)
No. 10 (bushing)	32
1/4" (bushing)	72
5/16"	130

## Pulley Alignment



Proper Belt

Tension



## Pulley Combination Chart

Motor RPM		1725															
<b>1/3 to 1-1/2 HP AX BELTS</b>		MOTOR PULLEY 1VL34		Dd1 1.9	Dd2 2.9	Pd1 2	Pd2 3										
				Turns on Motor Pulley													
				Open										Closed			
BLOWER PULLEY	DATUM DIAMETER	PITCH DIAMETER		5	4 1/2	4	3 1/2	3	2 1/2	2	1 1/2	1	1/2	0			
AK114	11	11.2		308	323	339	354	370	385	400	416	431	447	462			
<b>1/3 to 2 HP AX BELTS</b>		MOTOR PULLEY 1VL40		Dd1 2.4	Dd2 3.4	Pd1 2.6	Pd2 3.6										
				Turns on Motor Pulley													
				Open										Closed			
BLOWER PULLEY	DATUM DIAMETER	PITCH DIAMETER		5	4 1/2	4	3 1/2	3	2 1/2	2	1 1/2	1	1/2	0			
AK114	11	11.2		400	416	431	447	462	477	493	508	524	539	554			
AK94	9	9.2		488	506	525	544	563	581	600	619	638	656	675			
AK79	7.5	7.7		582	605	627	650	672	694	717	739	762	784	806			
AK66	6.2	6.4		701	728	755	782	809	836	863	889	916	943	970			
AK54	5	5.2		863	896	929	962	995	1028	1062	1095	1128	1161	1194			
AK46	4.2	4.4		1019	1059	1098	1137	1176	1215	1255	1294	1333	1372	1411			
AK39	3.5	3.7		1212	1259	1305	1352	1399	1445	1492	1539	1585	1632	1678			
AK32	3	3.2		1402	1455	1509	1563	1617	1671	1725	1779	1833	1887	1941			
<b>3 to 5 HP BX BELTS</b>		MOTOR PULLEY 2VP42		Dd1 2.9	Dd2 3.9	Pd1 3	Pd2 4										
				Turns on Motor Pulley													
				Open										Closed			
BLOWER PULLEY	DATUM DIAMETER	PITCH DIAMETER		6	5 1/2	5	4 1/2	4	3 1/2	3	2 1/2	2	1 1/2	1	1/2	0	
2BK160H	15.4	15.7		330	339	348	357	366	375	385	394	403	412	421	430	439	
2BK140H	13.4	13.7		378	388	399	409	420	430	441	451	462	472	483	493	504	
2BK120H	11.4	11.7		442	455	467	479	491	504	516	528	541	553	565	577	590	
2BK110H	10.4	10.7		484	497	511	524	537	551	564	578	591	605	618	631	645	
2BK100H	9.4	9.7		534	548	563	578	593	608	622	637	652	667	682	697	711	
2BK90H	8.4	8.7		595	611	628	644	661	677	694	710	727	744	760	777	793	
2BK80H	7.4	7.7		672	691	709	728	747	765	784	803	821	840	859	877	896	
2BK70H	6.4	6.7		772	794	815	837	858	880	901	923	944	965	987	1008	1030	
2BK60H	5.4	5.7		908	933	958	984	1009	1034	1059	1084	1110	1135	1160	1185	1211	
2BK55H	4.9	5.2		995	1023	1050	1078	1106	1133	1161	1189	1216	1244	1272	1299	1327	
2BK50H	4.4	4.7		1101	1132	1162	1193	1223	1254	1285	1315	1346	1376	1407	1438	1468	
<b>7-1/2 to 10 HP BX BELTS</b>		MOTOR PULLEY 2VP60		Dd1 4.3	Dd2 5.5	Pd1 4.7	Pd2 5.9										
				Turns on Motor Pulley													
				Open										Closed			
BLOWER PULLEY	DATUM DIAMETER	PITCH DIAMETER		6	5 1/2	5	4 1/2	4	3 1/2	3	2 1/2	2	1 1/2	1	1/2	0	
2BK160H	15.4	15.7		516	527	538	549	560	571	582	593	604	615	626	637	648	
2BK140H	13.4	13.7		592	604	617	630	642	655	667	680	693	705	718	730	743	
2BK120H	11.4	11.7		693	708	722	737	752	767	781	796	811	826	840	855	870	
2BK110H	10.4	10.7		758	774	790	806	822	838	854	871	887	903	919	935	951	
2BK100H	9.4	9.7		836	854	871	889	907	925	943	960	978	996	1014	1031	1049	
2BK90H	8.4	8.7		932	952	972	991	1011	1031	1051	1071	1091	1110	1130	1150	1170	
2BK80H	7.4	7.7		1053	1075	1098	1120	1143	1165	1187	1210	1232	1255	1277	1299	1322	

10 - 18 IN. BLOWER

### Sequence of Operation

The Indirect-fired heater is most easily understood when broken down into smaller individual systems. There are two main systems, a make-up air fan and a heater. The make-up air fan consists of a heavy-duty blower and motor. The heater may be further broken down into two control systems, the Flame Safety Control (FSC) and the Modulating Gas System (MGS). The burner mixes air with the gas (Natural or Propane) which heats a heat exchanger which heats the air.

### Modulating Gas System

The first system, the **Maxitrol modulating gas system**, consists of a temperature selector dial, a discharge air sensor, an amplifier, and a modulating gas valve. The two types of Maxitrol systems found on these units are the Maxitrol 20/30 and the Maxitrol 21/31. The 20 and 21 series are for single furnace arrangement and the 30 and 31 series are for multiple furnace arrangement. The Maxitrol 21/31 utilizes a discharge air sensor and modulates the discharge air to the selected temperature on the temperature selector dial. The Maxitrol 20/30 utilizes a room temperature sensor/selector in order to control the room temperature. The modulating gas valve controls the amount of gas to the burner based on the temperature rise needed. When the modulating gas valve is all the way open and achieving the maximum BTUs and temperature rise of the unit, it is called "high fire".

### Maxitrol Amplifier



## Flame Safety Control

The second system to understand is the **Flame Safety Control**. The FSC is there **only** to monitor the flame, NOT to control temperature. The FSC uses a sensor mounted on the burner pilot assembly to sense for pilot establishment. The FSC controls the opening of the redundant solenoid gas valves and the operation of the spark igniter to initiate a pilot flame upon start up. When there is a call for heat (determined by the Maxitrol system), the LED on the FSC is energized indicating that the unit has power. Then, there is a Pilot Trial For Ignition (PTFI). During PTFI, the FSC opens the pilot gas valves and allows gas to pass through the pilot line. At the same moment, the spark igniter is started, causing the electrode on the burner to ignite the gas. This results in a pilot flame. When the sensor detects the flame it powers the main gas valve and the system begins to modulate the flame. This is the normal operating mode. The FSC continues to monitor the flame for presence.

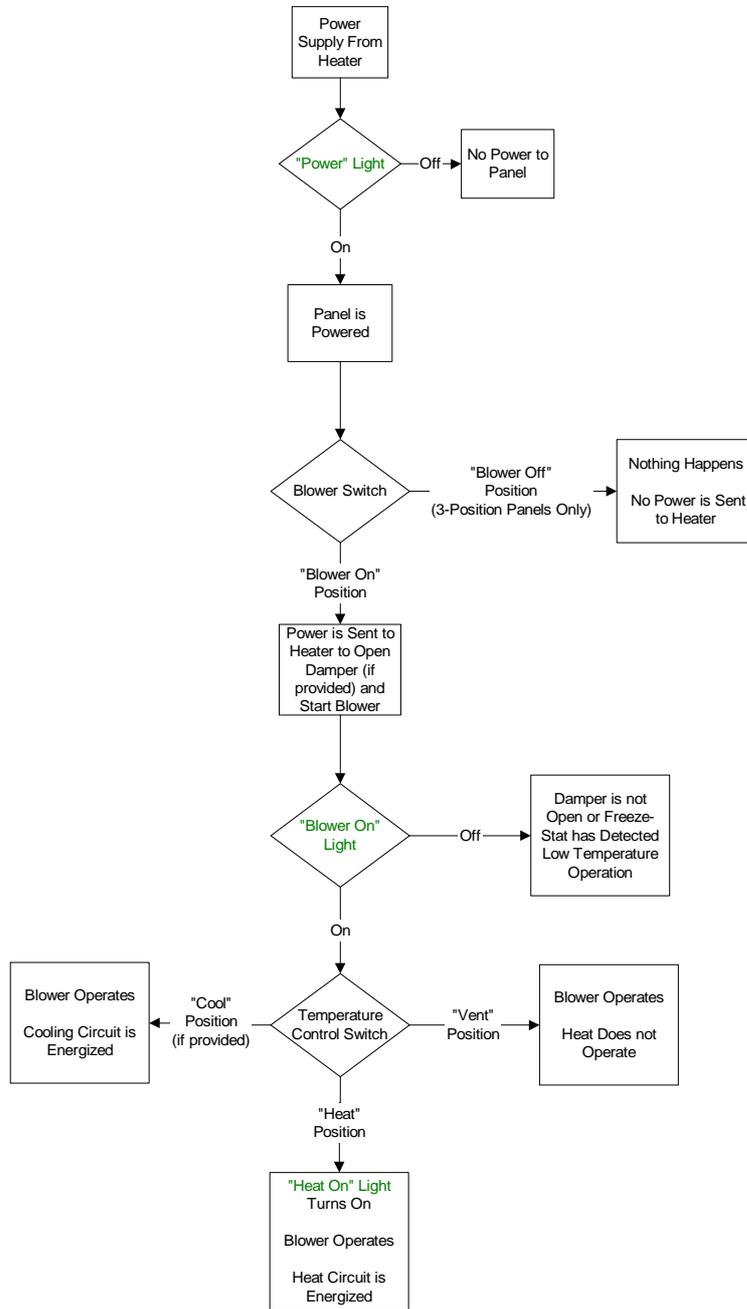
## Flame Safety



## Operation Summary

- With the blower already running and the airflow switch proven;
  - ✓ The outside air temperature falls below the setting of remote temperature selector
  - ✓ The Maxitrol amplifier sends a 24V signal out through the high temperature limit (automatic switch located in furnace and set at 150°F), the blocked vent safety switch, and through the centrifugal switch of the power vent
- The FSC is energized by this 24V signal from the Maxitrol amplifier and the following occurs;
  - ✓ FSC indicates that it has power by turning on the LED
  - ✓ Begins Pilot Trial For Ignition
  - ✓ The pilot gas solenoid valve is opened, the electrode begins sparking, and the sensor watches for flame initiation
  - ✓ When flame is established, the main valve opens and the unit begins modulating
  - ✓ The FSC monitors the flame while the Maxitrol system adjusts to the selected temperature
- The Maxitrol system checks the discharge air temperature (or the room temperature for the Maxitrol 20/30) and regulates the gas going to the burner to satisfy the temperature setting. The Maxitrol system will modulate the main burner gas from 100% down to 40% as needed. **If the burner remains on low fire for a short amount of time, the burner will be shut off and restarted as necessary.**

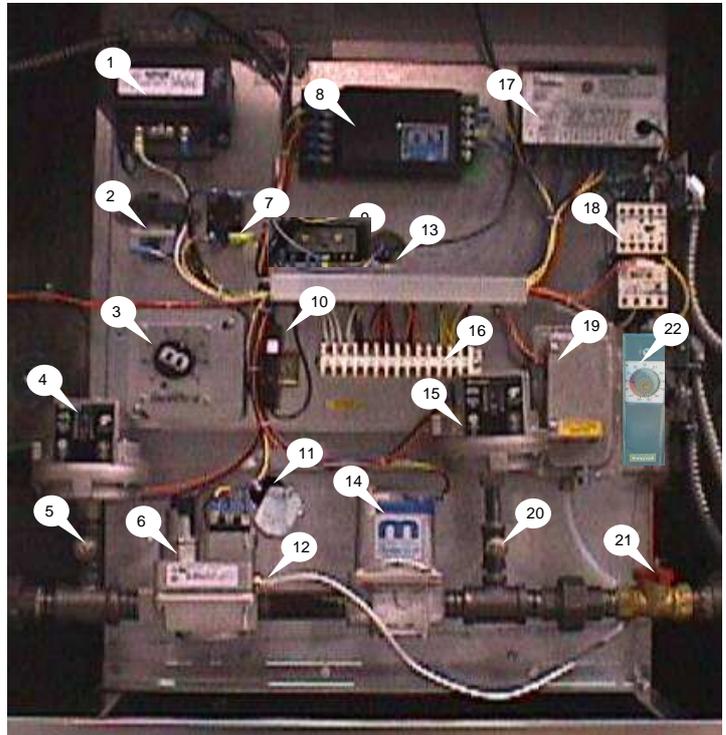
## Optional Remote Panel Circuit



## Components

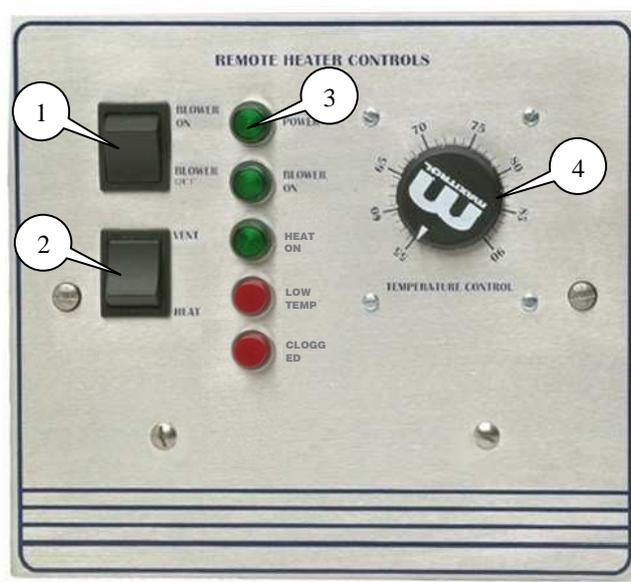
The following image and list outlines the typical in-direct fired heater components and their functions.

1. **Power Transformer** – Installed when motor voltage > 120V. Used to provide 120V service to controls.
2. **Control Transformer** – 120V primary; 24V secondary control transformer.
3. **Discharge Temperature Set-Point** – Controls the discharge air temperature. Furnace will not light if air temperature is higher than set-point.
4. **Low Gas Pressure Switch (Optional)** – De-energizes furnace controls if gas pressure falls below its set-point.
5. **Inlet Gas Pressure Tap** – Inlet gas pressure should be measured here.
6. **Combination Gas Valve** - A combination of redundant solenoid valves, pilot valve and gas regulator built into one unit.
7. **Power Vent Relay** – Energizes power vent motor on call for heat.
8. **Maxitrol Modulating Amplifier** - Regulates temperature by modulating gas valve
9. **Freeze-Stat Thermostat (Optional)** – De-energizes blower motor if the discharge air temperature falls below the set point.
10. **Circuit Breaker** – Protects electrical components from high current spikes.
11. **Burner View Port** – Allows burner to be monitored.
12. **Pilot Tubing** – Pilot tube connection to combination gas valve.
13. **Automatic Reset Thermal Limit** – Safety device that prevents the furnace from overheating.
14. **Modulating Gas Valve** – Modulates gas flow to burner to provide proper air temperature.
15. **High Gas Pressure Switch (Optional)** – De-energizes furnace controls if gas pressure rises above its set-point.
16. **Terminal Strip** – Central location to terminate control wiring. Should be used for troubleshooting.
17. **Flame Safety Control** – Initiates and monitors flame.
18. **Motor Starter** – Contactor with overload protection to start and protect motor.
19. **Airflow Switch** – A safety device insuring proper air flow during furnace operation.
20. **Manifold Gas Pressure Tap** – Manifold gas pressure should be measured here.
21. **Manual Gas Shut-Off Valve** Allows gas flow to burner to be shut off to leak test gas train
22. **Intake Thermostat** – Used on Models with two furnaces. Cycles second (downstream) furnace on and off with fluctuations in intake air temperature. Should be set to [Temp Discharge set point minus temp rise of first heat exchanger plus 5 degrees F)



## Remote Panel Option

The Remote Panel is a device used to control the operation of the heater from a remote location. This unit is available in both a “2 Position” or “3 Position” configuration and with or without a cooling output. It also will accommodate both the Maxitrol discharge temperature dial and the Maxitrol space sensing Selectrastat. It is important to understand the following Remote Panel controls and uses:



- 1. Blower On/Blower Off Switch** - Used to control blower operation and tempering mode of unit. The **Blower On** position sends power to the blower motor and the heater begins to ventilate. The **Blower Off** position turns the blower and heating functionality off. This switch is disabled when the “2 Position” remote panel is ordered and fan power is then controlled by the pre-wire package.
- 2. Heat/Vent Switch** – This switch is used to control the tempering mode of the unit. The **VENT** position will prevent the burner from operating and the heater will deliver untempered air. The **HEAT** position will force the burner on and the unit will heat the incoming air. This switch becomes a Heat/Vent/Cool switch when the cooling interlock is ordered. This option provides a 120V cooling output from the remote panel.
- 3. Lights-** Displays the current status of unit features. The light definitions are as follows:
  - POWER** - Illuminated when there is power to Remote Panel.
  - BLOWER ON** - Illuminated when the blower motor is powered and airflow is present.
  - HEAT ON** - Illuminates after pilot flame has established and main valve is powered.
  - LOW TEMP** - (Optional) Illuminated when the Freeze-stat turns off blower.
  - CLOGGED FILTER** – (Optional) Illuminated when the Intake Filters are Dirty.
- 4. Temperature Control** – Controls the discharge temperature of a standard unit. The temperature dial is replaced with Maxitrol Selectrastat in Space Heating applications and is used to control the space temperature.

## Troubleshooting

The following tables list causes and corrective actions for possible problems with in-direct heater units. Review these lists prior to consulting manufacturer.

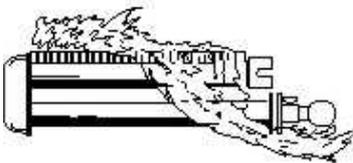
### Airflow Troubleshooting Chart

<b>Problem</b>	<b>Potential Cause</b>	<b>Corrective Action</b>
Fan Inoperative	Blown fuse or open circuit breaker	Replace fuse or reset circuit breaker and check amps
	Disconnect switch in "Off" position	Turn to "On" position
	Motor wired incorrectly	Check motor wiring to wiring diagram located on fan motor
	Broken fan belt	Replace belt
	Motor starter overloaded	Reset starter and check amps
	Remote panel set to "Blower Off"	Set Remote Panel to "Blower On"
Motor Overload	Fan rotating in the wrong direction	Be sure fan is rotating in the direction shown on rotation label
	Fan speed is too high	Reduce fan RPM
	Motor wired incorrectly	Check motor wiring to wiring diagram located on fan motor
	Overload in starter set too low	Set overload to motor FLA value
	Motor HP too low	Determine if HP is sufficient for job
	Duct static pressure lower than design	Reduce fan RPM
Insufficient Airflow	Fan rotating in the wrong direction	Be sure fan is rotating in the direction shown on rotation label
	Poor outlet conditions	There should be a straight clear duct at the outlet
	Intake damper not fully open	Inspect damper linkage and replace damper motor if needed
	Duct static pressure higher than design	Improve ductwork to eliminate or reduce duct losses
	Blower speed too low	Increase fan RPM. Do not overload motor
	Supply grills or registers closed	Open and adjust
	Dirty or clogged filters	Clean and/or replace
	Belt slippage	Adjust belt tension
Excessive Airflow	Blower speed too high	Reduce fan RPM
	Filters not installed	Install filters
	Duct static pressure lower than design	Reduce fan RPM
Excessive Vibration and Noise	Misaligned pulleys	Align pulleys
	Damaged or unbalanced wheel	Replace wheel
	Fan is operating in the unstable region of the fan curve	Refer to performance curve for fan
	Bearings need lubrication or replacement	Lubricate or replace
	Fan speed is too high	Reduce fan RPM
	Belts too loose, worn or oily	Inspect and replace if needed

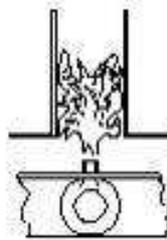
## Furnace Troubleshooting Chart

<b>Problem</b>	<b>Potential Cause</b>	<b>Corrective Action</b>
Pilot Does Not Light/Stay Lit	Main gas if off	Open main gas valve
	Air in gas line	Purge gas line
	Dirt in pilot orifice	Clean orifice with compressed air
	Gas pressure out of range	Adjust to proper gas pressure
	Pilot valve is off	Turn pilot valve on
	Pilot orifice fitting leak	Tighten pilot orifice
	Excessive drafts	Re-direct draft away from unit
	Safety device has cut power	Check limits and airflow switch
	Dirty flame sensor	Clean flame sensor
	Remote panel in "Vent" mode	Change to "Heat" mode
	No spark at igniter	Check wiring, sensor, and ignition controller
Main Burners Do Not Light (Pilot is Lit)	Defective valve	Replace combination valve
	Loose valve wiring	Check wiring to valve
	Defective pilot sensor	Replace pilot sensor
	Shut off valve closed	Open shut off valve
	Defective ignition controller	Replace ignition controller
Not Enough Heat	Unit cycling on high limit	Increase airflow through furnace and check gas pressure
	Main gas pressure too low	Increase main gas pressure – do not exceed 14 in. w.c. inlet pressure
	Too much airflow	Decrease airflow if possible
	Furnace undersized	Check design conditions
	Gas controls not wired properly	Check wiring
	Thermostat setting too low	Increase thermostat setting
	Thermostat malfunction	Check/replace thermostat
	Unit locked into low fire	Check wiring
Too Much Heat	Defective modulating gas valve	Check/replace modulating valve
	Thermostat setting too high	Decrease thermostat setting
	Unit locked into high fire	Check wiring
	Thermostat wired incorrectly	Check thermostat wiring
Lifting Flames or Flashback	Too much primary air	Reduce primary air
	Manifold pressure set too high	Reduce manifold pressure
	Orifice too large	Check orifice size
Yellow Tipping	Insufficient primary air	Increase primary air
	Dirty orifice	Check and clean orifice
	Misaligned orifice	Check manifold alignment
Floating Flames or Flame Rollout	Insufficient primary air	Increase primary air
	Orifice too large	Check orifice size
	Manifold pressure too high	Decrease manifold pressure
	Blocked vent	Check venting system

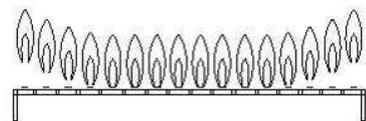
**Flame Rollout Condition**



**Floating Flame Condition**



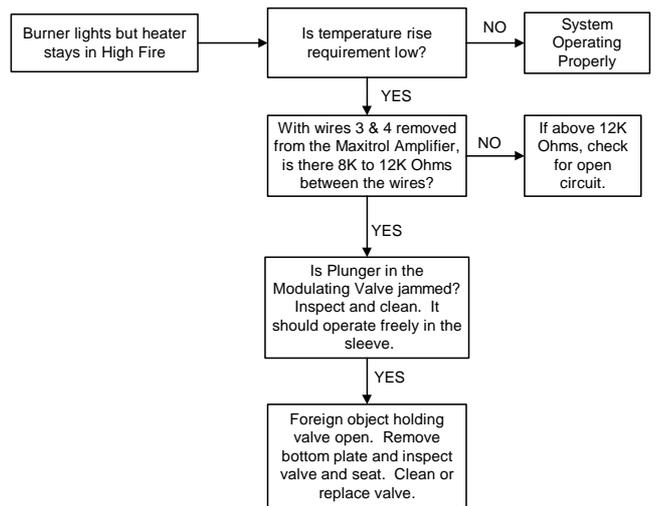
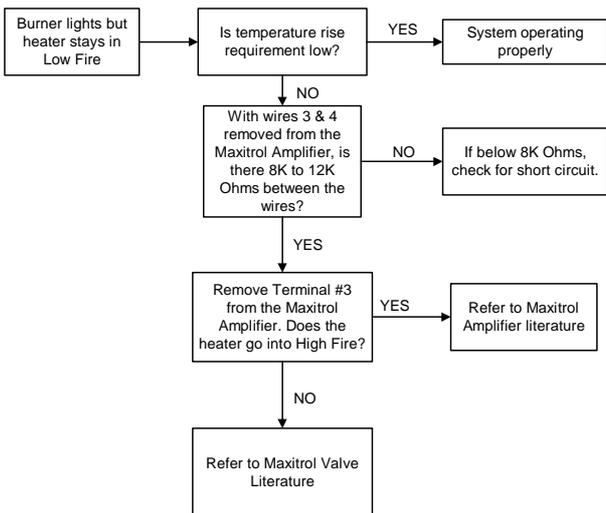
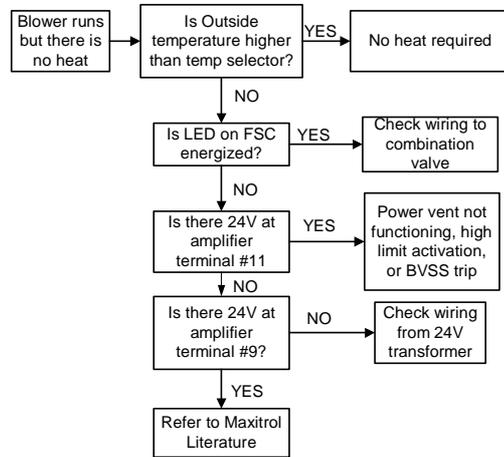
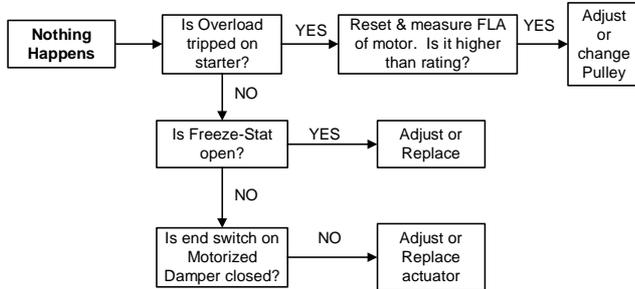
**Lifting Flame Condition**



### Remote Panel Troubleshooting Chart

<b>Light Indication</b>	<b>Condition</b>	<b>Possible Cause</b>
No Lights	Power not available to Remote Panel	Bad voltage to unit
		Main disconnect in "OFF" Position
		Circuit breaker tripped
		Bad main transformer
POWER Light Only	Proper unit Off Operation	No problem
	No power to motor starter	Blower On/Blower Off Switch in "Blower Off" Position
		Improper damper function
		Low Temperature Thermostat Timed Out (Option)
		Insufficient Airflow
	Improper Airflow	Bad airflow switch
		Problem with air probes
		Problem with airflow tubing
Broken Belt		
POWER Light and BLOWER ON Light	Proper Ventilation Operation	No Problem
	No Power to Flame Safety Controller	Heat/Vent Switch in "Vent" Position
		Gas Pressure Switch Tripped (option)
		High Temperature Limit Thermostat Tripped
CLOGGED FILTER Light On (Optional)	Filters Clogged	Filters Dirty or Need Replacement
LOW TEMP Light On (Optional)	Freeze-stat has shut blower down	Discharge Temperature Too Cold Heating System is not Functioning
POWER Light and BLOWER ON Light and HEAT ON Light	Proper Heating Operation	No Problem

## Troubleshooting Flowcharts



## MAINTENANCE

To guarantee trouble free operation of this heater, the manufacturer suggests following these guidelines. Most problems associated with fan failures are directly related to poor service and maintenance.

Please record any maintenance or service performed on this fan in the documentation section located at the end of this manual.

**WARNING: DO NOT ATTEMPT MAINTENANCE ON THE HEATER UNTIL THE ELECTRICAL SUPPLY HAS BEEN COMPLETELY DISCONNECTED AND THE MAIN GAS SUPPLY VALVE HAS BEEN TURNED OFF.**

### General Maintenance

1. Fan inlet and approaches to ventilator should be kept clean and free from any obstruction.
2. Motors are normally permanently lubricated. Check bearings periodically. If they have grease fittings lubricate each season. Use caution when lubricating bearings, wipe the fittings clean, the unit should be rotated by hand while lubricating. **Caution: Use care when touching the exterior of an operating motor. Motors normally run hot and may be hot enough to be painful or cause injury.**
3. All fasteners should be checked for tightness each time maintenance checks are performed prior to restarting unit.
4. Blowers require very little attention when moving clean air. Occasionally oil and dust may accumulate causing imbalance. If the fan is installed in a corrosive or dirty atmosphere, periodically inspect and clean the wheel, inlet and other moving parts to ensure smooth and safe operation.

### Re-Setting Of The Unit

If the flame safety control is locked out (pilot establishment fails or no gas supply), reset the unit by:

1. Turn OFF Power to the unit.
2. Turn Power to the unit back ON.

### Emergency shutdown of unit

To shut down the unit in the event of an emergency do the following:

1. Turn power OFF to the unit from main building disconnect.
2. Turn the external disconnect switch to the OFF position.
3. CLOSE the inlet gas valve located on the heater.

### Prolonged shutdown of the unit

For prolonged shutdown the following steps should be done:

1. Turn the external disconnect switch to the OFF position.
2. CLOSE the inlet gas valve located on the heater.

To re-start the unit the following steps should be done:

1. Turn the external disconnect switch to the ON position.
2. OPEN the inlet gas valve located on the heater.

## 2 weeks after startup

1. Belt tension should be checked after the first 2 weeks of fan operation. Belts tend to stretch and settle into pulleys after an initial start-up sequence. **Do not tension belts by changing the setting of the motor pulley**, this will change the fan speed and may damage the motor. To re-tension belts, turn the power to the fan motor OFF. Loosen the fasteners that hold the blower scroll plate to the blower. Rotate the motor to the left or right to adjust the belt tension. Belt tension should be adjusted to allow 1/64" of deflection per inch of belt span. Exercise extreme care when adjusting V-belts as not to misalign pulleys. Any misalignment will cause a sharp reduction in belt life and produce squeaky noises. Over-tightening will cause excessive belt and bearing wear as well as noise. Too little tension will cause slippage at startup and uneven wear. **Whenever belts are removed or installed, never force belts over pulleys without loosening motor first to relieve belt tension.** When replacing belts, use the same type as supplied by the manufacturer. On units shipped with double groove pulleys, matched belts should always be used.
2. All fasteners should be checked for tightness each time maintenance checks are performed prior to restarting unit.

## Every 3 months

1. Belt tension should be checked quarterly. See instructions in the previous maintenance section. Over-tightening will cause excessive bearing wear and noise. Too little tension will cause slippage at startup and uneven wear.
2. Filters need to be cleaned and/or replaced quarterly, and more often in severe conditions. Washable filters can be washed in warm soapy water. When re-installing filters, be sure to install with the **airflow in the correct direction** as indicated on the filter.

**Filter Quantity Chart**

Intake	16" x 20"	20" x 25"
Size 1 Sloped	3	
Size 2 Sloped		3
Size 3 Sloped	6	
Size 1 V-Bank		3
Size 2 V-Bank	8	
Size 3 V-Bank		8

## Yearly

1. Inspect bearings for wear and deterioration. Replace if necessary.
2. Inspect belt wear and replace torn or worn belts.
3. Inspect bolts and set screws for tightness. Tighten as necessary.
4. Inspect motor for cleanliness. Clean exterior surfaces only. Remove dust and grease from the motor housing to ensure proper motor cooling. Remove dirt and grease from the wheel and housing to prevent imbalance and damage.
5. The heat exchanger should be checked for cracks. The heat exchanger should be replaced immediately if cracks are detected.
6. Inspect the combustion blower motor for cleanliness. Clean exterior surfaces of the combustion blower motor only. Removing excess dust and grease guarantees proper motor cooling.
7. Before each heating season, examine the burner and gas orifices. Remove and inspect burner, burner ports, bottom of heat exchanger, and pilot assembly for cleanliness.

### Orifice and Gas Consumption Chart

Furnace Size	No. of Orifices	Natural Gas Orifice Drill Size	Propane Gas Orifice Drill Size	Natural Gas CFH	Propane Gas CFH
200	3	23	40	192.3	80
350	6	27	43	336.5	140
400	6	23	40	384.6	160

