AFFIX LABEL HERE

INSTALLATION AND SERVICING INSTRUCTIONS
UPFLOW, DOWNFLOW OR HORIZONTAL
TWO STAGE HEAT VARIABLE SPEED
GAS-FIRED NON-CONDENSING
WARM AIR FURNACE

Issue 0527

TABLE OF CONTENTS

RETAIN THESE INSTRUCTIONS FOR FUTURE REFERENCE

⚠WARNING

If the information in this manual is not followed exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.

Installation and service must be performed by a qualified installer, service agency or the gas supplier. Installation by an unqualified person may lead to equipment damage and/or a hazardous condition which may cause bodily injury and harm and, as such, at the sole discretion of the manufacturer, the entire warranty may be voided and be of no further force and effect.

⚠ DANGER

Electric Shock Hazard

Turn Off All Power Before Servicing.

WHAT TO DO IF YOU SMELL GAS:

- **Do not try to light any appliance.**
- **Extinguish any open flame.**
- **Do not touch any electrical switch; do not use any phone in your building.**
- **Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.**
- **If you cannot reach your gas supplier, call the fire department.**

SAFETY

The following is a list of safety precautions and their locations in this manual.

These safety rules and precautions must be followed when installing this furnace.

1. Use only with type of gas approved for this furnace. Refer to the furnace rating plate.

2. Install this furnace only in a location and position as specified in *The Location/Placement Section on page 7* of these instructions.

3. Provide adequate combustion and ventilation air to the furnace space as specified in *Air for Combustion and Ventilation section on page* 8 of these instructions.

4. Combustion products must be discharged outdoors. Connect this furnace to an approved vent system only, as specified in *Venting on page* 12 of these instructions.

5. Never test for gas leaks with an open flame. Use a commercially available soap solution made specifically for the detection of leaks to check all connections, as specified in *The Gas Connection section on page* 16 of these instructions.

6. Always install furnace to operate within the furnace's intended temperature-rise range with a duct system which has an external static pressure within the allowable range, as specified in *Furnace Specifications on page* 3 of these instructions. See furnace rating plate.

7. When a furnace is installed so that supply ducts carry air circulated by the furnace to areas outside the space containing the furnace, the return air shall also be handled by duct(s) sealed to the furnace casing and terminating outside the space containing the furnace. *See page 11 for Ducting.*

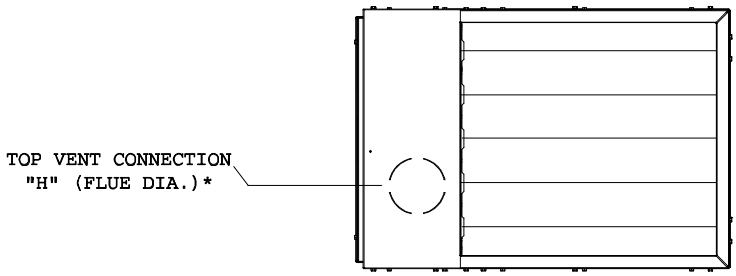
8. A gas-fired furnace for installation in a residential garage must be installed as specified in *The Location / Placement section on page 7* of these instructions.

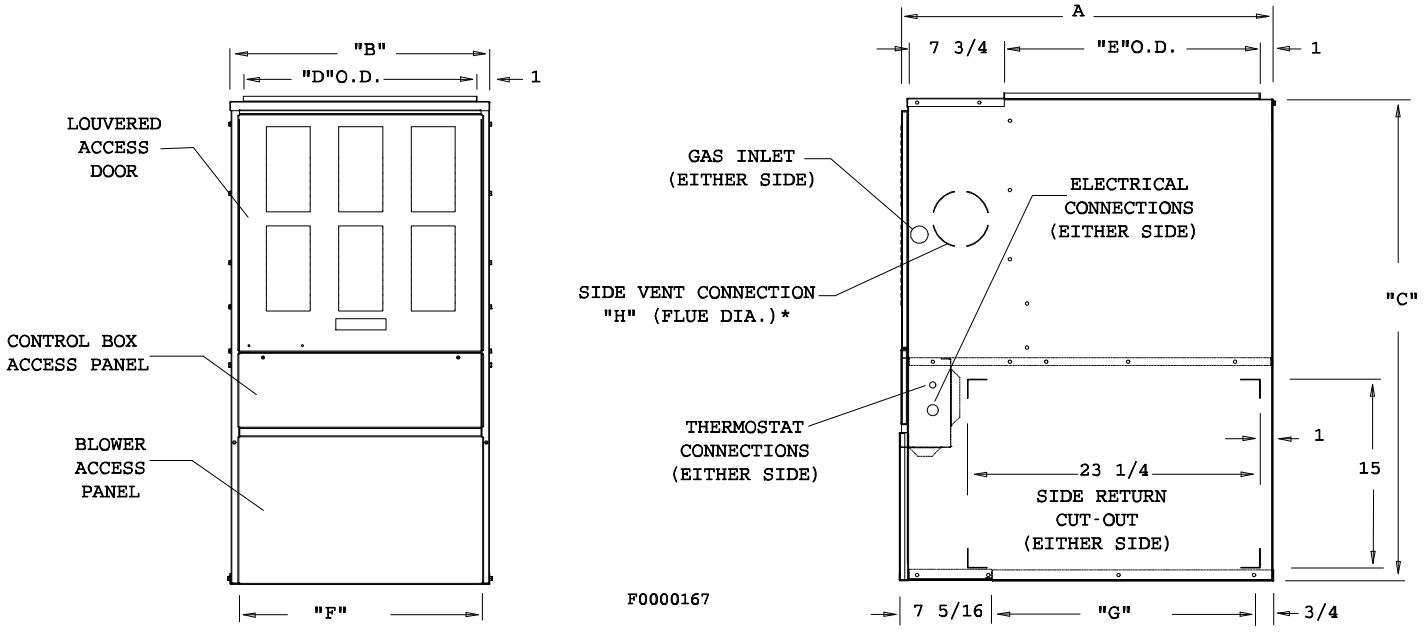
9. It is not recommended that this furnace be used as a construction heater during any phase of construction. Very low return air temperatures, harmful vapors and operation of the unit with clogged or misplaced filters will damage the unit. The unit may only be used for heating of buildings or structures under construction, if the conditions listed on *page 6 in the "Introduction" section of these instructions are met*.

FURNACE SPECIFICATIONS

MODEL	UNIT DIMENSIONS			DUCT SUPPLY OPENING		DUCT RETURN OPENING		VENT PIPE DIA.	MAX. OVER CURRENT PROTECTION	MAX. UNIT AMPS	ELECTRICAL SUPPLY MIN. WIRE SIZE(AWG)	TEMPERATURE RISE RANGE		NET WEIGHT LBS
	LENGTH	WIDTH	HEIGHT											
	A	B	C	D	E	F	G	H				LOW FIRE	HIGH FIRE	
AV050B3	29 1/2	13 1/2	38 1/4	11 1/2	20 3/8	12	21 5/8	4	15	9.9	14	30 - 60	40 - 70	105
AV075B3	29 1/2	13 1/2	38 1/4	11 1/2	20 3/8	12	21 5/8	4	15	9.9	14	30 - 60	40 - 70	113
AV100B4	29 1/2	17	38 1/4	15	20 3/8	15 1/2	21 5/8	4	15	11.7	14	30 - 60	40 - 70	141
AV125B5	29 1/2	20 1/2	38 1/4	18 1/2	20 3/8	19	21 5/8	4	20	11.7	14	30 - 60	40 - 70	167

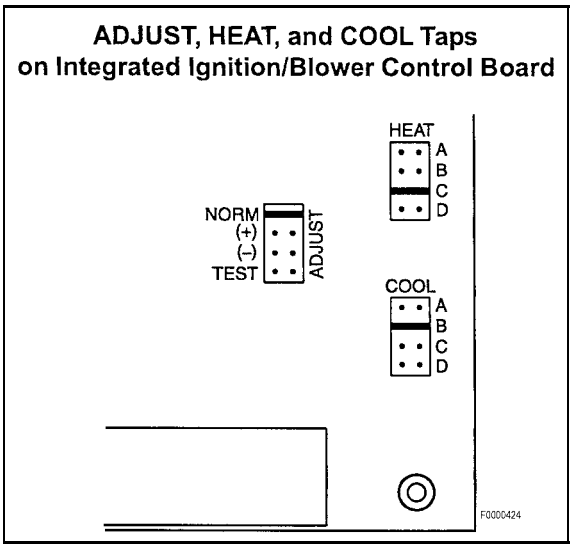
* REDUCER SUPPLIED WITH FURNACE WHEN CONNECTION SIZE IS DIFFERENT THAN PIPE DIA. REQUIRED (H) FOR FLUE VENT PIPE.





BLOWER MOTOR SPECIFICATIONS AND AIRFLOW ADJUSTING DATA

Adjusting Airflow



MODEL	MOTOR HP	BLOWER WHEEL	HEAT SETTINGS				COOL SETTINGS				
			HEATING CFM @ .50 STATIC				COOL CFM @ .50 STATIC				
			SETTING "A"	SETTING "B"	SETTING "C"	SETTING "D"	COOLING ADJUSTMENT	SETTING "A"	SETTING "B"	SETTING "C"	SETTING "D"
AV050B3	1/2	10 X 6	525	425	325	625	NORM (+) (-)	1200 1380 1020	1000 1150 850	800 920 680	600 690 510
AV075B3	1/2	10 X 6	740	640	540	840	NORM (+) (-)	1200 1380 1020	1000 1150 850	800 920 680	600 690 510
AV100B4	3/4	12 X 9	1250	1150	1050	1350	NORM (+) (-)	1600 1800 1360	1400 1610 1190	1200 1380 1020	1000 1150 850
AV125B5	3/4	12 X 12	1650	1550	1450	1750	NORM (+) (-)	2000 2200 1700	1800 2070 1530	1600 1840 1360	1400 1610 1190

THE UNIT, AS SHIPPED, IS FACTORY SET AT SETTING "A" TO RUN AT THE MIDDLE OF THE HEATING RISE RANGE SHOWN ON THE UNIT RATING LABEL.

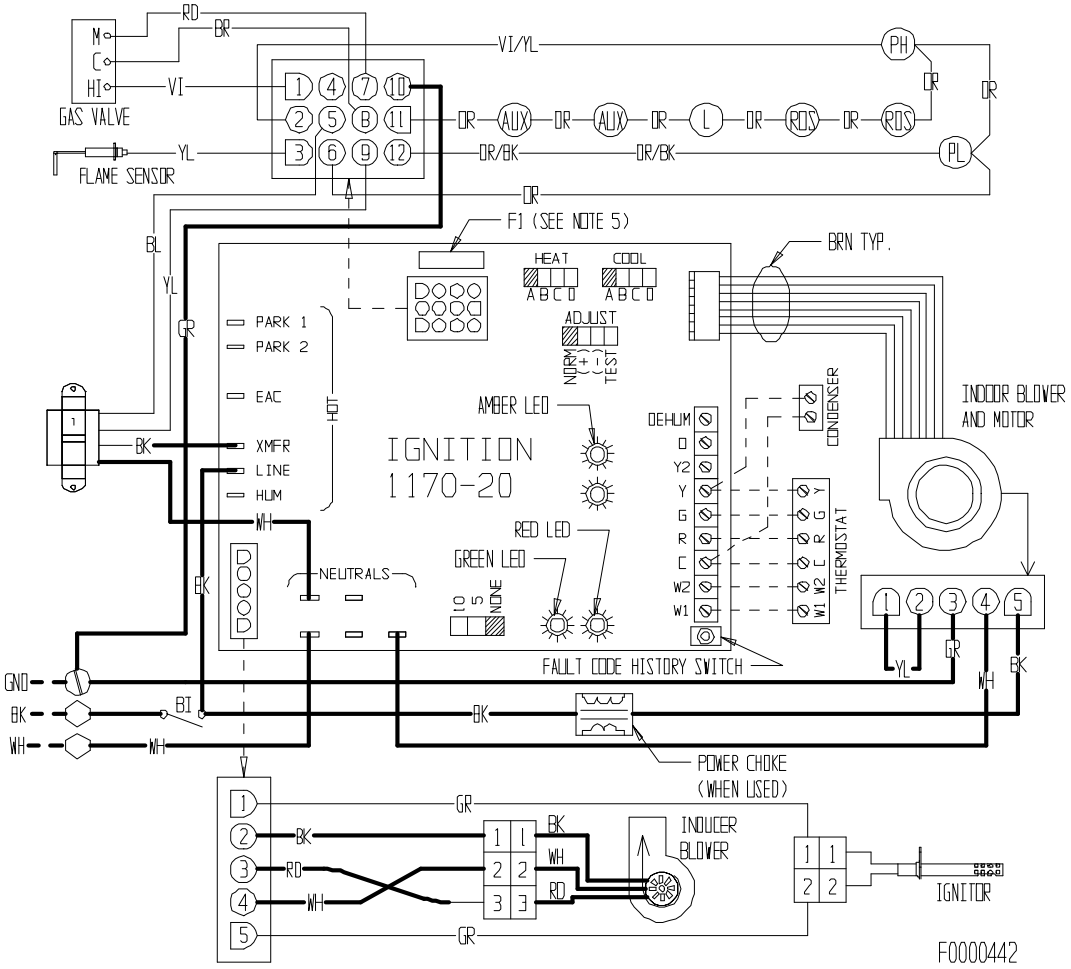
⚠ WARNING

When operating the furnace in the heating mode, the static pressure and the temperature rise (supply air temperature minus return air temperature) must be within those limits specified on the rating label. Failure to follow this warning could lead to severe furnace damage.

⚠ WARNING

Turn OFF all gas and electrical power to furnace before performing any maintenance or service on unit. (Unless specific test requires gas and electrical supplies.) Failure to take this precaution may result in personal injury due to electrical shock or uncontrolled gas leakage.

FURNACE WIRING SPECIFICATIONS



DIAGNOSTIC LIGHTS

A RED LED IS PROVIDED TO INDICATE SYSTEM FAULTS. ERROR CODES ARE AS FOLLOWS:

LED OFF	- NO POWER TO CONTROL OR CONTROL HARDWARE FAULT DETECTED
LED ON	- NORMAL OPERATION
1 FLASH	- FLAME PRESENT WITH GAS VALVE OFF
2 FLASHES	- PRESSURE SWITCH CLOSED WITH INDUCER OFF
3 FLASHES	- PRESSURE SWITCH OPEN WITH INDUCER ON OR IBS OPEN
4 FLASHES	- HIGH LIMIT SWITCH OPEN OR ROS OPEN
5 FLASHES	- NOT USED
6 FLASHES	- PRESSURE SWITCH CYCLE LOCKOUT
7 FLASHES	- LOCKOUT DUE TO NO IGNITION
8 FLASHES	- LOCKOUT DUE TO TOO MANY FLAME DROPOUTS
9 FLASHES	- INCORRECT LINE VOLTAGE PHASING

A GREEN LED IS PROVIDED TO INDICATE HIGH HEAT STATE

- LED OFF - NO DEMAND FOR HIGH HEAT
- LED ON - HIGH HEAT DEMAND, OPERATING NORMALLY
- LED FLASHING - HIGH HEAT DEMAND, HIGH PRESSURE SWITCH NOT CLOSED

A AMBER LED IS PROVIDED TO INDICATE BLOWER MOTOR CFM BEING DELIVERED COUNT THE NUMBER OF TIMES THE LED FLASHES AND MULTIPLY BY 100. EACH FLASH SIGNIFIES 100 CFM.

F0000444B

LINE V / 24 V — FACTORY WIRING

LINE V / 24 V — FIELD WIRING

FIELD CONNECTION

GROUND

LEGEND	
BK	BLACK
BL	BLUE
BR	BROWN
GR	GREEN
OR	ORANGE
RD	RED
VI	VIOLET
WH	WHITE
YL	YELLOW

L	LIMIT
PL	PRESSURE SWITCH LOW
PH	PRESSURE SWITCH HIGH
ROS	ROLL OUT SWITCH *
BI	BLOWER INTERLOCK
CU	CONDENSING UNIT
*	MANUAL RESET
AL	AUXILIARY LIMIT
T	TRANSFORMER
F1	LOW VOLT. FUSE
IL	IN LINE CONNECTION
IBS	INDUCER BLOWER SWITCH

F0000444C

NOTES:

(1) MAKE FIELD POWER SUPPLY CONNECTIONS TO BLACK AND WHITE WIRES CAPPED WITH ORANGE WIRE NUTS.

(2) WARNING---UNIT MUST BE GROUNDED. WIRING MUST CONFROM TO N.E.C AND LOCAL CODES.

(3) IF ANY OF THE ORIGINAL WIRE, AS SUPPLIED WITH THE FURNACE, MUST BE REPLACED, IT MUST BE REPLACED WITH WIRING MATERIAL HAVING A TEMPERATURE RATING OF AT LEAST 105 C AND BE A MINIMUM OF 16 GA. AWG COPPER STRAND WIRE.

(4) SET THE HEAT ANTICIPATOR ON THE THERMOSTAT AT 0.60 AMPS.

(5) LOW VOLT. FUSE 3 OR 5 AMP AUTOMOTIVE TYPE LITTLEFUSE 25700 (3,5) OR BUSS AT C(3,5).

F0000444A

⚠ WARNING

The furnace cabinet must have an uninterrupted or unbroken electrical ground to minimize personal injury if an electrical fault should occur. The unit must also be electrically grounded in accordance with local codes, or in the absence of local codes, with the latest edition of the (U.S.) National Electrical Code ANSI/NFPA No. 70 or CSA Standard C22.1; Part 1 Canadian Electrical Code, if an external electrical source is utilized. DO NOT use gas piping as an electrical ground.

INTRODUCTION

This furnace is design certified by CSA International as a Category I furnace using air from inside the structure for combustion.

It is shipped as a packaged unit, complete with burners and controls, and requires a line voltage (115V) connection to the junction box, a thermostat hook-up as per the wiring diagram and a gas line connection, ducting and flue piping. **This furnace can be installed in either upflow, downflow or horizontal airflow positions, at no time should this unit be operated on its back. The design of this furnace is NOT CSA Certified for installation in recreation vehicles, in manufactured (mobil) homes, outdoors or as a construction heater.**

This furnace has been designed to interface with split system cooling equipment (approved by a nationally recognized testing laboratory) so as to provide "year round air conditioning". The blower has been sized for both heating and cooling and the furnace controls include a cooling fan relay.

The furnace installation must conform with local building codes or in the absence of local codes, with the latest edition of the (U.S.) National Fuel Gas Code ANSI Z223.1 (NFPA-54) or Canadian Natural Gas and Propane Installation Codes CSA B149.1.

For complete information on installation standards consult the (U.S.) National Fuel Gas Code, obtainable from the National Fire Protection Association, Inc., Batterymarch Park, Quincy, MA 02269 or the American Gas Association, 1515 Wilson Boulevard Arlington, VA 22209 or the Canadian installation codes obtainable from Canadian Standards Association, 178 Rexdale Boulevard, Etobicoke, Ontario, Canada M9W 1R3.

This furnace is designed for minimum continuous return-air temperature of 60°F dB or intermittent operation down to 55°F dB such as when used with a night setback thermostat. Return-air must not exceed a maximum continuous temperature of 85°F dB.

The furnace may be used for heating of buildings or structures under construction, if the following conditions are met:

- The vent system must be permanently installed per these instructions.
- A room thermostat must control the furnace. The use of fixed jumpers that will provide continuous heating is not allowed.
- The return air duct must be provided and sealed to the furnace.
- Return air temperature range between 60° F and 80° F must be maintained.
- Air filters must be installed in the system and must be maintained during construction.
- Air filters must be replaced upon construction completion.
- The input rate and temperature rise must be set per the furnace rating plate.
- One hundred percent (100%) outdoor air must be provided for combustion air requirements during construction. Temporary ducting may supply outdoor air to the furnace. Do not connect combustion air duct directly to the furnace. Size the temporary duct following these instructions in the section "Air for Combustion & Ventilation" for air in a confined space with air from outside.
- The furnace heat exchanger, components, duct system, air filters and evaporator coils must be thoroughly cleaned following final construction clean-up.
- All furnace operating conditions (including ignition, input rate, temperature rise and venting) must be verified according to these installation instructions.

These instructions are written for individual residential installation only. For multi-unit installation or commercial applications, please contact manufacturer for recommendations.

LOCATION / PLACEMENT

Site Selection: This furnace may be located in an attic, closet, basement, crawl space, alcove or suspended from the ceiling of a utility room or basement. Select a location that will meet all requirements for safety, clearances, ventilation and combustion air, ductwork design, gas piping, electrical wiring and venting.

Clearances: The following minimum clearances, or greater, must be provided between the furnace and adjacent construction.

TABLE 1 MINIMUM INSTALLATION CLEARANCES

"UPFLOW" POSITION	**"DOWNFLOW"** POSITION	**"HORIZONTAL"** POSITION
Suitable for alcove or closet installation† on combustible flooring at minimum clearance from adjacent construction not less than the following:	Suitable for alcove or closet installation† on non-combustible flooring at minimum clearance from adjacent construction not less than the following: * Installation on combustible flooring only when installed on special base (see model & rating label for proper special base).	Suitable for attic, alcove or closet installation† on combustible flooring at minimum clearance from adjacent construction not less than the following: * Line contact only permissible between lines formed by intersection of the top and two sides of the furnace jacket and building joist, studs, or framing.

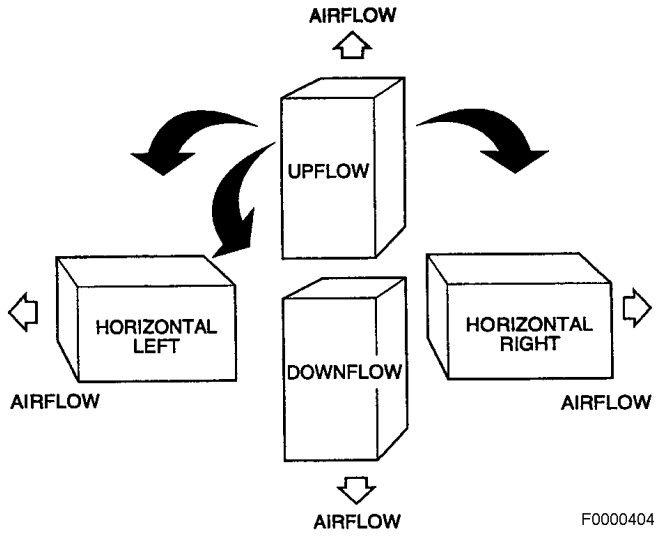
Top	Sides	Back	Front	Vent
2"	**1"**	**1"**	**6"**	**6" with single wall vent**
2"	**1"**	**1"**	**3"**	**1" with B1 vent**

† For closet installation see Air for Combustion and Ventilation.

⚠ WARNING

Failure to comply with all of the clearances will create a fire hazard.

INSTALLATION POSITIONS



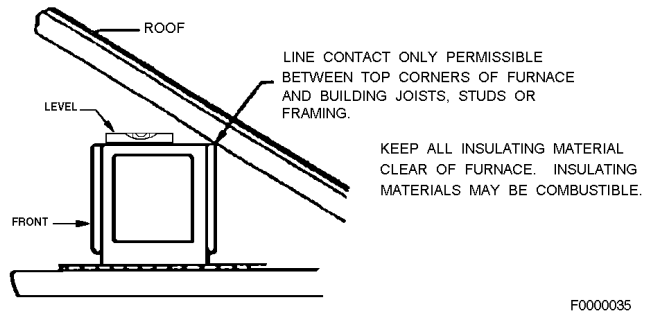
The furnace should also be located as near to the center of the air distribution system as possible, and should be installed level.

This furnace may be installed on non-combustible flooring, on wood flooring in the upflow or horizontal positions, however, it ***must not be installed directly on carpeting, tile or any other combustible material.*** *In the* ***downflow*** *position, it* ***must*** *be installed on non-combustible flooring, on the special base listed on the rating label* ***OR*** *on a cased coil.*

In a horizontal position, line contact with combustibles is only permissible between lines formed by the intersection of the furnace top, the front and back sides, and building joists, studs or framing (See Figure 1).

Figure 1

HORIZONTAL LINE CONTACT



Furnace must not lean back. It must be level or tilt up to 2° to the front. (See Figure 1.)

A clearance of at least 30" should be provided at the front of the unit for servicing. For attic installations, the passageway and servicing area adjacent to the furnace should be floored.

If the furnace is to be installed in a crawl space, consult local codes. (Use of a concrete pad 1" to 2" thick is recommended.)

If the furnace is to be suspended from the ceiling, it will be necessary to use steel pipe straps around each end of the furnace. These straps should be attached to the furnace with sheet metal screws and to the rafters with bolts. The furnace may also be suspended by using an angle iron frame bolted to the rafters. (See Table on page 3 for size and weight of furnace.) Care must be taken to allow for service access.

If a furnace is to be installed in a residential garage, it must be installed so the burners and the ignition source are located not less than 18" above the floor and the furnace must be located or protected to avoid physical damage by vehicles.

⚠ WARNING

Do not place combustible material on the furnace jacket. Failure to comply with this warning will create a fire hazard.

⚠ WARNING

This furnace is not watertight and is not designed for outdoor installation. This furnace shall be installed in such a manner as to protect the electrical components from water. Outdoor installation would lead to a hazardous electrical condition and to premature furnace failure.

AIR FOR COMBUSTION AND VENTILATION

Contaminated Combustion Air:

This furnace is not to be installed in a structure defined as having contaminated combustion air. Allowing exposure to substances containing chlorine or fluoride could harm the furnace and void the warranty. Substances to avoid include, but are not limited to:

- Permanent wave solutions
- Chlorinated waxes and cleaners
- Chlorine based swimming pool chemicals
- Water softening chemicals
- De-icing salts or chemical
- Carbon tetrachloride
- Halogen type refrigerants
- Cleaning solvents (such as perchloroethylene)
- Printing inks, paint removers, varnishes, etc.
- Hydrochloric acid
- Cements and glues
- Antistatic fabric softeners for clothes dryers
- Masonry acid washing materials
- Unrefined gases

⚠ WARNING

Contaminated combustion air may cause premature failure of the heat exchanger that may lead to a hazardous condition and/or bodily harm, or loss of life.

Adequate Ventilation and Combustion Air:

This section is provided to give guidelines for the introduction of air for ventilation and combustion air. The total quantity of air provided to the installation area must equal the requirements of all gas appliances in the area.

Adequate facilities for providing air for combustion and ventilation must be provided in accordance with the latest edition of the National Fuel Gas Code ANSI Z223.1/NFPA54 or CSA B149.1 Natural Gas and Propane Installation Codes, or applicable provisions of the local building codes.

The furnace shall be installed in a location in which the facilities for ventilation permits satisfactory combustion of gas, proper venting and maintenance of ambient temperature at safe limits under normal conditions of use. The furnace shall be located so as not to interfere with proper circulation of air.

In addition to air needed for combustion, ventilation in the form of process air must be provided as required for: cooling of equipment or material, controlling dew point, heating, drying, oxidation or dilution, safety exhaust and odor control. Air must be supplied for ventilation, including all air required for comfort and proper working conditions for personnel.

For purposes of this instruction the following definitions apply:

Confined Space: A space whose volume is less than 50 cubic feet per 1000 Btu/hr of the aggregate input rating of all appliances installed in that space.

Unconfined Space: A space whose volume is not less than 50 cubic feet per 1000 Btu/hr of the aggregate input rating of all appliances installed in that space. Rooms communicating directly with the space in which the appliances are installed, through openings not furnished with doors, are considered a part of the unconfined space.

If the installation area meets the definition of "Unconfined Space" and does not have additional air requirements as described, the furnace may be installed without making special provisions for combustion and ventilation air.

⚠ CAUTION

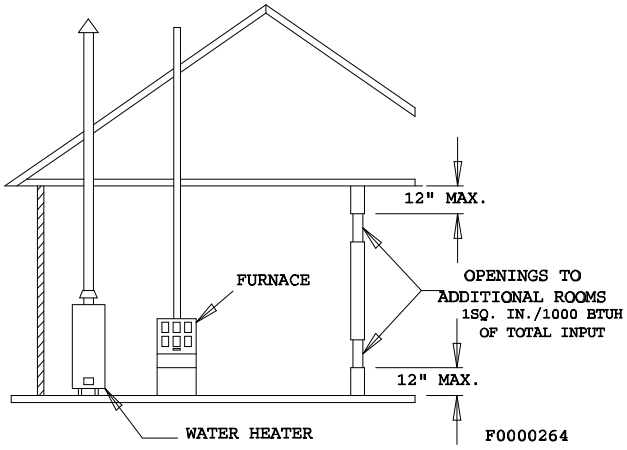
Whenever this furnace is installed in an area along with one or more gas appliances, the total Btu/hr input of all appliances must be included when determining the free area requirements for combustion and ventilation air openings.

⚠ WARNING

Do not block the combustion or ventilation air openings in the furnace. Any blockage will result in improper combustion and may result in a fire hazard or unsafe condition.

If ventilation and/or combustion air must be supplied to the "Confined Space" from inside the building structure, two permanent openings to an additional room of sufficient volume as to combine the volumes of the spaces to meet the criteria for an "Unconfined Space" must be created. Each opening must have a free area of not less than one square inch per 1000 Btu per hour of total input of all appliances within the "Confined Space" (but not less than 100 square inches). These openings must be located 12 inches from the top and bottom of the furnace area respectively and must be at least 3 inches long on the smaller side of the opening (See Figure 2). Neither opening can be blocked at any time.

Figure 2 CONFINED SPACE / INDOOR AIR



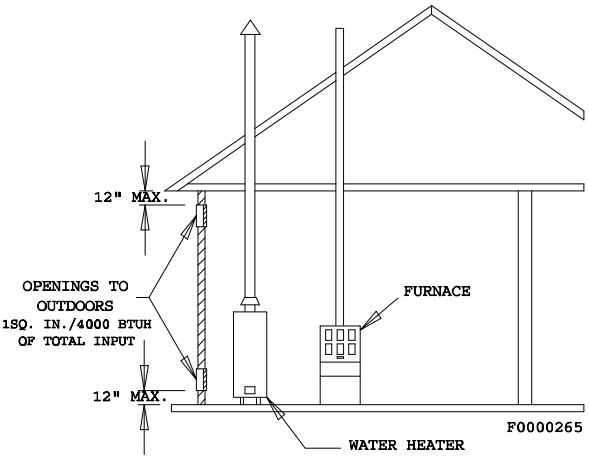
TOTAL INPUT (Btuh)	MIN. FREE AREA (Sq. In.)	ROUND DUCT (Dia. In.)
40,000	100	12
60,000	100	12
80,000	100	12
100,000	100	12
120,000	120	13
140,000	140	14
160,000	160	15

EXAMPLE:

50,000 Btuh Furnace & 10,000 Btuh Water Heater = 60,000 Btuh Total Input = 12" Dia. Round Duct.

If ventilation and/or combustion air must be supplied to the "Confined Space" from outside the building structure, two permanent openings to the outdoors must be created. Each opening must have a free area of not less than one square inch per 4000 Btu per hour of total input of all appliances within the "Confined Space". These openings must be located 12 inches from the top and bottom of the furnace area respectively (See Figures 3, 4, and 5). Neither opening can be blocked at any time.

Figure 3 CONFINED SPACE / OUTDOOR AIR



TOTAL INPUT (Btuh)	MIN. FREE AREA (Sq. In.)	ROUND DUCT (Dia. In.)
40,000	10	4
60,000	15	5
80,000	20	5
100,000	25	6
120,000	30	6
140,000	35	7
160,000	40	8

EXAMPLE:

50,000 Btuh Furnace & 10,000 Btuh Water Heater = 60,000 Btuh Total Input = 5" Dia. Round Duct.

Figure 4

CONFINED SPACE / OUTDOOR AIR

FROM ATTIC

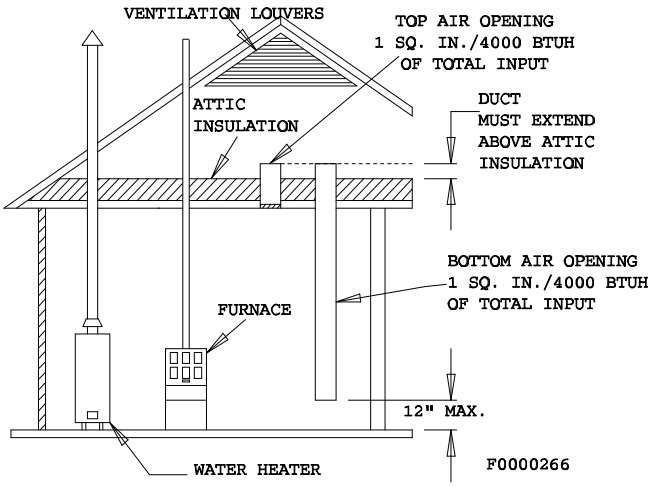
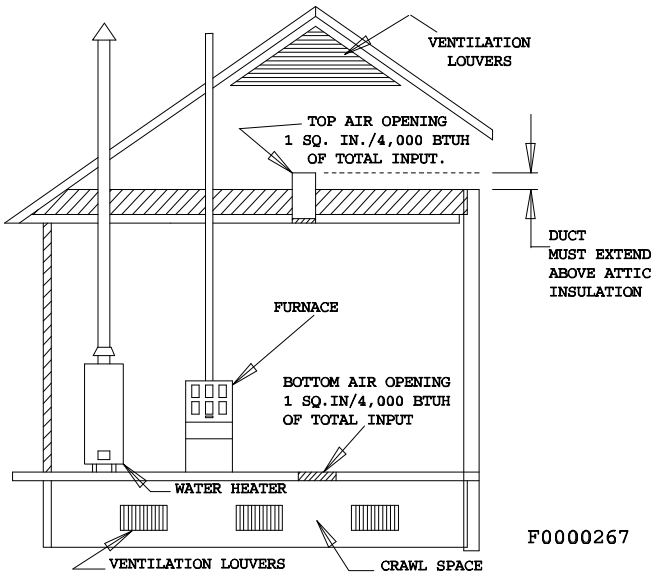


Figure 5

CONFINED SPACE / OUTDOOR AIR
FROM ATTIC & CRAWL SPACE



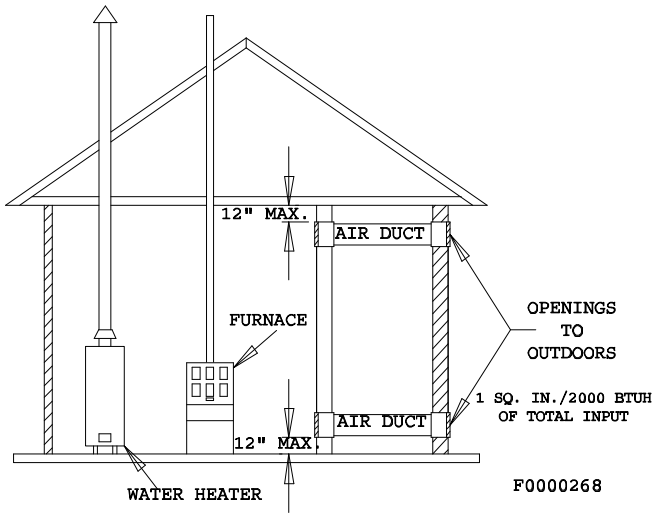
⚠ CAUTION

For an attic installation it is important to keep insulation 12" or more away from any furnace openings. Some types of insulating materials may be combustible.

When horizontal ducts are used to supply air from the outdoors, they must be of the same cross sectional area as the free area of the openings to which they connect. The minimum dimension of rectangular air ducts must not be less than 3 inches. Each opening must have a free area of not less than one square inch per 2,000 Btu per hour of total input of all appliances within the "Confined Space". These openings must be located 12 in. from the top and bottom of the furnace area. Neither opening can be blocked at any time (See Figure 6).

Figure 6

CONFINED SPACE / OUTDOOR
AIR THROUGH HORIZONTAL DUCTS



⚠ WARNING

Furnaces installed with combustion air drawn from a heated space which includes exhaust fans, fireplaces, or other devices that may produce a negative pressure should be considered confined space installations.

DUCTING

The proper sizing of warm air ducts is necessary to insure satisfactory heating operation. Ductwork should be in accordance with the latest editions of (U.S.) NFPA-90A (Air Conditioning Systems) and NFPA-90B (Warm Air Heating and Air Conditioning Systems) or Canadian equivalent.

Ductwork Recommendation:

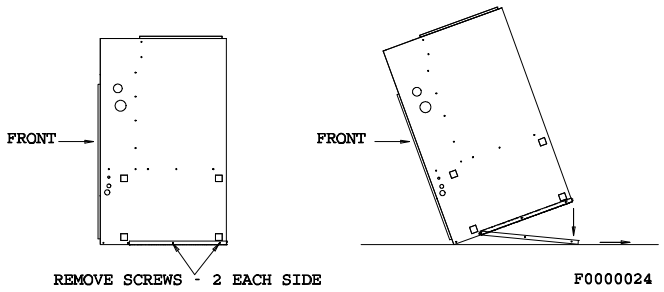
The supply duct work should be attached to the flanged opening provided at the discharge end of the furnace. See page 3 "Furnace Specificatons" for the dimensions of this opening.

A left, right, or bottom return air opening must be used as determined by the layout of the installation. ***The back must not be cut out for return connections.*** An externally mounted air filter is required.

This furnace has a two piece bottom panel. For bottom or end duct return, remove the back portion of the bottom panel by removing the four (4) screws - two (2) on each side toward the back of the furnace (See Figure 7). Tilt furnace toward the front, the back portion of the panel will drop down. Then the back portion can be removed by pulling toward the back of the furnace.

Figure 7

BOTTOM PANEL REMOVAL



Knockouts are provided on both sides of the furnace to facilitate the cutout required to the return air ductwork. **Furnace cutouts must be the full size specified by the corner markers. Undersized cutouts will adversely affect the airflow capability of the furnace and could cause overheating of the heat exchanger.**

The following recommendations should be followed when installing the ductwork:

1. Install locking-type dampers in all branches of the individual ducts to balance out the system. Dampers should be adjusted to impose the proper static at the outlet of the furnace.
2. Noncombustible flexible duct connectors are recommended to connect both the supply and return ducts to the furnace.
3. In cases where the return air grille is located close to the blower inlet, there should be at least one 90° air turn between blower and return grille. Further reduction in sound can be accomplished by installing acoustical air turning vanes and/or lining the inside of the duct with acoustical material.
4. It is recommended that the supply duct be provided with a removable access panel. This opening shall be accessible when the furnace is installed and shall be of such a size that the heat exchanger can be viewed for possible openings using light assistance or a probe can be inserted by sampling the air stream. The access panel shall be designed so as to prevent leaks when locked in position. If an air conditioning coil is installed, the access panel to the coil can be used for this purpose.

⚠ WARNING

When supply ducts carry air circulated by the furnace to areas outside the spaces containing the furnace, the return air shall also be handled by a duct sealed to the furnace casing and terminating outside the space containing the furnace. Incorrect ductwork termination and sealing will create a hazardous condition that could lead to bodily harm.

⚠ CAUTION

Air openings, intake and outlet pipes, return air grilles and warm air registers must not be obstructed.

To Convert to Downflow Position:

1. Convert the combustion blower to side flue exit, as outlined on page 14.
2. Install proper special base per Table 2 for installation on combustible flooring (follow instructions supplied with special base).
3. It is recommended that the return air be connected to the bottom panel of the furnace when it is installed in the downflow position.

NOTE: *SPECIAL SUB-BASE NOT REQUIRED WHEN FURNACE IS MOUNTED ON A METAL CASED EVAPORATOR COIL.*

Table 2

SPECIAL BASE INSTALLATION

MODEL	SPECIAL BASE NUMBER	CAT. NO.
AV050B3 AV075B3	20066501	68L77
AV100B4	20066502	68L78
AV125B5	20066503	68L79

NOTE: Installation on combustible flooring only when installed on one of the above listed special bases or as identified on the furnace model and rating label.

Filters:

Air filters **must** be used in every installation. For side return installations, air filters **must** be installed external to the furnace casing. An external filter rack kit with filter (parts No. 20069901 or Cat. No. 68L75 12 / 15½" x 25" sizes and 20069902 or Cat. No. 68L76 for 15½" / 19" x 25" sizes) is available as an optional accessory.

For bottom (end) return installations, the above optional external rack may be used, if the unit was not provided with a internal filter. Minimum filter size and suggested filter materials are shown in Table 3. (If different type filter is used, it must be an equivalent high airflow capacity.)

Table 3 EXTERNAL FILTER RACK SIZE

MODEL	SIDE RETURN	BOTTOM/END RETURN
050-3 075-3	15 ½ X 25	12 X 25
100-4	15 ½ X 25	15 ½ X 25
125-5	15 ½ X 25	19 X 25

This furnace may use either a disposable filter, permanent filter, electronic or high efficiency media air cleaner. Consult filter/cleaner manufacturers for maintience service and static pressure drop for air moving requirements.

When installing the furnace with cooling equipment for year round operation, the following recommendations must be followed for series or parallel air flow:

1. In series flow applications, the evaporator coil is mounted after the furnace in an enclosure in the supply air stream. The furnace blower is used for both heating and cooling airflow.
2. In parallel flow installation, dampers must be provided to direct air over the furnace heat exchanger when heat is desired and over the cooling when cooling is desired. At no time may the evaporator coil be located on the return air side of the heat exchanger.

IMPORTANT: The dampers should be adequate to prevent cooled air from entering the furnace, and if manually operated, must be equipped with means to prevent operation of either the cooling unit or furnace unless the damper is in the full cool or full heat position.

⚠ WARNING

The coil **MUST** be installed on the air discharge side of the furnace. Under no circumstances should the air flow be such that cooled, conditioned air can pass over the furnace heat exchanger. This will cause condensation in the heat exchanger and possible failure of the heat exchanger that could lead to a fire hazard and/or hazardous conditions that may lead to bodily harm. Heat exchanger failure due to improper installation will not be covered by warranty.

VENTING

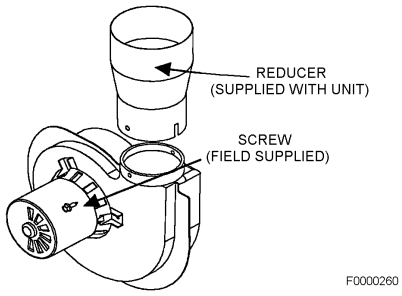
Venting for this category I furnace must be to the outside and in accordance with local codes or requirements of the local utility. In the absence of local codes, venting must conform to the applicable sections of the latest edition of the (U.S.) National Fuel Gas Code ANSI Z223.1/NFPA54, and/or CSA B149.1 Natural Gas and Propane Installation Codes, and the vent manufacturers instructions.

This furnace is CSA International certified as a Category I forced air appliance and **can not be vented into a vent system with any Category II, III or IV appliance**. It must be vented vertically, or nearly vertically, unless installed with a listed mechanical venter in accordance with horizontal venting instructions. It must not be connected to any portion of a mechanical draft system operating under positive pressure

The 3" (in.) to 4" (in.) vent adaptor coupling (supplied with unit) **MUST BE USED**. *It must be connected directly to the outlet of the combustion blower using a field supplied corrosion resistant sheet metal screw (See Figure 8).*

Figure 8

VENT ADAPTOR MOUNTING



Pre-Installation Vent System Inspection:

Before this furnace is installed, it is highly recommended that any existing vent system be completely inspected.

For a chimney or "B" vent, this should include the following:

1. Inspection for any deterioration in the chimney or "B"

vent. If deterioration is discovered, the chimney must be repaired or the "B" vent must be replaced.
2. Inspection to ascertain that the vent system is clear and free of obstructions. Any blockage must be cleared before installing this furnace.
3. Cleaning the chimney or "B" vent if previously used for venting a solid fuel burning appliance or fireplace.
4. Confirming that all unused chimney or "B" vent connections are properly sealed.
5. Verification that the chimney is properly lined and sized per the applicable codes.

Masonry Chimney:

This furnace can be common vented into an existing tile lined masonry chimney provided:

1. The chimney is currently serving at least one drafthood equipped appliance.
2. The vent connectors and chimney are sized in accordance with the applicable sections of the (U.S.) National Fuel Gas Code ANSI Z223.1/NFPA54, and/or CSA B149.1 Natural Gas and Propane Installation Codes.

This furnace must **NOT** vented **ALONE** into an existing masonry chimney (either tile lined or unlined) unless the chimney is also lined with either a type B vent system or a listed single wall, metal lining system. Both of these systems must be sized in accordance with the applicable sections of the (U.S.) National Fuel Gas Code ANSI Z223.1/NFPA54, and/or CSA B149.1 Natural Gas and Propane Installation Codes.

Before venting this furnace into a chimney, check the chimney for deterioration and repair if necessary. This furnace must not be vented into a chimney serving a separate appliance designed to burn solid fuel. Type"B" vent connectors must be used on all installations and it must be sized per the applicable sections of the (U.S.) National Fuel Gas Code ANSI Z223.1/NFPA54, and/or CSA B149.1 Natural Gas and Propane Installation Codes.

Type "B" Vent:

The furnace is also approved for use with a "B" vent that terminates through the roof. Refer to the applicable sections of the (U.S.) National Fuel Gas Code ANSI Z223.1/NFPA54, and/or CSA B149.1 Natural Gas and Propane Installation Codes for proper sizing and set-up of this furnace with "B" vent for a dedicated vent system or a common vented system.

Horizontal Venting:

This furnace is design certified by CSA International for horizontal venting through an outside wall by use of one of the following auxiliary draft inducer kits:

Table 4 AUXILIARY DRAFT INDUCERS

Vent Kit MFR	Model	* Furnace Input
Field Controls Co.	SWG-4G	50000, 75000, 100000 or 125000
Tjernlund Products Inc.	SS1 OR SS1C	50000, 75000, 100000 or 125000
	GPAK-J	50000, 75000 or 100000
	GPAK-1	100000 or 125000
* See rating label on this furnace for input		
Vent Length: Max. 60 ft. - Min. 12 ft. Vent Diameter: 4 in. Follow instructions included with venting kit for proper installation and setup.		

Location Requirements for Horizontal Venting:

Locate the vent terminal adhering to the following minimum clearances and as specified in the auxiliary draft inducer vent kit:

1. Vent terminal must be located at least one (1') foot above the grade or at least one (1') foot above the normal expected snowfall.
2. Avoid installing vent terminal above public walkways. If this is not possible, install the terminal at least seven (7') feet above the walkway.
3. Vent terminal should be at least four (4') feet to the side of and at least one (1') foot above doors and windows.
4. Vent terminal should be at least three (3') feet above any forced air inlet located within ten (10') feet.
5. Vent terminal should be located at least six (6') feet from the combustion air intake of another appliance.
6. Vent terminal should be located at least four (4') feet above any electric or gas meters, regulators, and relief equipment.

General Venting Requirements:

This furnace may be common vented only with other Category I appliances. Common venting is allowed as permitted by National and/or local codes. Refer to the applicable sections of the (U.S.) National Fuel Gas Code ANSI Z223.1/NFPA54, and/or CSA B149.1 Natural Gas and Propane Installation Codes for proper sizing and set up.

The vent must be terminated with a listed vent cap. This venting must be installed in accordance with the vent manufacturer's instructions and be in accordance with all local codes and/or National Codes. Follow Figure 9 for vent exit options.

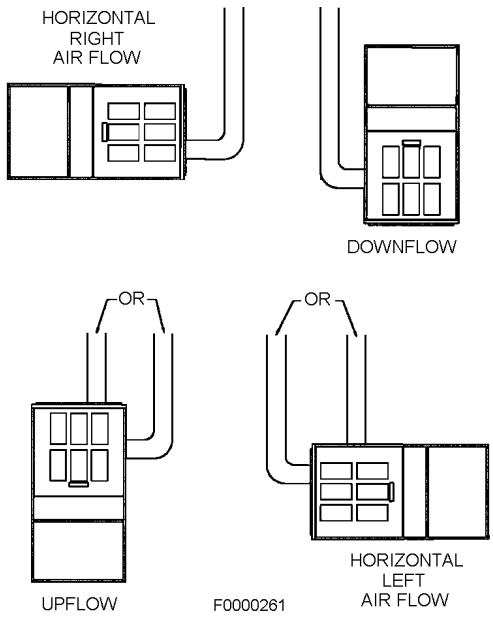
The following requirements are provided for a proper venting system:

1. Be sure that the chimney flue is clear of any dirt or debris.
2. Be sure that the chimney is not servicing an open fireplace.
3. Never reduce the pipe size below the outlet size of the furnace without checking the applicable sections of the (U.S.) National Fuel Gas Code ANSI Z223.1/NFPA54, and/or CSA B149.1 Natural Gas and Propane Installation Codes.

4. All pipe should be supported using the proper clamps and/or straps. These supports should be at least every four (4') feet.
5. All horizontal runs of pipe should have at least a 1/4" (in.) per foot of upward slope from the furnace to the vent terminal.
6. All runs of pipe should be as short as possible with as few turns as possible.
7. Seams should be tightly joined and checked for leaks.
8. The flue pipe must not extend into the chimney but be flush with the inside wall.
9. The chimney or vent pipe must extend at least three (3') feet above the highest point where it passes through a roof of a building and at least two (2') feet higher than any portion of a building within a horizontal distance of ten (10') feet. It shall also extend at least five (5') feet above highest connected equipment flue collar.

Figure 9

VENT EXIT OPTIONS



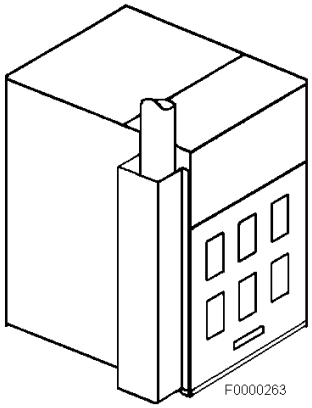
10. The 3" to 4" vent adaptor coupling must be used to connect to the combustion blower outlet. It must be installed directly to the combustion blower outlet (See Figure 8).

To Convert to Side Flue Exit:

1. Remove the louver door from the furnace. (Be sure the side vent exit knock-out is removed from the right side panel of the cabinet. See Figure 9.)
2. Disconnect the pressure switch tubing from the combustion blower.
3. Remove the four (4) screws that secure the combustion blower adaptor plate to the flue collector box, taking care to support the blower assembly so that it does not fall.
4. Rotate the blower 90° (degrees) clockwise, so that the outlet of the blower is pointing toward the right side panel of the furnace.
5. Insure that the gasket is in place between the blower adaptor plate and the flue collector box. Reattach the blower assembly to the flue collector box, using the four (4) screws removed in step 3. Be sure that the screws are properly tightened and that the gasket seals the plate to the box.
6. Reconnect the pressure switch tubing to the combustion blower.
7. **(Optional)** Install vent pipe guard. Kit Number 20284801.

Figure 10

VENT PIPE GUARD KIT



For Horizontal Positions:

It is not necessary to reposition any of the components of the furnace in order to install it in either horizontal position. As outlined above, it is permissible to use the side vent exit for the horizontal-left position, if desired.

Checking For Vent Oversizing:

If this furnace is replacing a furnace that is attached to a venting system serving other appliances, the venting system is likely to be too large to properly vent all of the attached appliances. An improperly sized venting system can lead to condensation, leakage, or spillage.

⚠ WARNING

CARBON MONOXIDE POISONING HAZARD

Failure to follow the steps outlined below for each appliance connected to the venting system being placed into operation could result in carbon monoxide poisoning or death.

The following steps shall be followed for each appliance connected to the venting system being placed into operation, while all other appliances connected to the venting system are not in operation:

1. Seal any unused openings in the venting system.
2. Inspect the venting system for proper size and horizontal pitch, as required in the *National Fuel Gas Code, ANSI Z223.1/NFPA 54* or the *CSA B149.1, Natural Gas and Propane Installation Codes* and these instructions. Determine that there is no blockage or restriction, leakage, corrosion and other deficiencies which could cause an unsafe condition.
3. As far as practical, close all building doors and windows and all doors between the space in which the appliance(s) connected to the venting system are located and other spaces of the building.
4. Close fireplace dampers.
5. Turn on clothes dryers and any appliance not connected to the venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they are operating at maximum speed. Do not operate a summer exhaust fan.
6. Follow the lighting instructions. Place the appliance being inspected into operation. Adjust the thermostat so appliance is operating continuously.
7. Test for spillage from draft hood equipped appliances at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle.
8. If improper venting is observed during any of the above tests, the venting system must be corrected in accordance with the *National Fuel Gas Code, ANSI Z223.1/NFPA 54* and/or *CSA B149.1, Natural Gas and Propane Installation Codes*.
9. After it has been determined that each appliance connected to the venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas-fired burning appliance to their previous conditions of use.

ELECTRICAL CONNECTIONS

When installed, the furnace must be electrically grounded in accordance with local codes or, in the absence of local codes, with the (U.S.) National Electrical Codes, ANSI/NFPA 70 or CSA Standard C22.1; Part 1 Canadian Electrical Code. For proper installation refer to furnace rating label for electrical ratings and for the field wiring of this unit refer to furnace wiring specifications on page 5 or alternately from the wiring diagram on page 27. In all instances, other than wiring for the thermostat, the wiring to be done and any replacement of wire shall conform with the temperature limitation for Type T wire [63°F rise (35°C)].

The electrical connections and the thermostat connections are made at the openings on either side panel of the unit in the control box area. Either side may be used as convenient, but the provided hole plugs must be inserted in the unused holes.

The control system depends on the correct polarity of the power supply. Connect "Hot" (H) wire and "Ground" (G) wire as shown in furnace wiring specification on wiring diagram. Use reference Table on page 3 (Furnace Specifications), for over current protection, max unit amp rating and wire size. Use copper wire only for 115V-supply service to unit. When replacing any original internal wiring, use only 105°C, 16 AWG copper wire.

Thermostat:

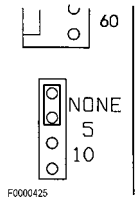
Instructions for wiring the thermostat are packed in the thermostat (field supplied) box. Make the thermostat connections as shown in furnace wiring specifications at the 24-volt terminal board located in the control box.

Single Stage Thermostat Operation:

The automatic heat staging option allows a single stage thermostat to be used with a two stage furnace. To activate this option, move the jumper pin (see Figure 11) to desired setting (5 minutes or 10 minutes). The furnace will start on first (1^{ST}) stage heat and stay at first (1^{ST}) stage heat for the duration of the selected time before switching to 2^{nd} stage heat.

Figure 11

AUTOMATIC HEAT STAGING JUMPER



When installing optional accessories to this appliance, follow the manufacturer's installation instructions included with the accessory.

⚠ WARNING

The unit cabinet must have an uninterrupted or unbroken electrical ground to minimize personal injury if an electrical fault should occur. This may consist of electrical wire or approved conduit when installed in accordance with existing electrical codes. Do not use gas piping as an electrical ground. Failure to follow this warning can result in an electrical shock, fire, bodily harm, or loss of life.

GAS CONNECTIONS

Gas piping shall be of such size and so installed as to provide a supply of gas sufficient to meet maximum demands without undue loss of pressure between the gas meter and the furnace. It is recommended that the gas line to the furnace shall be a separate line direct from the meter, unless the existing gas line is of ample capacity. Refer to gas pipe capacity table in the National Fuel Gas Code ANSI Z223.1/NFPA54, and/or CSA B149.1 Natural Gas and Propane Installation Codes.

If local codes allow the use of a flexible gas appliance connector, always use a new listed connector. Do no use a connector which has previously serviced another gas appliance.

Use a joint compound (pipe dope) that is resistant to the action of liquefied petroleum gases or any other chemical constituents of the gases to be conducted through the piping.

For proper furnace operation the maximum gas supply pressure is 14" w.c. and the minimum gas supply pressure is 4.5" w.c. - Natural (11" w.c. - LP) as shown on rating label.

Before any system of gas piping is finally put into service, it should be carefully tested to determine if it is gas tight. Check all piping for leaks using soapy water and a brush. The piping must stand a pressure of six (6) inches of mercury (3 PSIG) for a period of ten (10) minutes or as required by local authority.

⚠ WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow the safety warnings exactly could result in serious injury, death or property damage.

Never test for gas leaks with an open flame. Use a commercially available soap solution made specifically for the detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury or loss of life.

⚠ WARNING

The furnace and its individual shutoff valve must be **disconnected** from the supply piping system during any pressure testing of that system at test pressures in excess of 1/2 PSIG (3.5kPa or 14"w.c.).

The furnace 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 pressures equal to or less than 1/2 PSIG (3.5kPa or 14"w.c.). Failure to follow the above procedures could lead to a hazardous condition and bodily harm.

Figure 12-A

GAS CONTROL PIPING

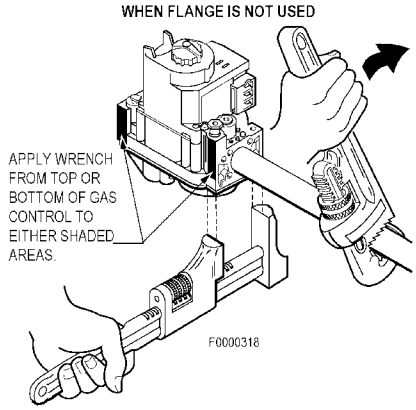
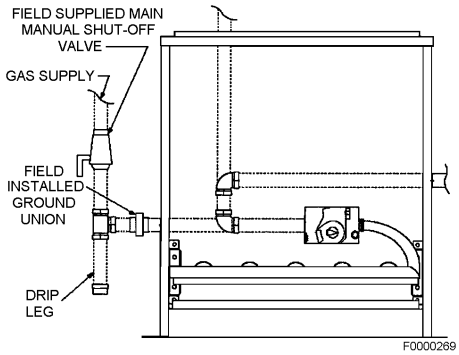


Figure 12-B

TYPICAL GAS SERVICE CONNECTION



This furnace is manufactured for use with Natural gas and must be converted using the proper LP conversion kit for use with LP (Propane) gas. For LP (Propane) gas, a tank regulator is required to reduce supply pressure to 12"-13"w.c. For manifold pressure see Table 6.

A main manual shut off valve must be used in the gas piping. The shut off type and location must follow local codes and should always be in an accessible but protected location. In the absence of local codes the recommended methods for installing the gas piping to the furnace are shown in Figures 12-A and 12-B.

The gas valve contains two threaded ports for a 1/8" NPT tap in order to test incoming gas pressure and outgoing manifold pressure (See Figure 13).

⚠ CAUTION

Many soaps used for leak testing are corrosive to certain metals. Piping must be rinsed thoroughly with clean water after leak check has been completed.

⚠ WARNING

Never use an open flame when testing for gas leaks! Use of an open flame could lead to a fire or explosion.

CONTROL BOARD & VARIABLE SPEED MOTOR FEATURES

Humidifier Connections:

Terminals are provided on the blower control board for connections to a 120-volt optional humidifier. The "HUM" terminal is energized whenever the thermostat calls for heat. Refer to furnace wiring diagram for specific connection information.

Electronic Air Cleaner Connections:

Terminals are provided on the blower control board for connection of a 120-volt optional electronic air cleaner. The "EAC" terminal is energized whenever the thermostat calls for heat, cooling, or continuous blower. Refer to the furnace wiring diagram for specific connection information.

Continuous Blower Operation:

The comfort level of the living space can be enhanced when using this feature by allowing continuous circulation of air between calls for cooling or heating. The circulation of air occurs at half the full cooling airflow rate.

To engage the continuous blower operation, place the fan switch on the thermostat into the ON position. A call for fan from the thermostat closes R to G on the ignition control board. The control waits for a 1 second thermostat debounce delay before responding to the call for fan by ramping the circulating blower up to 50% of the cooling speed, but not less than 425 cfm's. When the call for continuous fan is satisfied, the control immediately de-energizes the circulating blower.

Dehumidification:

For situations where humidity control is a problem, a dehumidification feature has been built into the variable speed motor. At the start of each cooling cycle, the variable speed motor will run at 82% of the rated airflow for 7.5 minutes. After 7.5 minutes has elapsed, the motor will increase to 100% of the rated airflow.

Additional dehumidification can be achieved by connecting a humidistat to the DEHUM and R terminals on the integrated ignition/blower control board. In this setup, the variable speed motor will operate at a 10% reduction in the normal cooling airflow rate when there is a call for dehumidification.

Both dehumidification methods described above can be utilized on the same furnace.

Variable Speed Features:

The furnace is equipped with a variable speed circulation air blower motor that will deliver a constant airflow within a wide range of external static pressures.

Other features of this variable speed motor include:

Soft Start:

The variable speed motor will slowly ramp up to normal operating speed. This minimizes noise and increases comfort by eliminating the initial blasts of air encountered with standard motors.

Soft Stop:

At the end of a cooling or heating cycle, the variable speed motor will slowly ramp down after a short blower "off" delay. If continuous blower operation has been selected, the variable speed motor will slowly ramp down until it reaches the airflow for that mode.

Circulating Airflow Adjustments

Heating Mode:

The unit, as shipped, is factory set (setting "A") to run at the middle of the heating rise range as shown on the unit rating plate. Adjustments can be made to the heating airflow by repositioning the jumper plug marked HEAT-A, B, C, D (see AirFlow Adjustment Table on page 4) based on the information found in the table. **Heating rise must always be within the rise range shown on the rating plate.**

Cooling Mode:

The units are factory set for the highest airflow for each model. Adjustments can be made to the cooling airflow by repositioning the jumper plug marked COOL - A, B, C, D (see AirFlow Adjustment Table on page 4) based on the information found in the table.

By moving the ADJUST jumper plug (see Table on page 4) from the NORM position to the (+) or (-) position will also cause the cooling airflow setting to be raised or lowered by 15%.

The TEST position on the ADJUST tap is not used.

To determine what CFM the motor is delivering at any time, count the number of times the amber LED on the control board flashes. Each flash signifies 100 CFM; count the flashes and multiply by 100 to determine the actual CFM delivered (for example: 10 flashes x 100 = 1000 CFM).

UNIT SEQUENCE OF OPERATION

Here's How Your Heating System Works:

Standby Mode

When the control is in standby mode, it continually monitors thermostat input, rollout switch, and flame sense.

Call For Heat

On a call for 1st stage heat (W1) from the room thermostat, the ignition control performs a 1-second self-check. The control verifies the limit switch is closed and both low and high pressure switches are open. The control always starts on low-fire and ignores 2nd stage call for heat until low heat is established and heat blower on delay is complete. The induced draft blower is energized to high speed and waits for the low pressure switch to close before starting a 15-second pre-purge period. Upon completion of the pre-purge the hot surface igniter is energized for a period of 7 seconds (15 seconds on retries) before the gas valve is energized on 1st stage and main burners ignite. The induced draft blower remains on high speed with the gas on low fire for the first 15 seconds of steady heat and ignores any 2nd stage demand. After the 15 second period the control switches the inducer to low speed. After a 30 seconds blower "on" delay, the control energizes the low heat circulating air blower. The blower runs at reduced CFM (approximately 400 CFM) for 30 seconds then ramps up to 1st stage heat speed.

If 1st stage heating operation is not sufficient to satisfy the heating demand, the room thermostat initiates a call for 2nd stage heat (W1 and W2). The control changes the inducer from low to high speed and confirms the high-fire pressure switch contacts are closed and the gas valve energizes on 2nd stage heat. The circulating air blower then ramps up to 2nd stage heat speed.

When the 2nd stage call for heat is satisfied, the control shuts off the gas valve and runs the combustion air blower for a post purge period of 5 seconds. The circulating air blower continues to run for approximately 3 minutes before ramping down. If the thermostat W2 call ends and W1 remains, the control de-energizes the high gas output, changes the inducer speed from high to low and the gas valve drops back to 1st stage heat. After approximately 2 minutes the circulating air blower ramps down to 1st stage heat speed.

In the event the unit loses ignition, the control will attempt to recycle up to five times before it goes into a 1-hour lockout. Lockout may be manually reset by removing power from the control for more than 1 second or removing the thermostat call for heat for more than 3 seconds.

If during a heating cycle the limit control senses an abnormally high temperature and opens, the ignition control de-energizes the gas valve and the combustion blower while the circulating blower ramps up to 2nd stage heat speed. The circulating blower remains energized until the limits are closed.

⚠ WARNING

Should overheating occur, or the gas supply fail to shut OFF, turn OFF the manual gas valve to the appliance BEFORE turning OFF the electrical supply. A failure to adhere to this warning can result in a fire or explosion and bodily harm.

Fan "ON"

A call for continuous fan from the thermostat closes R to G on the control board. The control waits for a 1-second debounce delay before responding by energizing the circulating air blower at 50% of the cooling speed. When the call for fan is turned off, the control de-energizes the circulating blower.

Cooling

A call for cooling from the thermostat closes R to Y and R to G on the blower control board. The control waits for a 1-second thermostat debounce delay before energizing the circulating air blower to 82% of the cooling speed. After 7.5 minutes, the circulating blower automatically ramps up to 100% of the cooling speed. When a call for cooling is satisfied, the circulating blower ramps back down to 82% of the cooling speed for 60 seconds then shuts off.

STARTUP AND OPERATIONAL CHECKOUT

⚠ WARNING

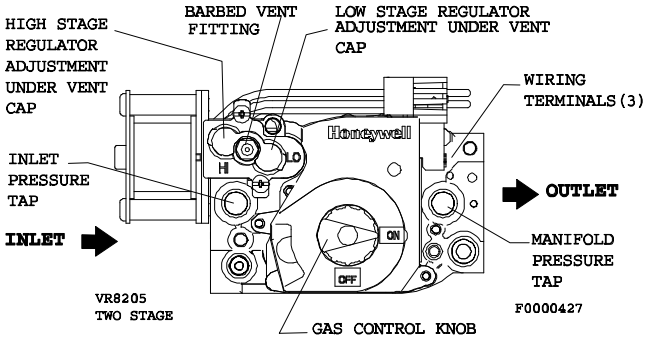
It is not recommended that this furnace be used as a construction heater during any phase of construction. Very low return air temperatures, harmful vapors and operation of the unit with clogged or misplaced filters will damage the unit. The unit may only be used for heating of buildings or structures under construction, if the conditions listed on page 6 in the *"Introduction"* section of these instructions are met.

The automatic gas valve controls the flow of gas to the main burners. The control circuit built into the automatic valve body has 2 positions: "OFF" and "ON" (Figure 13). To shut off gas manually: Switch from "ON" to "OFF" position. When in "OFF" position, the main burners are extinguished.

This furnace is equipped with an automatic hot-surface ignition control and does not require the manual lighting for furnace operation.

Figure 13

GAS CONTROL DIAGRAM



⚠ WARNING

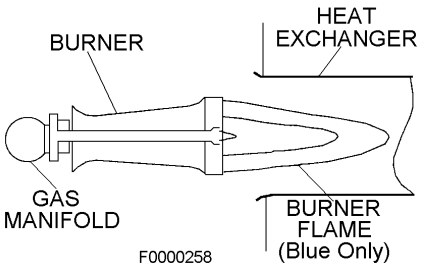
Do not attempt to manually light the burners. Failure to follow this warning can lead to electrical shock that could result in bodily harm.

After the ductwork connections have been made, gas piping and electrical wiring completed and the furnace has been properly vented, the unit should be started and adjusted for proper operation. Check off the following steps as they are completed.

1. Be sure all electrical power is OFF.
2. Check all wiring using proper wiring diagram on inside of the control box cover.
3. Turn ON the electrical power.
4. Set the ignition system control switch in the "ON" position.
5. Set the thermostat above room temperature.
6. The hot-surface ignitor will heat-up to an "orange" glow, the main burners will ignite.

Figure 14

TYPICAL FLAME APPEARANCE (Main Burners)



7. Recheck for leaks in the manual shut off valve, gas control valve and gas connections using a soap solution.

⚠ WARNING

Never use an open flame when testing for gas leaks! Use of an open flame could lead to a fire or explosion.

⚠ CAUTION

Many soaps used for leak testing are corrosive to certain metals. Piping must be rinsed thoroughly with clean water after leak check has been completed.

Manifold Pressure Adjustment:

Turn OFF the gas and electrical before preceeding! Remove the manifold pressure tap pipe plug from the gas valve (Figure 13 outlet pressure tap) and install a pressure tap and connect it to a manometer. Turn on the gas and electrical supplies.

The gas control (Figure 13) has two separate pressure regulator adjustment screws, one for 1st stage (marked "LO") and the second one for 2nd stage (marked "HI"). **The adjusting screws are positioned on either side of the barbed fitting. The pressure regulator adjustment is sensitive: one turn of the adjusting screw will result in a relatively large change in manifold pressure. Turn regulator-adjusting screws IN (clockwise) to increase pressure, OUT (counterclockwise) to decrease presure.**

Set the unit on high fire and adjust the 2nd stage high fire pressure regulator to the required setting. Disconnect the violet wire from the "HI" terminal on the gas control and the burners will drop down to the 1st stage low fire, then adjust the 1st stage pressure regulator setting as required. Gas input must never exceed the value shown on the furnace rating label. These units are equipped for rated input at manifold pressures of 2.3" w.c. (1st stage) and 3.5" w.c. (2nd stage) for natural gas. When these furnaces have been converted for use with LP (propane) gas, the manifold pressures are 6.4" w.c. (1st stage) and 10.0" w.c. (2nd stage). After proper adjustments, reconnect violet wire and furnace should go up to 2nd stage high fire. Turn OFF gas, replace manifold pressure tap pipe plug, regulator adjustment vent cap, and turn ON gas.

⚠ WARNING

At higher altitudes and varying heating valves, manifold pressure or orifice changes maybe required. Consult Tables 7 and 8 for appropriate values. Failure to follow this warning could lead to a hazardous furnace operating condition and result in serious bodily injury or loss of life.

Determining Furnace Input - Natural Gas Only

NOTE: All access doors must be in place when checking gas input.

1. Turn OFF all other gas appliances (except for pilot burners) served by the same gas meter.
2. With furnace operating in full heat cycle, note how many seconds it takes for one full revolution of the smallest dial on the meter. Typically, this will be a 1/2 - or - 1 - cubic foot test dial.
3. Using the number of seconds for one revolution and the size of the meter dial, determine the cubic foot per hour of gas flow by using the formula provided below or Table 5.

$$\text{Cubic Ft/Hr} = \frac{\text{Number of Dial Revolutions x Cubic Foot/Revolution x 3600}}{\text{Time (in seconds) Required for Number of Timed Revolutions}}$$

TABLE 5

Gas Rate (Cubic Feet per Hour)

Seconds for One Revolution	TEST DIAL 1/2 Cubic Feet	TEST DIAL 1 Cubic Foot	TEST DIAL 2 Cubic Feet	Seconds for One Revolution	TEST DIAL 1/2 Cubic Feet	TEST DIAL 1 Cubic Foot	TEST DIAL 2 Cubic Feet
10	160	360	720	36	50	100	200
12	150	300	600	38	47	95	190
14	129	257	514	40	45	90	180
16	113	225	450	42	43	86	172
18	100	200	400	44	41	82	164
20	90	180	360	46	39	78	156
22	82	164	325	48	37	75	150
24	75	150	300	50	36	72	144
26	69	138	276	52	35	69	138
28	64	129	258	54	34	67	134
30	60	120	240	56	32	64	128
32	56	113	226	58	31	62	124
34	53	106	212	60	30	60	120

4. Calculate the furnace input using the following formula:

   BTUH = Cubic Ft/Hr x BTU/Cubic Foot

   The local gas supplier should be able to provide the heating value of the gas, in BTU/cubic foot. If a specific value is not available, use 1000 BTU/cubic foot for Natural gas or 2500 BTU/cubic foot for Propane (LP).

⚠ WARNING

Furnace input should be maintained within ± 2% of the value on the rating plate or appropriate altitude derate. Adjust manifold pressure or change orifices size if required.

5. Calculate the unit's actual input rate.

Example: If the heating value of the natural gas is 1015 Btu/cu. and it takes 60 seconds to burn 2 cu. ft. of gas then:

$$\text{Input} = \frac{\text{1015 Btu/cu. ft. X 1 rev X 2 cu. ft./rev. X 3600}}{\text{60 sec.}}$$

Input = 121,800 Btu/hr.

Burner Orifice Sizing:

The furnace is supplied with standard orifices for the gas shown on the rating plate. Table 6 shows combinations of heating values and specific gravities for various gases, from which proper input can be obtained.

If changing orifices is required, remove the manifold from the furnace (following the instructions found on page 24) and replace orifices as required by Table 6, the altitude derating section of this instruction or as local code dictates.

TABLE 6

Burner Orifice Selection

Type of Gas@Manifold Press. (Heating Value-Specific Gravity) Btu per Cu. Ft.	Orifice Size (Drill #)
Natural Manifold Press.= 3.5"w.c.	
800-0.6	40
900-0.6	41
1000-0.6	42
1100-0.6	43
Propane Manifold Press.= 10"w.c.	
2500-1.53	54

After securing the manifold assembly, replace all other components and/or wiring, being sure that all connections and screws are tightened properly.

Altitude Derating:

The following information is provided as guidelines for altitude derating and is not meant to supersede any state or local codes. Local codes have priority over any others and in some case might limit your options in dealing with an altitude derate situation.

NOTE: In Canada for altitudes up to 4500 ft. (1372 m) see the rating label on this furnace for proper manifold pressure and orifice size. Certification for installations at altitudes over 4500 ft. (1372 m) is the jurisdiction of local authorities.

Check with your local gas company to find out if the gas supply in your area is derated. Gas deration negates the necessity of performing any adjustment on the furnace.

If your gas supply is not derated, regardless of the type of gas used, installation of this furnace at elevations above 2,000 ft. requires an input reduction at the rate of four percent (4%) for each 1,000 ft. above sea level.

Unless an orifice change is specified by an applicable code, the recommended method of altitude derating this furnace is to appropriately lower your manifold pressure. The appropriate manifold pressures based on the elevation and the heating value can be found in Table 7.

TABLE 7

High Altitude Manifold Pressure Derate

(with standard 42 orifice Natural / 54 orifice LP sizes)

Altitude (Feet)	*Heating Value of Natural Gas (BTU/FT3)					LP Propane
	900	950	1000	1050	1100	2500
0-999	4.32	3.88	3.50	3.16	2.84	10
1000-1999	4.32	3.88	3.50	3.16	2.84	10
2000-2999	3.67	3.29	2.97	2.68	2.41	8.46
3000-3999	3.38	3.04	2.74	2.47	2.22	7.74
4000-4999	3.11	2.79	2.52	2.27	2.04	7.05

* Heating-Value based on atmospheric pressure of 30 inhg and 60°F temperature.

If local codes require an orifices change the appropriate orifice size based on the elevation and the heating value can be found in Table 8. Sizing of the orifice must be based on the previously mentioned 4% derate for each 1,000 feet for installations at/or above 2,000 feet rule and the orifices must be drilled in such a way as to assure concentricity. **Hand drilling of orifices is unacceptable.**

TABLE 8

High Altitude Orifice Size Derate

Altitude (Feet)	*Heating Value of Natural Gas (BTU/FT3)					LP Propane
	900	950	1000	1050	1100	2500
2000-2999	N.C.	N.C.	43	43	44	N.C.
3000-3999	N.C.	N.C.	43	44	44	N.C.
4000-4999	43	43	44	44	45	55

* Heating-Value based on atmospheric pressure of 30 inhg and 60°F temperature.

⚠ WARNING

Hand drilling of orifices is never acceptable since it could lead to delayed ignition, overfiring, improper combustion, flashback and flame rollout. All these conditions could lead to a fire hazard and bodily harm, or loss of life.

Blower Adjustment Checkout:

This furnace is equipped with a variable speed circulation air blower motor that will deliver a constant airlfow within a wide range of external static pressures. The unit as shipped is factory set to run at the middle of the heating rise range as shown on the unit rating plate.

For low heat to high heat transition the control changes the blower speed from low heat speed to high heat speed. Check the temperature rise between the return and supply plenums to make sure it is within the rise range shown on the rating plate.

Heat blower off delay is a fixed 180 second delay. After the 180 second delay the motor will slowly ramp down to a soft stop. N0 adjustments need to be made in the heating mode.

Limit Control Checkout:

After the furnace has been in operation for at least 15 minutes, restrict the return air supply by blocking the filters or closing the return registers and allow the furnace to shut down on high limit. The main burners will shut OFF and the main blower and combustion blower should continue to run. Remove the restriction and the burners should come back on in a few minutes.

Flame Rollout Switch:

This unit is equipped with two (2) manual reset flame-rollout switches that protects against improper venting of the flue gases from the heat exchanger due to blockage causing heat (or flames) to "rollout" into the burner box from the heat exchangers, either safety device will activate and shut off power to the automatic gas valve before there is damage to the furnace. The loss of power to the gas valve will shut off the gas burners. Should this occur, it will be necessary to determine the cause of the rollout, correct the condition that caused it, and reset the flame-rollout switch.

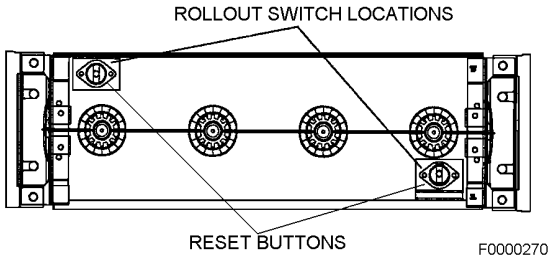
⚠ WARNING

The furnace should be allowed to cool-off before attempting to reset the switch. Failure to follow these instructions could result in injury due to burns!

The switches are located behind the front access door. Remove front access door from the furnace and reset by pushing in the button in the middle of the switch (between the two wire connections - See Figure 16). Very little force is required to push the reset button, and a "click" should be heard when the switch resets.

Figure 16

FLAME ROLLOUT SWITCH



Pressure Switch Check:

To check the operation of the pressure switch vent safety control, remove the vent adaptor from the combustion blower. Place the furnace into operation for high fire. Gradually cover up the blower outlet; the furnace should first drop to low fire and with further restriction of the opening, the main burners should shut OFF. Remove the restriction and the unit should relight. Replace the vent adaptor and reseal the opened joints as required.

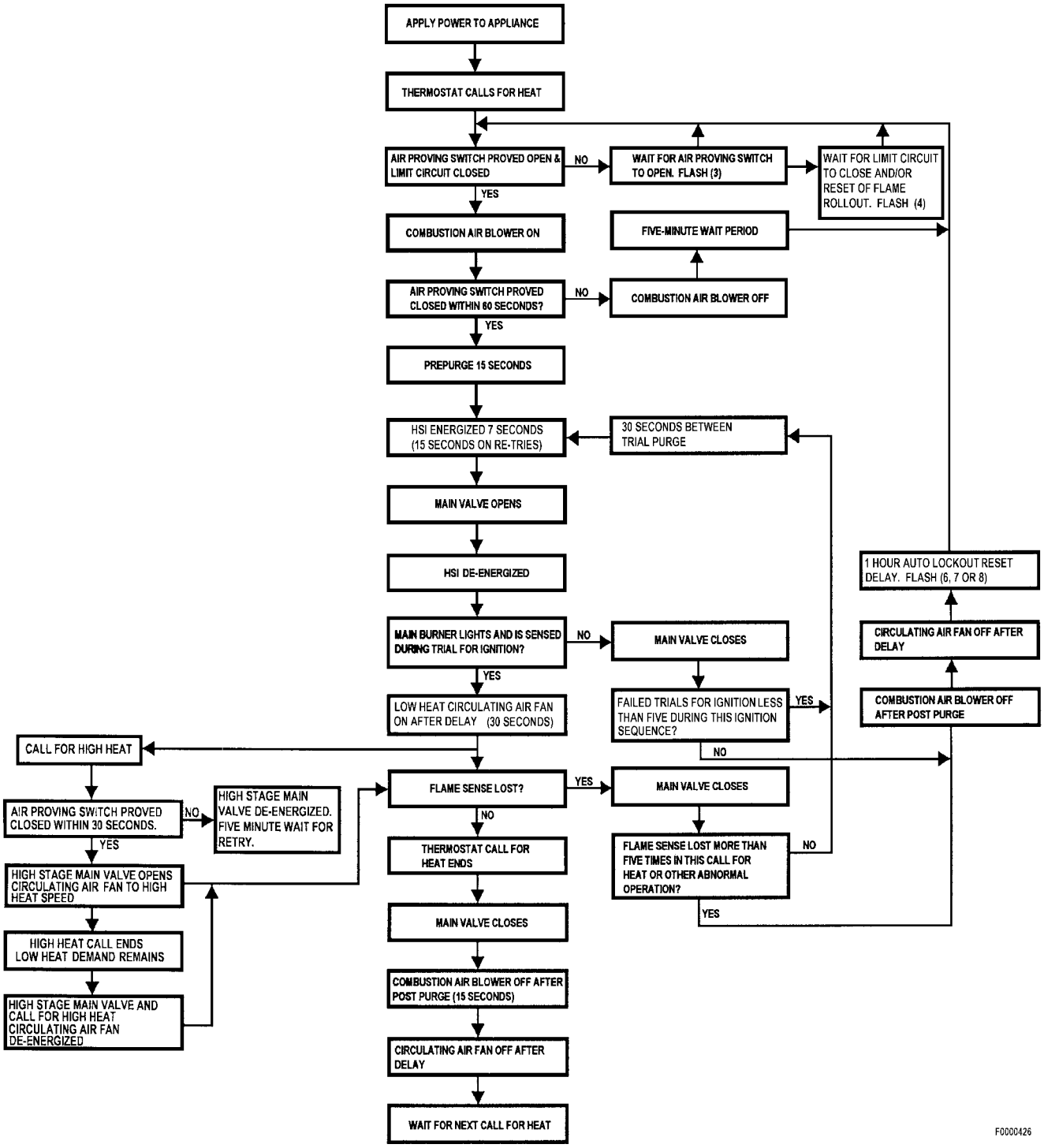
The operational checkout is now complete. Be sure to adjust the thermostat to the desired setting and inform the homeowner how to operate the furnace system before leaving the job site.

⚠ WARNING

If the pressure switch activates to shut the furnace down, the vent system must be checked and cleared. Failure to do so may result in serious bodily harm or nuisance furnace shutdown and/or a hazardous condition that may lead to property damage, personal injury or death.

SEQUENCE OF OPERATION

DIRECT IGNITION SYSTEM CONTROL



SERVICING THE FURNACE

⚠ CAUTION

ELECTRICAL SHOCK, FIRE OR EXPLOSION HAZARD

Failure to follow safety warnings exactly could result in dangerous operation, serious injury, death or property damage.

Improper servicing could result in dangerous operation, serious injury, death or property damage.

- Before servicing, disconnect all electrical power to furnace.
- Wehn servicing controls, label all wires prior to disconnecting. Reconnect wires correctly.
- Verify proper operation after servicing.

⚠ WARNING

The ability to properly perform maintenance on this equipment requires certain mechanical skills and tools. If you are at all uncertain, contact your dealer for qualified maintenance and service since improper service could lead to furnace shutdown or a hazardous condition which could lead to an unsafe condition and bodily harm.

Combustion Component Check:

The heat exchanger, gas burners and venting system must be checked each year, prior to the heating season, by a qualified dealer/serviceman.

The following procedures should be performed:

1. Remove the burner/manifold assembly from the furnace, follow the instructions found on this page.
2. Place the burner/manifold assembly on a flat work area and vacuum the burners. It might be necessary to use a soft bristly brush to remove dirt and then vacuum.
3. Disconnect wiring to combustion blower.
4. Disconnect wiring to pressure switches, and remove pressure switches.
5. Remove the burner opening inlet plate and the flue collector box with the combustion blower attached. This will expose both the burner and flue openings of the primary heat exchangers.
6. Vacuum the length of each heat exchanger tube using a straight attachment into the burner openings and the flue openings.
7. Replace the flue collector box, burner opening inlet plate, and burner/manifold assembly. Insure that all gaskets are properly positioned and that no leaks exist.
8. Reattach all wiring and piping as per the wiring diagram and installation instructions.
9. Turn on utilities and check for leaks using soapy water and a brush.
10. A visual check of the main burner should be made at the beginning of each heating season.
11. Check the input rate and adjust if necessary.
12. Perform a safety check of the limit control and pressure switch.
13. Check the air filter, clean and/or replace as necessary.
14. Replace the appropriate access panels or door.

⚠ WARNING

Never use an open flame when testing for gas leaks! Use of an open flame could lead to a fire or explosion!

⚠ CAUTION

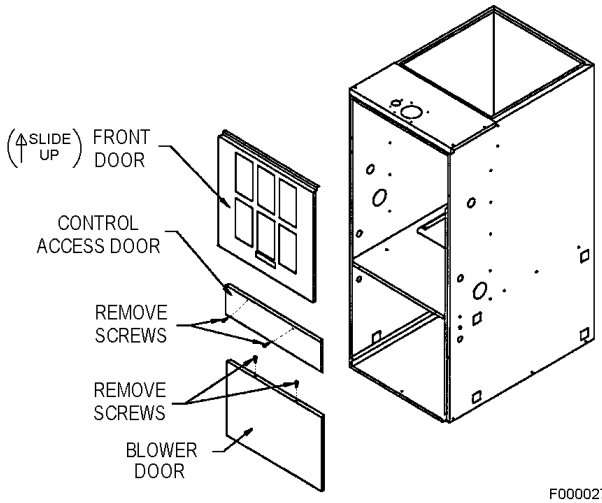
Many soaps used for leak testing are corrosive to certain metals. Piping must be rinsed thoroughly with clean water after leak check has been completed.

Manifold (or Burner/Manifold) Removal/Replacement:

1. Make sure that all utilities (gas and electricity) are turned off upstream of the furnace.
2. Remove the louvered access door by sliding the door straight up, swinging the bottom of the door away from the furnace, and pulling the door down and out of the furnace (See Figure 17).
3. Disconnect the gas line from the gas valve. Be sure that a wiring diagram is available, or be ready to mark any wires that are disconnected. Unplug the three connectors from the gas valve.

Figure 17

FURNACE PANEL REMOVAL



4. Disconnect wires from rollout switch.
5. Remove manifold or burner/manifold assembly.

Manifold ONLY

a. Remove the No. 10 screws that secure the manifold pipe to both legs of the manifold assembly. **The manifold pipe must be supported during this step, or it could fall and damage the furnace or cause bodily injury!**
b. Slide the manifold pipe (with valve and orifice) forward, out of the furnace.

Burner/Manifold Assembly

a. Remove the No. 10 screws that secure the burner/manifold assembly legs to the furnace. **The manifold pipe must be supported during this step, or it could fall and damage the furnace or cause bodily injury!**
b. Slide the burner/manifold assembly forward, out of the furnace until the assembly is clear of the manifold retention pins.
c. Rotate the assembly slightly, in order for the legs to clear the sides of the cabinet, and remove through the front of the furnace.

8. To reinstall the manifold pipe or burner/manifold assembly, reverse the above steps.

Blower Removal/Replacement:

Removal

1. Turn OFF all electrical power to the furnace.
2. Remove the control box access panel and blower access panel.
3. Unplug wires from the blower assembly to the control box.
4. Remove the four (4) screws securing the control box in the unit (two (2) in the cabinet at the sides of the blower door opening and two (2) at the top rear of the control box). Be sure to support the control box so that it does not fall!
5. Rotate the control box out of the cabinet and support it so that no strain is placed on any wiring. It may be necessary to disconnect the electrical supply and thermostat wiring from the control board.
6. Remove the blower retaining screws from the front of each blower leg (See Figure 18). These are the two (2) screws located in the blower compartment that secure the blower legs to the blower partition panel.
7. Slide the blower forward about two (2) inches. This will disengage the rear of the blower legs from the blower partition. Rotate the front of the blower down to clear the control box mounting tabs on the underside of the blower partition, and continue sliding the blower forward until it is out of the unit. Take care to clear the control box mounting tabs. If necessary, disconnect the auxiliary limit leads on the sides of the blower housing.

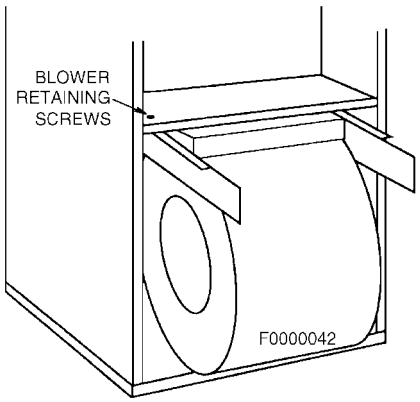
Replacement

1. Place the blower in the blower opening of the unit and reconnect the auxiliary limit leads.
2. Slide the blower back, into the unit, taking care to clear the control box mounting tabs.
3. When the blower is about halfway into the cabinet, rotate the rear of the blower UP so that the rear of the blower legs engage the side rails in the blower partition.
4. Continue sliding the blower into the unit until the front of the blower housing is behind the control box mounting tabs. Rotate the front of the blower UP until the legs lie flat against the bottom of the blower partition, then slide blower fully into position. The rear of the blower should be against the stop in the partition and the rear of the blower legs should be under the partition.
5. Reattach the two (2) blower securing screws, the control box, any disconnected wiring, the blower access panel, and the control box access panel.

Lubricating Motors:

Direct drive motor and blower assemblies are factory lubricated and normally do not require oiling. If oiling is required lubrication of the blower motor is to be preformed only by a qualified service agency.

Figure 18
BLOWER REMOVAL AND REPLACEMENT



TROUBLE SHOOTING With LED Indicator Assistance

Troubleshooting
Make the following visual checks before toubleshooting:

1. Check to see that the power to the furnace and the integrated ignition/blower control board is ON.

2. The manual shutoff valves in the gas line to the furnace must be open

3. Make sure all wiring connections are secure.

4. Review the **Sequence of Operation** (see page 23).

Start the system by setting thermostat above room temperature. Observe system response. Then use the information provided in this section to check the system operation.

The furnace has a built-in, self-diagnostic capability. If a system problem occurs, a fault code is shown by a red LED on the control board. The control continuously monitors its own operation and the operation of the system. If a failure occurs, the LED will indicate the failure code. The flash codes are presented in Table 9.

Fault Code History Button
The control stores the last five fault codes in memory. A pushbutton switch (fault code history switch) is located on the control (see Page 5). When the pushbutton switch is pressed and released, the control flashes the stored fault codes. The most recent fault code is flashed first; the oldest fault code is flashed last. To clear the fault code history, press and hold the pushbutton switch in for more than 5 seconds before releasing.

High Heat State LED
On these models, a green LED is provided on the control board to indicate high heat state (see Table 10).

CFM LED
An amber LED is provided on the control board to display CFM. To determine what CFM the motor is delivering at any time, count the number of times the amber LED flashes. Each flash signifies 100 CFM; count the flashes and multiply by 100 to determine the actual CFM delivered (for example: 10 flashes x 100 = 1000 CFM).

Table 9

Failure Codes - Red LED

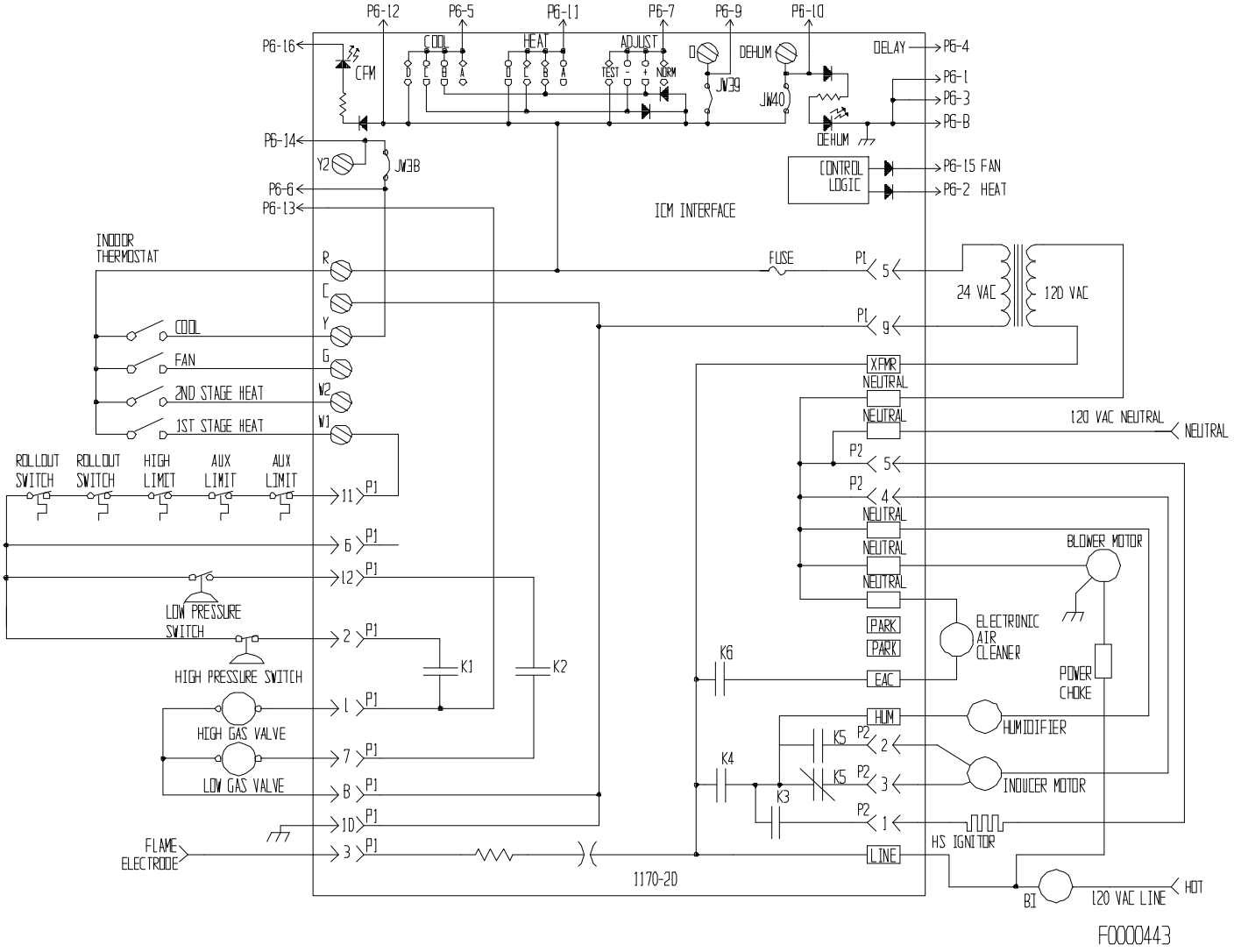
LED Status	Fault Description
LED Off	No power to control or control hardware fault detected
LED On	Normal operation
1 Flash	Flame present with gas valve off
2 Flashes	Pressure switch closed with inducer off
3 Flashes	Low-fire pressure, or IBS switch open
4 Flashes	High limit switch or rollout switch open
5 Flashes	Not used
6 Flashes	Pressure switch cycle lockout
7 Flashes	Lockout due to no ignition
8 Flashes	Lockout due to too many flame dropouts
9 Flashes	Incorrect polarity and phasing

Table 10

High Heat State - Green LED

LED Status	Description
LED Off	No demand for high heat
LED On	High heat demand, operating normally
LED Flashing	High heat demand, high pressure switch not closed

WIRING DIAGRAM



NOTES