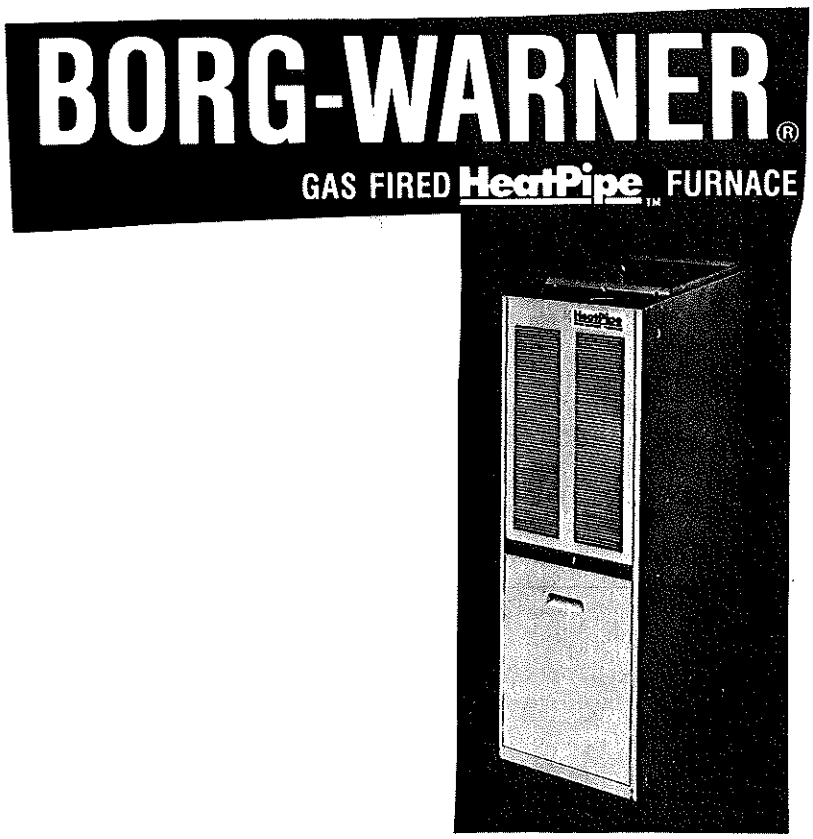
BORG-WARNER



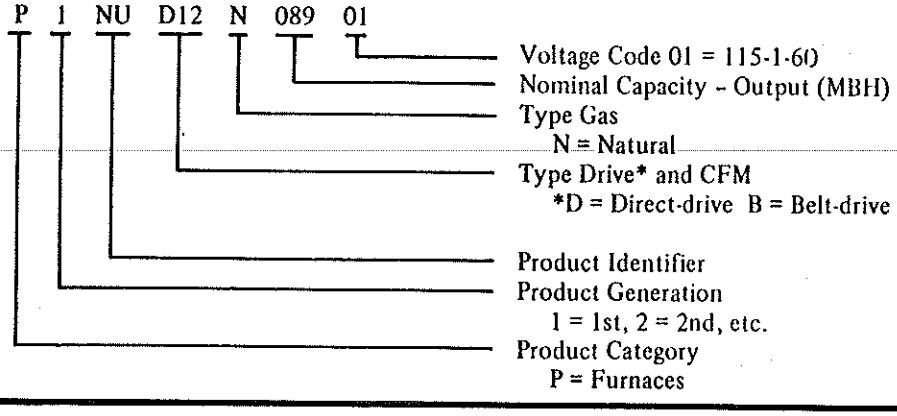
PHYSICAL DATA

Model	AFUE %	Heating Capacity		Air Temp. Rise °F	CFM @ Mean Air Temp. Rise	Max. Outlet Air Temp.	Blower Dimensions (Inches)			Calif. Seasonal Effic. %	Nitrous Oxide Emissions Nanograms /Joule
		Output MBH	Input MBH				Diam.	Width	H.P.		
P1NUD08N06301	84.6	62	73.5	60 to 90	964	200	9	6	1/4	77	20
P1NUD12N06301	84.6	62	73.5	35 to 65	1156	200	10	8	1/3	77	20
P1NUD12N08901	84.6	88	105.0	55 to 85	1376	200	10	8	1/3	77	20
P1NUD16N08901	84.6	88	105.0	40 to 70	1652	200	10	8	1/2	77	20

Model	Electrical			Filter Size		Add-On Cool.		Approx. Oper. Wt. Lbs.
	Max. Over-Current Protection	Unit Ampacity	Min. Wire Size 75' Circ. Oneway	Side	Bottom	Tons	CFM @ .50 ESP	
P1NUD08N06301	15	6.0	#14 AWG	16 x 25*	14 x 25	2	800	160
P1NUD12N06301	15	7.0	#14 AWG	16 x 25*	14 x 25	3	1200	165
P1NUD12N08901	15	7.0	#14 AWG	16 x 25	20 x 25*	3	1200	185
P1NUD16N08901	20	9.0	#14 AWG	16 x 25	20 x 25*	4	1600	185

Input ratings are given to BTU/Hr. and are for elevations up to 2000 feet. For elevations above 2000 feet, ratings should be reduced at the rate of 4 percent for each additional 1000 feet above sea level.
*Size supplied with unit.
Heating capacity and AFUE determined in accordance with DOE test procedures.

NOMENCLATURE



GENERAL

These compact furnaces are styled for residential installation in basements, closets, recreation rooms or garages. All models are natural gas-fired, and may not be converted to LP gas operation.

NOTE, CAUTION, and WARNING. NOTES are intended to clarify or make the installation easier. CAUTIONS are given to prevent equipment damage. WARNINGS are given to alert the installer that personal injury and/or equipment damage may result if installation procedures are not handled properly.

LIMITATIONS

Do not install this unit in a mobile home. This furnace is designed for installation in a building constructed on-site.

A furnace installed in a residential garage shall be located to protect against vehicular damage. The furnace shall be installed such that the burners, and any source of ignition is a minimum of 18" above the floor.

Blower and burner must never be operated without blower door in place. This is to prevent drawing of dangerous fumes (which could contain hazardous carbon monoxide) into the home. Such fumes could result in personal injury or death.

Where local regulations are at a variance with instructions, installer should adhere to local codes, or in the absence of local codes, the installation must conform with American National Standard, National Fuel Gas Code (Z223.1-1984).

COMBUSTION AIR AND VENTILATION

Provisions must be made for ventilation adequate to properly support combustion and to maintain a safe ambient temperature. When the unit is installed in a confined space, two permanent openings must be provided in the enclosure. One opening shall be within 12 inches of the top and one within 12 inches of the bottom of the enclosure. Each opening shall have a minimum free area of 1 square inch per 1,000 BTU per hour of the total input of all appliances in the confined space.

For closet installation of the unit, two permanent openings are required with each opening having one square inch free area per 1,000 BTUH total input of all appliances in the enclosure, for combustion air and ventilation. Openings should be rectangular in shape (height equal to one-half width) located 6 inches from the floor and the ceiling.

All air from outdoor when communicating directly with the outdoors or through vertical ducts, the total free area of each opening shall be at least 1 square inch for each 4,000 BTUH of furnace input.

When communicating with the outdoors through horizontal ducts, the total free area of each opening shall be at least 1 square inch for each 2,000 BTUH of furnace input.

If unit is installed where there is an exhaust fan, sufficient ventilation must be provided to prevent the exhaust fan from pulling negative pressure in the room.

Combustion air openings must not be restricted in any manner.

For a more complete discussion of venting and of ventilation air requirements under various conditions, see the American National Standard 'National Fuel Gas Code' (Z223.1-1984).

CLEARNACES

CAUTION: The furnace area must not be used as a broom closet or for any storage purposes because a fire and personal injury could result.

These units are A.G.A. design certified for closet installation on a wood floor, but must not be installed on (or adjacent-to) carpeting, tile, or any other combustible material.

Top of Plenum	1 in.
Back	0 in.
Front	5 in.
Sides	0 in.
From vent or flue in any direction	6 in.

A 30-inch service access must be provided at front of the unit, this may include the area created by opening the closet door.

DUCT WORK

Duct systems and register sizes must be properly designed for the air flow volume and external static pressure rating of the furnace.

Oversizing duct work is unnecessarily expensive, while undersizing can be even more expensive in terms of customer dissatisfaction and service problems. When duct work is undersized, it imposes higher external static pressure than design allows, and may cause poor air distribution and/or noise problems.

Motor used on direct-drive blowers tend to increase in speed with increase in external static pressure, and may become noisy when the external static pressure is excessive.

It is required that a closed return duct system be used, with return duct connected to the unit, and that supply and return duct connections at the unit be made with flexible joints to minimize noise transmission.

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 a duct(s) sealed to the furnace casing and terminating outside the space containing the furnace.

If a central return is used, connecting duct must be installed so that furnace fan will not interfere with combustion air or draft. Room, closet, or alcove in which unit is installed must not be used as a return air chamber.

PLUMBING

CAUTION: Never apply pipe wrench to body of combination automatic gas valve. Wrench must be placed on projection or wrench boss of this valve when installing piping to it.

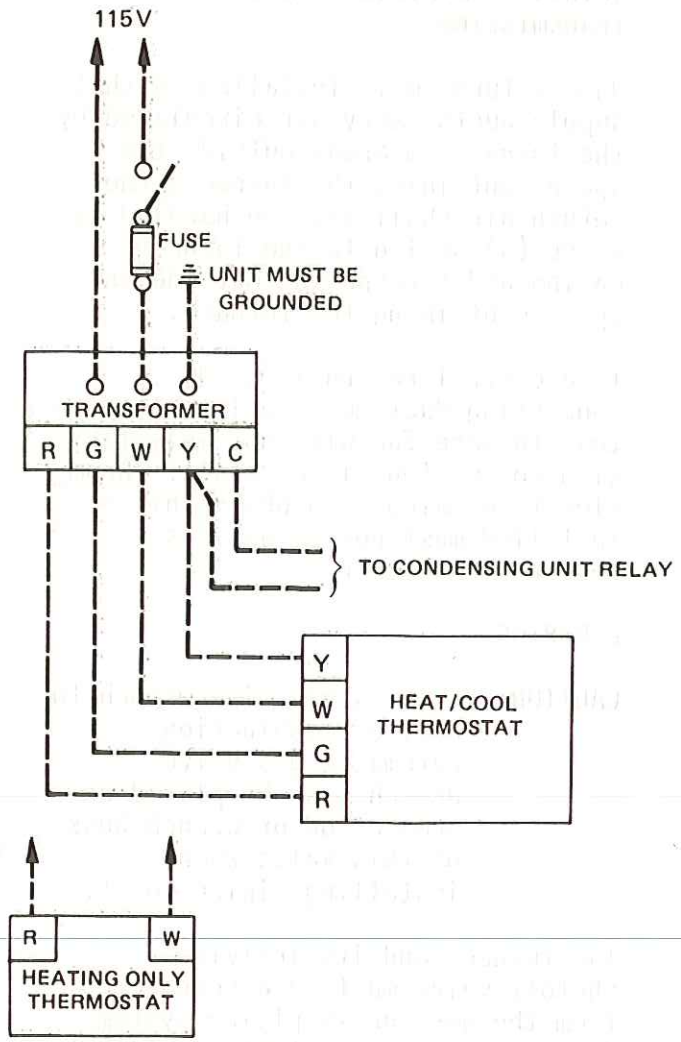
The furnace and its individual shutoff valve must be disconnected from the gas supply piping system during any pressure testing of that system at test pressures in excess of 1/2 psig.

When piping is completed check all connections for leaks, using a soap solution. NEVER USE A FLAME.

POWER AND CONTROL WIRING

Copper wire must be used. Care should be taken to assure proper polarity or control circuit will not start the furnace operation sequence. Furnace fusing required is 15 amps for all units except P1NUD16N08901.

FIELD WIRING DIAGRAM



THERMOSTAT

Set the thermostat heat anticipator at 1.0 amps.

INTERLOCK SWITCH

These units are supplied with an Electrical Interlock Switch mounted in the blower compartment. This switch interrupts power at the unit when the panel covering the blower compartment is removed. This prevents operation of the automatic gas control valve and the blower.

WARNING: Blower and Burner must never be operated without blower panel in place.

This is to prevent drawing gas fumes which could contain hazardous carbon monoxide into the home.

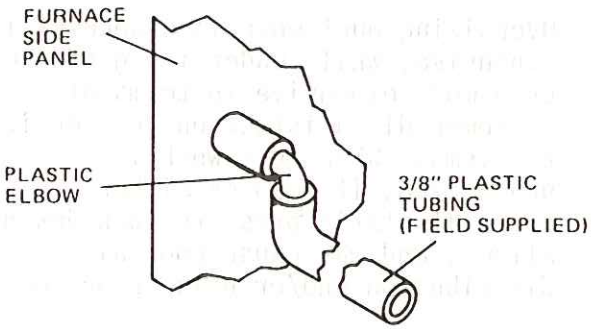
CONDENSATE

Condensate droplets might form inside the vent tubing as it passes through areas cooler than the flue gas temperature. If condensate does form, the droplets will flow backward through the vent tube into the drain pipe. A factory installed drain tube with a built-in trap is supplied to remove condensate from the venting system.

Route the drain tube and elbow through the drain hole in the left hand side of the furnace.

Attach on the other end of the plastic elbow a piece of 3/8" ID plastic tubing to a floor drain.

NOTE: An external condensate drain trap is not required, as one is provided in the factory drain line. This must be filled with water during installation.



OPERATION

OPERATING INSTRUCTIONS

WARNING: This furnace is equipped with an automatic re-ignition system. DO NOT attempt to manually

light the burner.

START-UP

1. Turn "off" electric power to the unit.

2. Turn room thermostat to the lowest setting.

3. Turn the gas valve know counterclockwise to the "on" position.

4. Turn "on" electric power to the unit.

5. The glow coil should light. After 45 seconds, the combustion blower starts, as well as the air blower. Cycle the burner several times by interrupting the electrical power or by using the thermostat.

6. Keep the knob on the gas valve in the ON position and set the thermostat to the desired temperature.

SHUTDOWN

1. Depress the knob of the automatic gas valve slightly while turning it clockwise to the OFF position.

2. Turn OFF electric power to the unit.

This unit has a natural gas 100% shutoff system and is supplied with a burner ignition control designed to automatically light the power burner each time the thermostat calls for heat.

If the power burner should fail to light, after two trial ignitions, a "no heat" condition will result, and will produce the following condition:

The safety control will prevent gas from reaching the power burner. The unit will not return to the normal heating cycle until the abnormal conditions (that caused the failure of the power burner to light) are corrected.

ADJUSTMENT OF MANIFOLD GAS PRESSURE AND COMBUSTION AIR

NOTE: These units have been thoroughly inspected and functionally tested to insure proper unit performance and operation. No field adjustment of gas pressure or combustion air should be required; therefore, DO NOT re-adjust any of the settings.

WARNING: To properly operate the HeatPipe furnace, the following line gas pressure must be maintained:

Minimum Gas Pressure: 5" W.C.
Maximum Gas Pressure: 14" W.C.

DERATION

Input ratings are given to BTU/hr. and are for elevations up to 2,000 ft. for elevations above 2,000 ft. ratings should be reduced at a rate of 4 percent for each additional 1,000 feet above sea level.

CHECKING GAS INPUT

1. Turn off all other gas appliances connected to the gas meter.

2. With the furnace turned on, measure the time needed for one revolution of the hand on the smallest dial on the meter. A typical domestic gas meter usually has a 1/2 or 1 cubic foot test dial.

3. Using the number of seconds for each revolution and the size of the test dial increment, find the cubic feet of gas consumed per hour.

4. To find the BTU Input, multiply the number of cubic feet of gas consumed per hour by the BTU content of the gas.

ADJUSTMENT OF TEMPERATURE RISE

The temperature rise, or temperature difference between the return air and the heated air from the furnace must lie within the range shown on the A.G.A. or CGA rating plate and within the application limitations. After the temperature rise has been determined, the CFM can be calculated.

^{o}F Temperature Rise =

$$\frac{\text{Btuh Input}}{1.30 \times \text{CFM}} \text{ OR CFM} = \frac{\text{Btuh Input}}{1.30 \times {}^{o}F \text{ Temp. Rise}}$$

After about 20 minutes of operation, determine the furnace temperature rise. Take readings on both the return air and the heated air in the ducts, about six feet from the furnace, where they will not be affected by radiant heat. Increase the blower CFM to decrease the temperature rise; decrease the blower CFM to increase the rise.

AIR FILTER

The filter should be checked periodically for dirt accumulation. Dirty filters greatly restrict the flow of air and over burden the system. Clean or replace the filter at least every three months. On new construction, check the filter every week for the first four weeks. Inspect the filter at least monthly after that, especially if the system is running constantly.

The filter supplied with the furnace is a permanent or cleanable type. Clean this filter by washing in warm water. Make sure to shake all the water out of it and have it reasonably dry before reinstalling the filter into the furnace. When replacing a filter, be sure to use the same size and type as originally supplied.

SEQUENCE OF OPERATION

The following describes the sequence of operation of the HeatPipe gas-fired furnace. Refer to the schematic wiring diagram for component location.

CONTINUOUS BLOWER

On cooling/heating units with fan switch, when the fan switch is set in the ON position, a circuit is completed between terminal RC (16) and G (18) of the thermostat. This energizes the R relay (15). Contact IR-2 (3) opens. The motor is energized through the black, high-speed tap (2). The blower then operates on high speed.

INTERMITTENT BLOWER

When the system switch is set on HEAT and the fan switch is set on AUTO, and the room thermostat calls for heat, a circuit is completed between terminal 4 (18) and W (17) of the thermostat. This energizes the igniter control (13). This control energizes the silicon carbide igniter (9, 10), which starts to heat. After 45 $\pm$ 15 seconds, the igniter control energizes the 1M contactor (15), and the gas valve (17).

When 1M contactor (15) is energized, contacts 1M-1 (5) and 1M-2 (3) close. Contact 1M-1 (5) energizes the combustion blower motor (5) contact 1M-2 (3) energizes the blower motor through the blue medium speed tap (3), and the blower operates at medium speed.

When the gas valve (17) is

energized, it opens. since the valve is a negative pressure valve, no gas will flow until the combustion blower (5) operates.

As gas starts to flow and ignition occurs, the igniter control (13) is switched to a flame sensing function. If a flame is detected within 6.8 ± 1 seconds after ignition, normal furnace operation continues until the thermostat circuit between terminals 4 (18) and W (17) is opened. When the supply air temperature reaches 125 ± 12°F, the fan switch (4) closes.

When the thermostat circuit opens, the igniter control (13) is de-energized, which, in turn, de-energizes the 1M contactor (15), opening contacts 1M-1 (5), and 1M-2 (3), de-energizing the combustion blower motor; and closes the gas valve (17). With the gas flow interrupted, the flame is extinguished.

The blower motor continues to operate until the supply air temperature drops below 100°F. When this occurs, the fan switch (4) opens, de-energizing the blower motor. The heating cycle is then complete, and the unit it ready for the start of the next heating cycle.

SAFETY CONTROLS

LIMIT SWITCH (13) - This control is mounted on the vestibule panel with the helix in the supply air stream. If the limit switch opens because of excessive supply air temperatures, the circuit to the igniter control (13), gas valve (17), and combustion blower (5) is de-energized. When the circulation air temperature returns below the safe limit (25°F below the cut-out point), the furnace will restart through its normal ignition sequence.

UNIT	LIMIT SETTING
P1NUD08N06301	170° ± 15°F
P1NUD12N06301	170° ± 15°F
P1NUD12N08901	170° ± 15°F
P1NUD16N08901	170° ± 15°F

HEAT EXCHANGER PRESSURE SWITCH (13) -This control is mounted on the condenser header at the top end of the heat exchanger. If the pressure in the heat exchanger exceeds 200 ± 7 psig, the circuit to the igniter control (13), the gas valve (17), and the combustion blower (5), is de-energized when the pressure returns to a safe level, 90 ± 10 psig, the furnace will restart through its normal ignition sequence.

VENT PRESSURE SWITCH (13) - This control is mounted in the burner compartment and is connected to the exhaust vent transition. If the differential pressure between the vent and atmosphere exceeds .95 ± .05 in. W.C., the circuit to the igniter control (13), the gas valve (17), and the combustion blower (5), is de-energized. When the differential pressure falls below .89 ± .05 in. W.C., the furnace will restart through its normal ignition sequence.

VENT FUSIBLE LINK CONTROL (13) - This control is mounted in the exhaust vent transition in the burner compartment. If the flue temperature exceeds 468 ± 3°F, the circuit to the igniter control (13), gas valve (17), and combustion blower (5), is de-energized. This is a one-time fusible link type control. Before the furnace can operate again, the control must be replaced. The operation of this control indicates a possible fluid leak in the heat pipe heat exchanger.

IGNITER CONTROL (13) - The igniter control is located in the blower compartment. During the ignition sequence, after the silicon carbide igniter (9, 10) is energized for 45 ± 4 seconds, and ignition occurs, the igniter is switched to a flame sensor. If no flame is detected after 6.8 ± 1 seconds, the gas valve (17) and the blower motor (5) are de-energized, and the igniter control (13) locks out. The igniter control (13) can be reset by lowering and then raising the thermostat to remove and reapply power to the system.

If a flame loss occurs after the 6.8 ± 1 second trial periods, the igniter is retried once before the igniter control (13) locks out.

GAS VALVE (17) - The gas valve is located in the burner compartment. The gas valve (17) is a negative pressure valve. If the gas valve were to stick open, gas would not flow unless the combustion blower motor were energized. Also, if the combustion blower contact, 1M-1 (5) were to fail closed, gas would not flow unless the gas valve (17) were energized.

FUSE PLUG - This control is mounted on the condenser header on the top of the heat exchanger. If the pressure in the heat exchanger exceeds 340 ± 25 lbs, the disc ruptures and relieves the pressure. This control should never function because of the heat exchanger pressure switch. If it does operate, the heat exchanger must be replaced.

If a power failure occurs, the furnace shuts off and resumes normal operation when the power is restored.

VENT EXHAUST SYSTEM

This furnace may be vented vertically through a roof, or into a masonry chimney. It may not be vented horizontally. Each of the available venting options presents a distinctly different situation, requiring distinctly different materials and procedures.

When a 4" diameter vent system is applied to this furnace, it is classified as a Category I appliance. A Category I appliance is one which operates with non-positive vent pressures, and a difference between actual flue gas temperatures and dew point temperatures of 140°F or greater. Category I furnaces may be common-vented using a standard vent system.

When a 3" diameter vent system is applied, the furnace is a Category III appliance, operating with positive vent pressure, and a difference between actual flue gas temperatures and dew point

VERTICAL VENTING THROUGH A ROOF

The furnace may be vented vertically through a roof using dedicated Type B (conventional) venting.

The Type B vent material must have an inside diameter of 4 inches. The actual horizontal length of the vent connector must not exceed five feet when Type B venting is used.

CAUTION: If the actual horizontal length of the vent connector exceeds five feet, the furnace becomes a Category III appliance, and conventional venting means may no longer be applied.

Most through-the-roof applications will require Category III venting, due to the actual length of the vent connector required to extend through the roof of the structure.

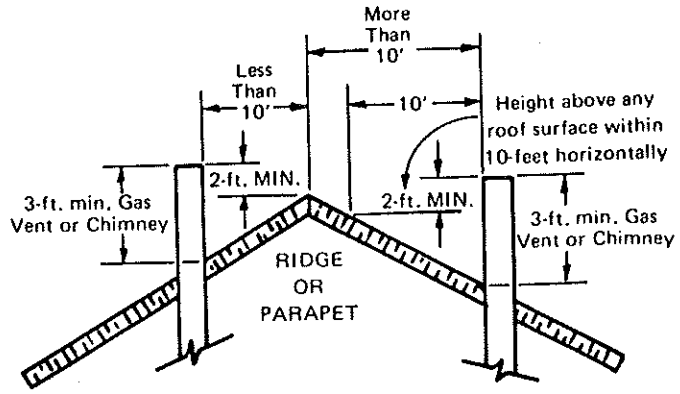


FIGURE 1 - THROUGH THE ROOF VENTING

Industry standards require that a Category III vent system be gas and water tight. The material used must also be condensate resistant. Three-inch diameter 29-4C stainless steel single-wall pipe is satisfactory for this application, and may be used as a single-wall vent or with a Type B shield.

Horizontal portions of a vent connector must be pitched upward from the furnace at least 1/4" per horizontal foot. The female end of the vent connector or vent pipe sections must point toward the furnace, to allow any vent condensate to drain back down the vent system without undue drip, puddling or blockage. All pipe joints should be fastened with sheet metal screws and sealed with Dow-Corning RTV-732, GE RTV-108, or equivalent high-temperature sealant which will withstand temperature to 450°F. Seal the vent connection to the furnace, all pipe joints, seams and elbow swivel joints.

Single-wall venting may only be used if the vent runs directly from the space containing the furnace, through a roof to the outside, and cannot originate in an attic, crawl space, or any other unoccupied or concealed space. If the vent must pass through other than just a roof to reach the outside, it must be shielded by approved means. Such shielding means may include the use of a properly installed Type B vent to completely encase the single-wall pipe. The single-wall vent may also be installed through a masonry chimney. When a Type B1 shield is used, all single-wall pipe connections must be fastened with three (3) sheet metal screws and sealed with a high-temperature sealant as previously described. The shielding vent must be sized large enough to allow insertion of the single-wall pipe through the center, and assembled in accordance with the manufacturer's instructions.

Whether the single-wall vent is shielded by a Type B vent or a masonry chimney, the single-wall vent must be continuous from the furnace flue connector to a proper vent termination. An approved cap which has a vent capacity not less than the pipe, and does not obstruct the pipe outlet shall be attached to the end of the single-wall metal pipe.

The termination of the vent must be extended high enough above the roof or any neighboring obstruction so that wind from any direction will not create a positive pressure in the vicinity of the outlet of the vent. Extend the vent three feet higher than the point of emergence through the roof, and at least two feet higher than any object within a radius of 10 feet.

VENTING THROUGH A MASONRY CHIMNEY

The furnace may be vented into a dedicated masonry chimney. This chimney must be a field-constructed chimney of solid masonry units, bricks, stones, listed masonry chimney units or reinforced Portland cement concrete. It must be lined with suitable chimney flue liners. The appropriate venting tables in the National Fuel Gas Code (ANSI Z223.1-1984) must be followed.

Extend the chimney high enough above the roof or any neighboring obstruction so that wind from any direction will not create a positive pressure in the vicinity of the outlet of the chimney. Extend the chimney three feet higher than the point of emergence through the roof, and at least two feet higher than any object within a radius of 10 feet.

Category I furnaces may be connected to a common chimney or listed, Type B gas vent with other listed, natural draft gas-fired appliances. The vent system of this power combustion furnace operates at a negative pressure when vented vertically into a 5" diameter or larger common vent pipe. The operation of this furnace under blocked vent conditions is equivalent to other conventional furnaces. The National Fuel Gas Code (ANSI Z223.1-1984/Z21.47a-1985) Appendix C should be followed on the above mentioned and other common venting systems unless superseded by local codes or utility requirements.

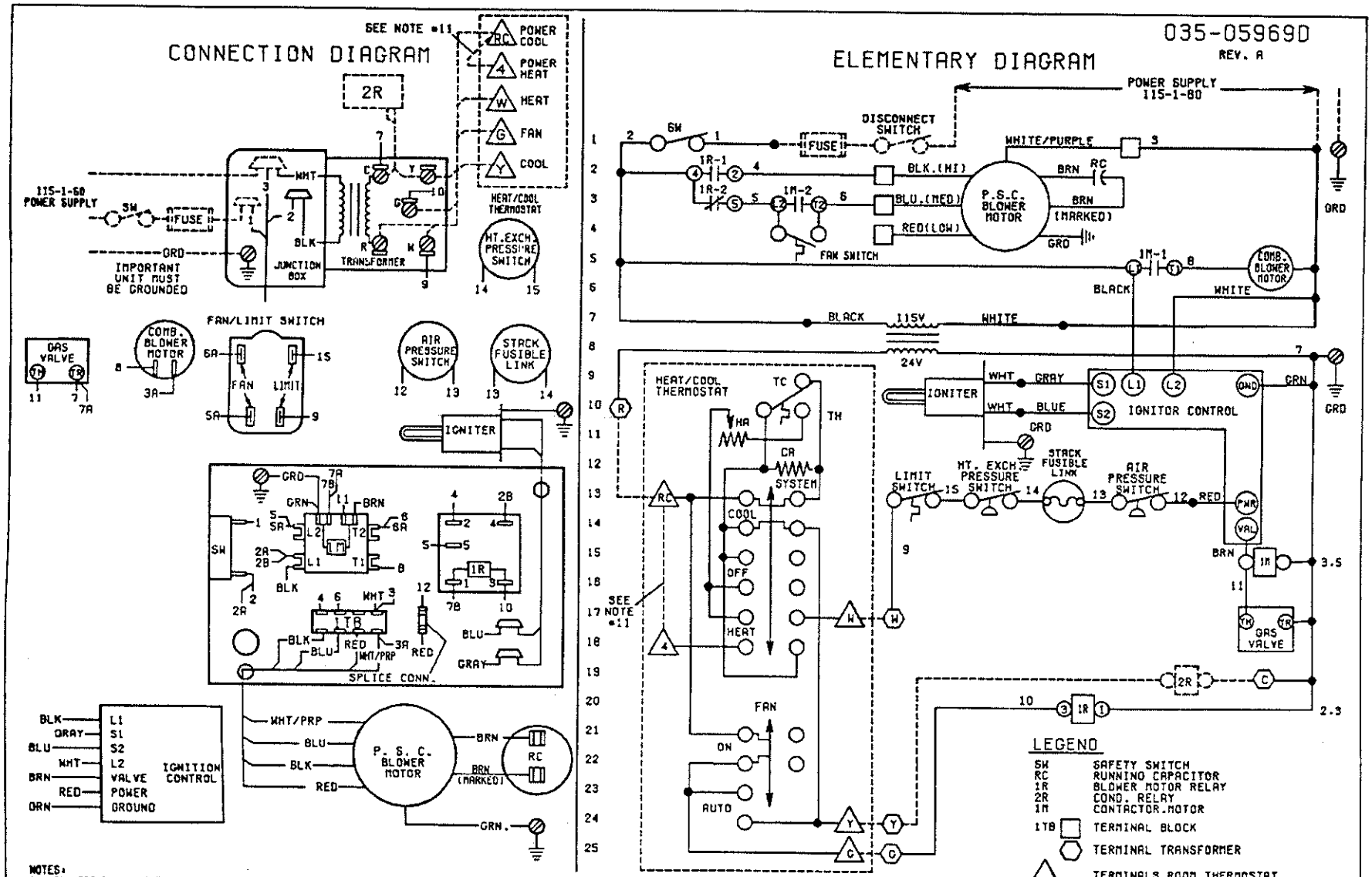
CAUTION: Do not run the vent pipe into a chimney for wood burning stoves, oil furnaces, incinerators, coal stoves, or other fossil-fueled devices except listed gas appliances. The free area of the chimney must be sufficient to vent both appliances.

Category I: Zero or negative vent pressure. Vent gas temperature above 140 degrees F over dew point. Non-condensing.

Category II: Zero or negative vent pressure. Vent gas temperature below 140 degrees F over dew point. Condensing.

CategoryIII: Positive vent pressure. Vent gas temperature above 140 degrees F over dew point. Non-condensing.

Category IV: Positive vent pressure. Vent gas temperature below 140 degrees F over dew point. Condensing.



NOTES:
1. ALL FIELD WIRING TO BE IN ACCORDANCE WITH NATIONAL ELECTRIC CODE (NEC), CANADIAN ELECTRIC CODE (CEC), AND/OR LOCAL OR CITY CODES.
2. DRAWING PRACTICES AND SYMBOLS ARE IN ACCORDANCE WITH AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI) GRAPHIC ELEC. STANDARDS.
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.
4. MOTORS ARE INHERENTLY PROTECTED.
5. NUMBERS ALONG LEFT SIDE OF ELEMENTARY DIAGRAM DESIGNATE LINE IDENTIFICATION ONLY. NOT TERMINAL MARKINGS. NUMBERS ALONG RIGHT SIDE OF DIAGRAM DESIGNATE LINE LOCATIONS OF RELAY CONTACTS. AN UNDERLINED LOCATION NUMBER DENOTES A NORMALLY CLOSED CONTACT.
6. COMPONENT TERMINAL MARKINGS ARE INDICATED BY ENCIRCLED NUMBERS AND/OR LETTERS.
7. NUMBERS ALONG VERTICAL OR HORIZONTAL LINES EXCLUSIVE OF LINE IDENTIFICATION AND ENCIRCLED NUMBERS DESIGNATE CIRCUIT IDENTIFICATION.
8. USE COPPER CONDUCTORS ONLY FOR SUPPLY CONNECTIONS.
9. UNIT MUST BE FIELD GROUNDED.
10. BLOWER MULTI-SPEED MOTOR POWER LEADS ARE FIELD CONNECTED AS FOLLOWS: BLACK LEAD (HIGH SPEED), BLUE LEAD (MED. SPEED), & RED LEAD (LOW SPEED). SEE INSTALLATION INSTRUCTIONS FOR AIR FLOW AND STATIC PRESSURE DATA.
11. FOR HEAT/COOL OPERATION A FIELD SUPPLIED JUMPER WIRE MUST BE CONNECTED BETWEEN THERMOSTAT TERMINALS Rc AND 4