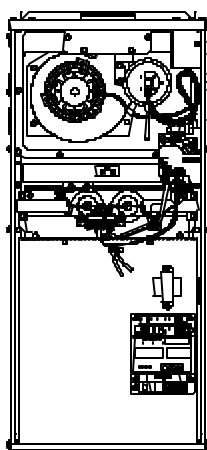
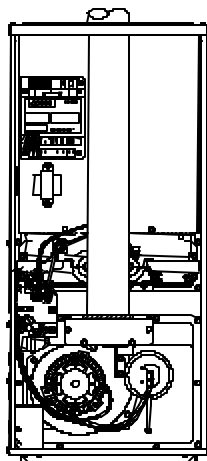


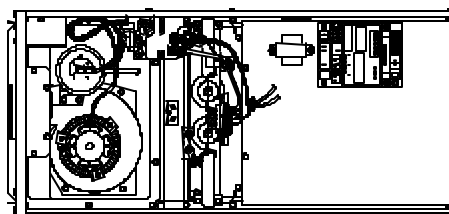
# MULTI-POSITION FURNACE INSTALLER'S INFORMATION MANUAL



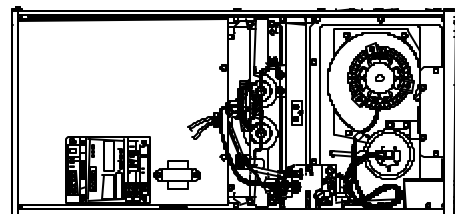
UPFLOW



DOWNFLOW



HORIZONTAL AIR-LEFT



HORIZONTAL AIR-RIGHT

**ATTENTION, INSTALLER!** After installing the furnace, show the user how to turn off gas and electricity to the furnace. Point out control and switch locations for turning off gas and electricity. Go over the User Information Manual and Section 26, "Maintaining Furnace In Good Working Order" in this manual with the user. Make sure the user understands the importance of following all safety precautions, including what could happen if they don't.

Attach the following documents on or adjacent to the furnace. Tell the user where these documents are located:

- User's Information Manual
- Installer's Information Manual
- Parts List
- Warranty Information

While these instructions have been written as accurately and thoroughly as possible, they may not cover every system variation or contingency. Questions of interpretation may arise. For more information, solutions to particular problems or clarification, contact your local distributor or the manufacturer.

**ATTENTION, USER!** Your furnace installer should give you the important documents listed above. You should immediately read the User's Information Manual for important safety information to keep you and your family safe. Keep these as long as you keep your furnace. Pass them on to future furnace purchasers or users. If any of the documents are missing or illegible, contact your installer or furnace manufacturer for replacement. Throughout this manual, when we use the word "you" we refer to the qualified service technician who is responsible for application, installation and service of your furnace.

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

?? **WHAT TO DO IF YOU SMELL GAS**

- Do not try to light any appliance.
- 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 gas supplier, call the fire department.



**WARNING:** Individuals who install this furnace, must have the training and experience necessary to install gas furnaces. They must also have training and experience necessary to install related comfort air conditioning appliances. Improper installation could create a hazard, resulting in the possibility of damage, injury or death.

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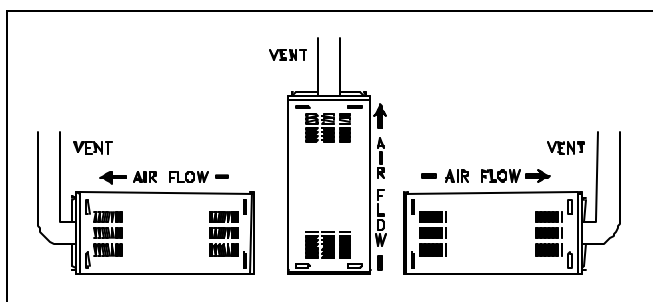


Figure 1. Upflow Configuration.

You may install this furnace in the upflow configuration in one of the three positions shown in Figure 1. This furnace is usually shipped from the factory in the upflow configuration.

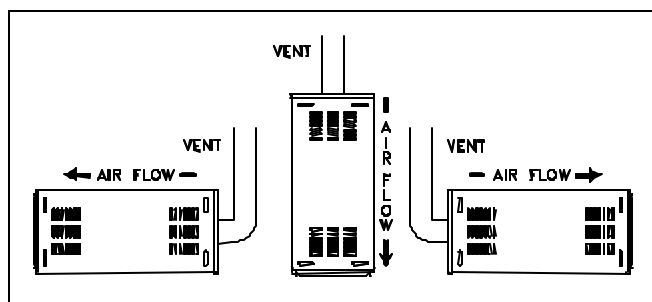


Figure 2. Downflow Configuration.

You may install this furnace in the downflow configuration in one of the three positions shown in Figure 2. Conversion from upflow to downflow can be done quickly and easily by following the instructions in Section 4, "Conversion to Downflow Configuration."

## SECTION 1. IMPORTANT SAFETY RULES

To alert you to potential hazards, we use the signal words "WARNING" and "CAUTION" throughout this manual. "WARNING" alerts you to situations that could cause or

result in serious injury or death. "CAUTION" alerts you to situations that could cause or result in minor or moderate injury or property damage. For a safe and reliable installation be sure to read and follow all warnings and cautions.

We also use the words "must" and "should" in this manual. "Must" is mandatory. "Should" is advisory.



**WARNING:** Read and follow the safety rules in this section and throughout this manual. Failure to do so could cause improper furnace operation, resulting in damage, injury or death.

**Rule 1.** Use only gas approved for use in this furnace, as indicated on the furnace rating plate. Use only natural gas in furnaces designed for natural gas. Use only propane (LP) gas in furnaces designed for propane (LP) gas. Make sure the furnace will operate properly on the gas type available to the user. Do not use butane gas in this furnace.



**WARNING:** Use of a non-approved gas in this furnace could cause sooting or overheating of heat exchanger.

**Rule 2.** Do not install this furnace outdoors or in a mobile home, trailer or recreational vehicle. It is not design certified for these installations. This furnace is suitable for a home built on site or a manufactured home completed at the final site.

**Rule 3.** Do not install the furnace in a corrosive or contaminated atmosphere. Make sure all combustion and ventilation air requirements are adhered to in addition to local codes and ordinances.

**Rule 4.** This furnace is not to be used for temporary heating of buildings or structures under construction.

**Rule 5.** Provide adequate combustion and ventilation air to space where the furnace is being installed. Connect this furnace to an approved vent system, venting combustion products outdoors.

**Rule 6.** Check for gas leaks anytime work is done on the gas supply line, the furnace gas control, the pilot and pilot line or the main burner manifold.

**Rule 7.** Never test for gas leaks with an open flame. Use a commercial soap solution made specifically for leak detection to check all connections.

**Rule 8.** Completely seal supply and return air ducts to furnace casing. Duct system must run to an area outside furnace room or closet. Seal duct work wherever it runs through walls, ceilings or floors of furnace room or closet.

## SECTION 2. MEETING CODES

This furnace complies with American National Standard and National Standard of Canada for Gas Fired Central Furnaces, ANSI Z21.47 / CAN/CGA-2.3. It is certified for operation with either natural gas or propane (LP) gas for indoor installation in a building constructed on site. It meets the requirement for a 100% shut-off gas control system.

Before installing this furnace, make sure you know all applicable codes. Be sure to consult local authorities having jurisdiction over furnaces for information on electrical wiring, gas piping and vent pipe. The installation of this furnace must conform with local building codes or in the absence of local codes, with the ANSI Z223.1, National Fuel Gas Code and/or CAN/CGA B149, Canadian Installation Codes.

Electrical wiring must conform with local building codes or in the absence of local codes, with the current National Electrical Code, ANSI/NFPA 70 and/or current Canadian Electrical Code, CSA C22.1.

## SECTION 3. DETERMINING BEST FURNACE LOCATION

You may install this furnace in an alcove, attic, basement, closet, garage or utility room as an upflow furnace or downflow furnace (conversion to downflow is detailed in Section 4 of this manual).

You may also install it in an alcove, attic, basement, garage or crawl space as a horizontal furnace.

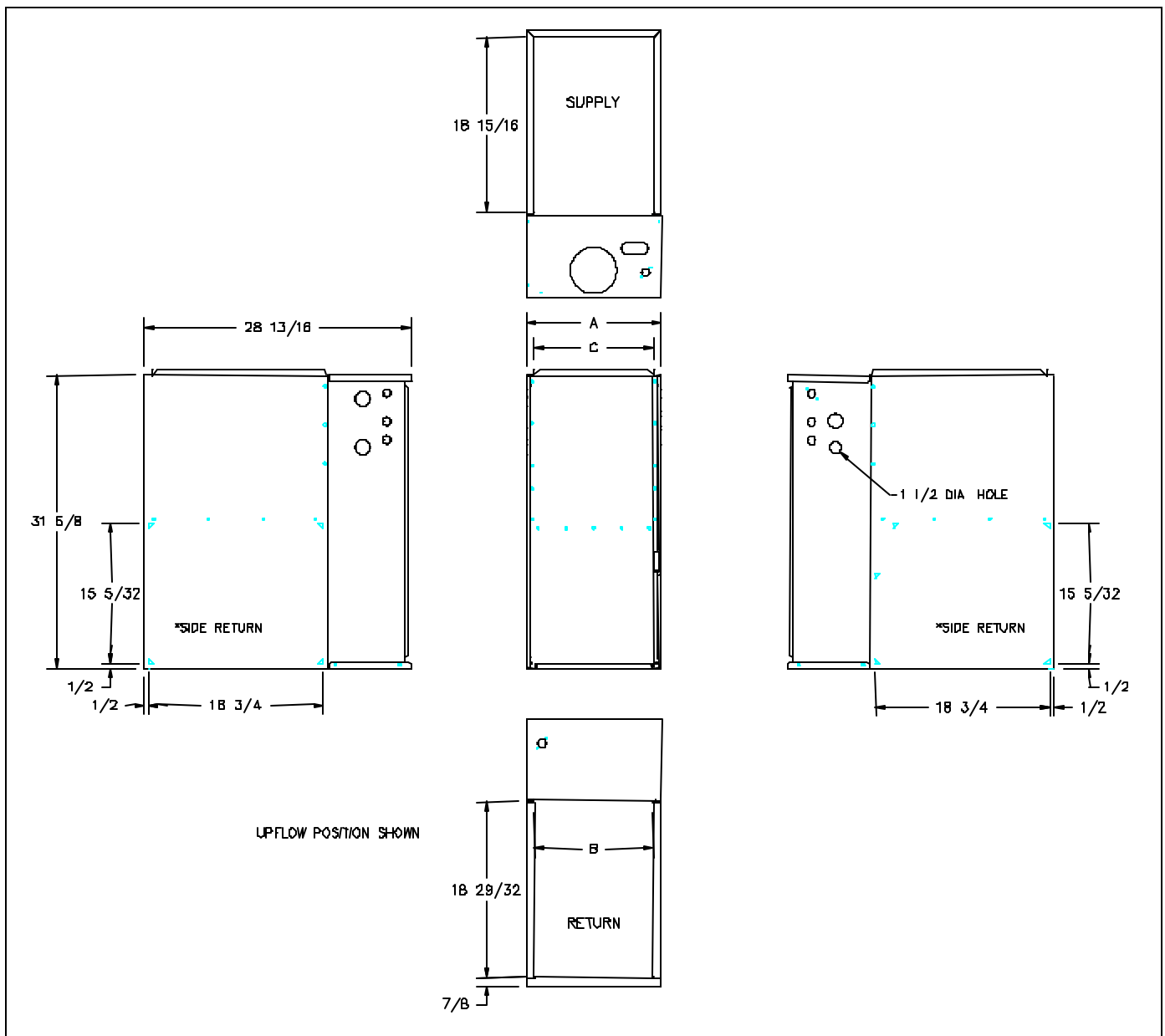


**WARNING:** Do not install furnace on its back or front. Doing so could cause a fire.

Select a location that meets all requirements described in this manual for:

- ?? Safety
- ?? Minimum Clearances
- ?? Combustion and Ventilation Air
- ?? Venting
- ?? Duct System
- ?? Gas Piping
- ?? Electrical Wiring

Locate the furnace as close to the chimney or vent and as near to the center of the air distribution system as possible.



Btu/Hr* INPUT	MOTOR* H.P.	VENT DIA	FURNACE WIDTH A	RETURN** AIR SIZE 18-29/32" x B	SUPPLY** AIR SIZE 18-15/16" X C	BLOWER WHEEL SIZE	TEMP RISE °F	CFM at 0.50" W.C.
40,000	1/4	3"	14-1/2	12-3/4"	12-15/16"	10-4	50-80	805
40,000	1/3	3"	14-1/2	12-3/4"	12-15/16"	10-6	30-60	1265
60,000	1/4	4"	14-1/2	12-3/4"	12-15/16"	10-4	45-75	850
60,000	1/3	4"	14-1/2	12-3/4"	12-15/16"	10-6	45-75	1260
60,000	1/2	4"	17-1/2	15-3/4"	15-15/16"	10-8	35-65	1635
80,000	1/4	4"	14-1/2	12-3/4"	12-15/16"	10-4	50-80	915
80,000	1/3	4"	14-1/2	12-3/4"	12-15/16"	10-6	40-70	1235
80,000	1/2	4"	17-1/2	15-3/4"	15-15/16"	10-8	50-80	1645
80,000	3/4	4"	20-1/2	18-3/4"	18-15/16"	(2) 10-4	40-70	1930
100,000	1/3	4"	17-1/2	15-3/4"	15-15/16"	10-6	55-85	1245
100,000	1/2	4"	17-1/2	15-3/4"	15-15/16"	10-8	50-80	1585
100,000	3/4	4"	20-1/2	18-3/4"	18-15/16"	(2) 10-4	40-70	1950
120,000	1/2	4"	20-1/2	18-3/4"	18-15/16"	10-8	45-75	1660
120,000	3/4	4"	20-1/2	18-3/4"	18-15/16"	(2) 10-4	45-75	1965
140,000	3/4	4"	23-1/2	21-3/4"	21-15/16"	(2) 10-4	45-75	1860
140,000	3/4	4"	23-1/2	21-3/4"	21-15/16"	(2) 10-6	50-80	2235

\*See Furnace Rating Plate located on blower door.

\*\*These are furnace dimensions. See Sections 12 and 13 for proper ductwork and floor opening dimensions.

Figure 3. Furnace Dimensions and Specifications.

Provide ample space for servicing and cleaning, and around air openings into the combustion chamber. Location must allow 30 inches minimum front clearance for service.

You may install furnace on non-combustible flooring or for upflow or horizontal installations on wood flooring. A combustible floor base, available from the manufacturer, is required for downflow furnace installation on wood flooring. See Section 5, "Allowing For Clearances."

Install the furnace so all electrical components are protected from water.

Install the furnace level.

When the furnace is in a repair garage or inside the heated space, exhaust fans can adversely affect its operation. Exhaust fans in kitchen, bathrooms, clothes dryers or anywhere within heated space increase combustion and ventilation air requirements. This is because exhaust fans reduce the amount of combustion and ventilation air available to the furnace. A fireplace also reduces amount of combustion and ventilation air.



**WARNING:** You must allow for these reductions or there could be inadequate combustion and ventilation air. This could cause nausea, asphyxiation, or fire.

Sufficient air must be provided to ensure there will not be a negative pressure in furnace room or space. In addition, there must be a positive seal between furnace and return air duct to avoid pulling air from burner area.

When a cooling unit is installed with this furnace, the furnace must be installed on the upstream side of the cooling unit to avoid condensation in the furnace heat exchanger.

When furnace is in a residential garage, it must be installed so that pilot and main burners are located no less than 18 inches above the floor. Also, furnace should be protected from physical damage by vehicles.

When furnace is in a public garage, airplane hanger, or other building having hazardous atmosphere, install unit in accordance with recommended good practice requirements of the National Fire Protection Association, Inc. Consult local code authorities for additional location requirements.

See Figure 3 for dimensions and specifications.

## SECTION 4. CONVERSION TO DOWNFLOW CONFIGURATION

Most furnaces are shipped from the factory in the upflow configuration with the vent collar extending out through the top plate at the supply end of the furnace. In this configuration, the furnace can be installed as an upflow furnace or as a horizontal furnace on its left or right side.

In the downflow configuration, the inducer assembly is repositioned - locating the vent collar inside the furnace vestibule near the manifold pipe. In this configuration the

furnace can be installed as a downflow furnace or as a horizontal furnace on its left or right side.

Before starting the conversion, lay the furnace on its back with the front door removed. Read the following instructions all the way through and study the components described. See Figure 4 for component identification and location.

**NOTE:** If possible, decide on direction of gas entry now, because the screws to change direction of the furnace gas-control-inlet elbow are accessible during this conversion. See Section 9, "Installing Gas Piping."

1. Remove the two junction box mounting screws and the four top plate mounting screws. Save all screws. Remove the top plate and front duct flange.
2. Disconnect three pressure switch wires and inducer motor.
3. Remove and save ten screws from the inducer pan. Do not drop screws into heat exchanger openings.
4. Lift inducer/pan assembly about 1/4 inch and tilt left side up to clear top casing flanges.
5. Rotate inducer/pan assembly 180 degrees as shown in Figure 5. Line up mounting holes and replace the ten screws in inducer pan.
6. Remove wire tie from around the excess length of red/yellow, blue and purple pressure switch wires.
7. Re-connect pressure switch wires as follows. (Wires are numbered on insulation near terminals).
  - a) Purple wire (#7) to pressure switch common (C) terminal.
  - b) Blue wire (#3) to pressure switch normally closed (NC) terminal.
  - c) Red/yellow wire (#12) to pressure switch normally open (NO) terminal.
  - d) Route pressure switch wires around inducer motor and away from hot flue box.
8. Re-connect inducer motor.
9. Replace wire tie in the same area such that wires do not touch hot flue box or inducer pan.
10. Remove and save the four screws that secure base panel to casing sides. Remove base panel.
11. Install top plate removed in step 1 in place of the base panel. Secure with four screws. Vent collar is now lined up with vent outlet hole in top plate.

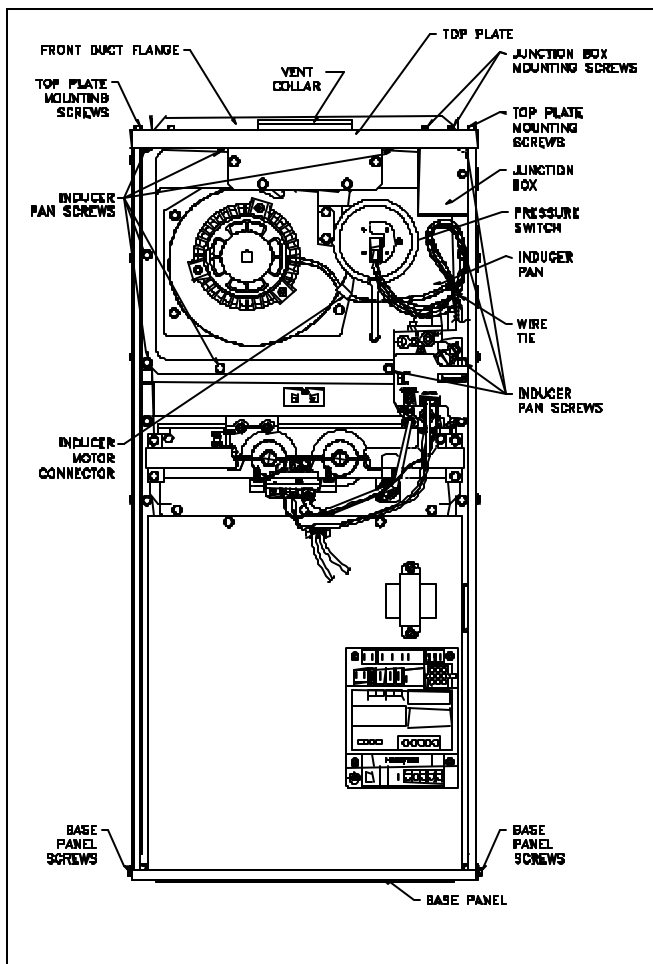


Figure 4. Upflow Configuration.

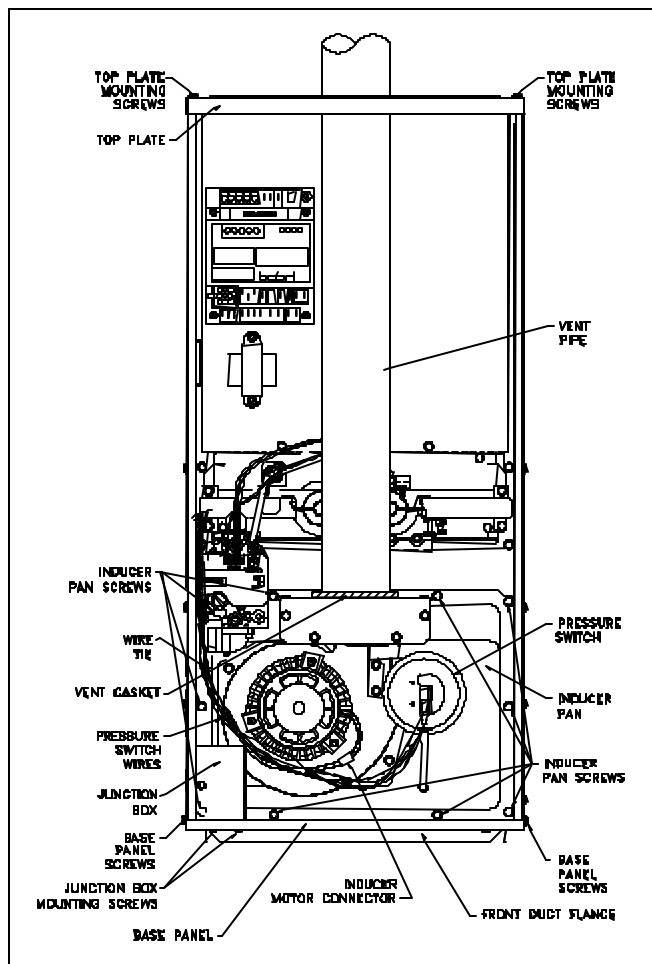


Figure 5. Downflow Configuration.

12. Line up front duct flange with holes in casing. Place base panel over front duct flange and secure both to casing with four screws.
13. Install junction box on base panel using two #6B blunt-point screws removed in step 1. Junction box cover and screw must face front of furnace.
14. Gasket around vent collar must be in place. If gasket is loose, glue it. If gasket is damaged, replace it.
15. Install a 30-inch or longer section of single wall vent pipe to the vent collar with three equally spaced screws. This pipe serves as a vent collar extension to which an appropriate vent system can be attached. Additional vent pipe sections or Type B adapter may then be added when installing the furnace.



**WARNING:** If vent collar extension is shorter than 30 inches and the vent becomes blocked, combustion products may be drawn into furnace causing the furnace to produce carbon monoxide. This could cause nausea or death by asphyxiation.

## SECTION 5. ALLOWING FOR CLEARANCES

Use tables 1 and 2 for minimum clearances to combustibles. Also, instructions for attic, crawl space and suspended furnaces are given.



**WARNING:** Furnace installation must meet all minimum clearances from combustible material specified in this manual and all applicable codes. Failure to do so could cause a fire.



**WARNING:** Do not install furnace in any of the following conditions:

- ? On carpeting, tile or other combustible material, except wood flooring
- ? In a closet in horizontal position
- ? In a downflow position, on wood flooring without a combustible floor base

Doing any of the above could cause a fire.

## UPFLOW AND DOWNFLOW CLEARANCES

Table 1. Upflow/Downflow - Minimum Clearance To Combustibles (Inches)

VENT MATERIAL	VENT CLEARANCE	TOP	SIDES	BACK	FRONT
SINGLE WALL	6	1	1*	0	6
TYPE B1	1	1	0	0	2

\* 14½-inch casings require 1-inch clearance due to single wall vent pipe requirements. All other casing sizes require no clearance.

?? Upflow position is approved for installation on wood flooring.

?? Downflow position is approved for installation on wood flooring when installed with Combustible Floor Base part number 4024400. Read installation instructions packaged with combustible floor base to correctly install. See Figures 6 and 7 for rough-in dimensions.

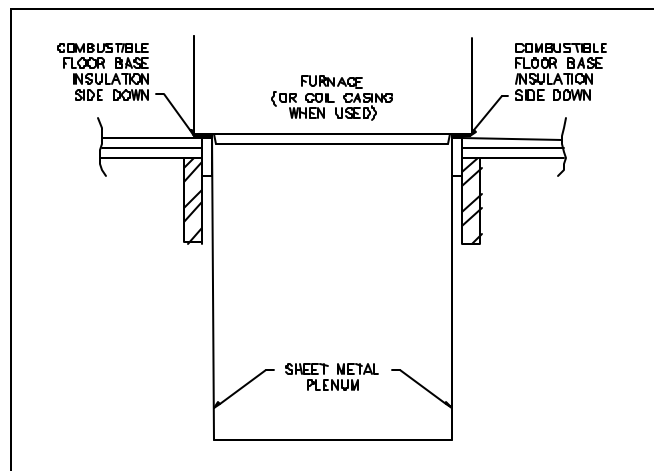


Figure 7. Furnace, Plenum and Base Installed On A Combustible Floor.

## HORIZONTAL CLEARANCES

Table 2. Horizontal - Minimum Clearance To Combustibles (Inches)

VENT MATERIAL	VENT CLEARANCE	TOP	SIDES	BACK	FRONT
SINGLE WALL	6	1	2*	0	18
TYPE B1	1	1	2*	0	18

\* Clearance shown is for air inlet plenum and air outlet plenum ends. Vent must maintain clearance listed above.

Horizontal position is approved for installation on wood flooring.

## ATTIC INSTALLATION

Line contact is permissible for furnaces installed in horizontal positions. The intersection of furnace top and sides forms a line as shown in Figure 8. This line may be in contact with combustible material.

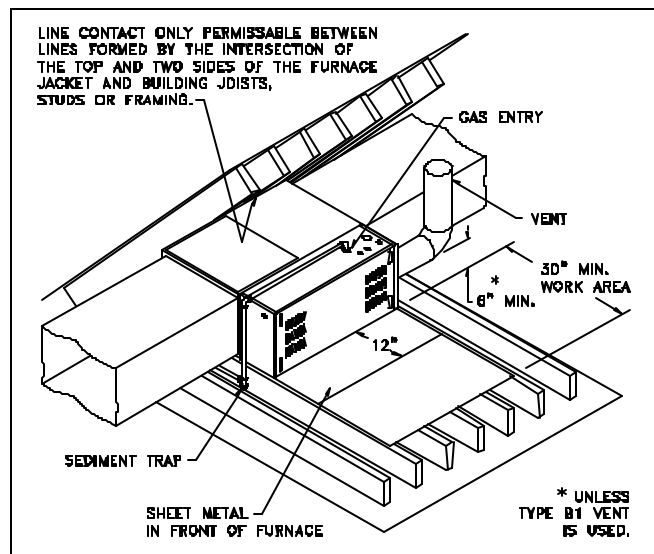


Figure 8. Typical Attic Installation.

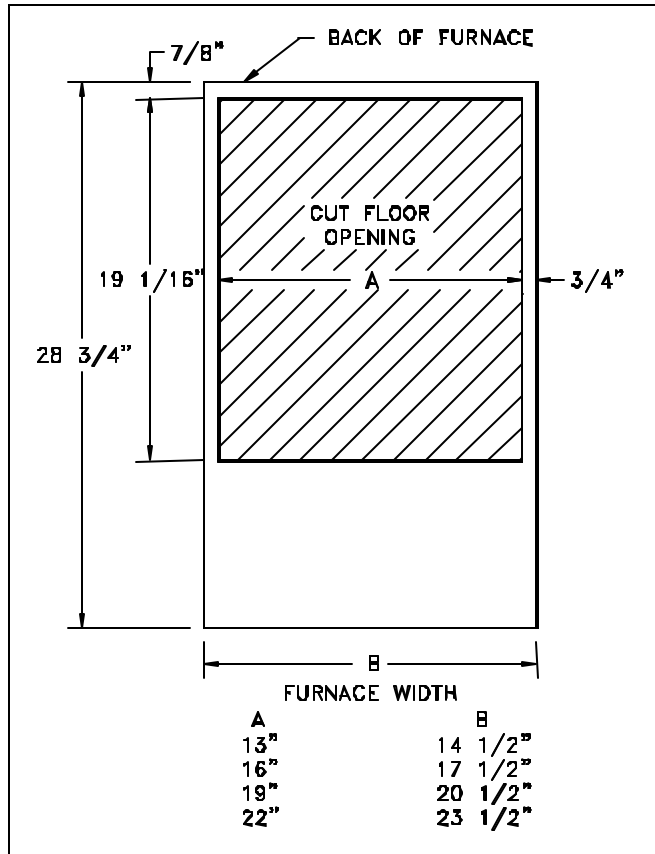



Figure 6. Downflow Floor Opening.

When using single wall vent pipe, horizontal furnaces with 14½-inch high casings must be raised 1 inch to provide 6-inch vent clearance to combustible material.

Install a platform under furnace that extends a minimum 30 inches in front of furnace. This provides a work area and keeps insulating materials away from combustion air openings. See Figure 8. Secure platform to joists.



**WARNING:** Some insulating materials are combustible. When a furnace is installed in an attic or other insulated space, keep all insulating materials at least 12 inches away from furnace and all burner combustion air openings. Failure to do so could cause fire.

### CRAWL SPACE INSTALLATION

Furnace can be hung from floor joists or installed on suitable blocks or pad. Pad or blocks must provide enough height to eliminate potential for water damage. Maintain clearances as described above.

### SUSPENDING FURNACE

Some installations require that the furnace be suspended from rafters or floor joists. A common way to do this using threaded rods is shown in Figure 9. Consider this means when people may walk underneath furnace. Figure 10 shows another common suspension means using pipe strap. Other means that provide adequate support may be used.

Level furnace from front to back and from left to right within 1/4 inch per four feet. Maintain clearances as described previously.

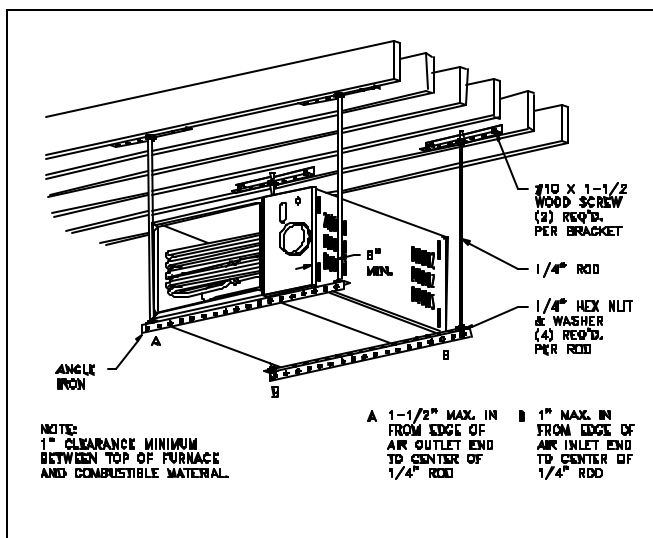


Figure 9. Suspending Using Threaded Rod.

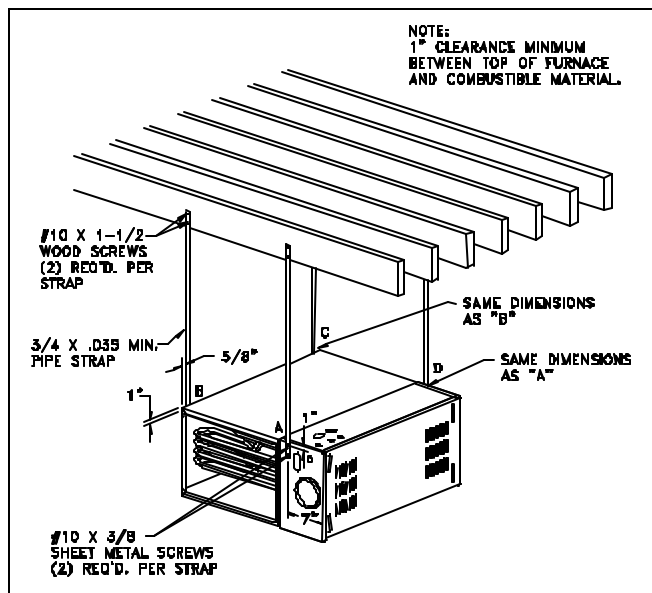



Figure 10. Suspended Using Pipe Strap.

## SECTION 6. PROVIDING COMBUSTION AND VENTILATION AIR

The total amount of combustion and ventilation air provided within the building must equal the requirements of all gas appliances in the building. You must also allow for reduction of air available for combustion and ventilation caused by exhaust fans, range hoods and fireplaces. Sufficient air must be provided to ensure there will not be a negative pressure in furnace room or space. In addition, there must be a positive seal between furnace and return air duct to avoid pulling air from burner area.

Provide for adequate combustion and ventilation air in accordance with Section 5.3, Air for Combustion and Ventilation, of the National Fuel Gas Code, ANSI Z223.1/NFPA 54, or Sections 7.2, 7.3 or 7.4 of CAN/CGA B149 Installation Codes, or applicable provisions of local building codes.



**WARNING:** Furnaces and any other fuel burning appliances must have enough fresh air for proper combustion. Lack of adequate combustion air could cause the furnace to produce carbon monoxide resulting in nausea or asphyxiation.

Excessive exposure to air contaminated with chlorine, fluorine, bromine and iodine may result in safety and performance related problems. The following types of installation may require outdoor air for combustion due to chemical exposures:

- ?? Commercial buildings, repair garages, beauty parlors, etc.
- ?? Buildings with indoor pools
- ?? Furnaces installed in laundry rooms
- ?? Furnaces installed in hobby or craft rooms
- ?? Furnaces installed near chemical storage rooms



?? Furnaces installed near exhaust fans that vent the above areas

Exposure to the following substances in the combustion air supply may also require outdoor air for combustion:

- ?? Aerosols
- ?? Permanent wave solutions
- ?? Chlorinated waxes, bleaches and cleaners
- ?? Cat litter
- ?? Chlorine-based swimming pool chemicals
- ?? Cleaning solvents
- ?? Paint removers and varnishes
- ?? Adhesives
- ?? Antistatic fabric softeners
- ?? Most refrigerants



**WARNING:** Combustion air that contains chlorine, fluorine, bromine or iodine could cause corrosion in heat exchanger or vent system, resulting in nausea or death by asphyxiation.

### UNCONFINED SPACE INSTALLATION

The National Fuel Gas Code, ANSI Z223.1/NFPA 54 and CAN/CGA B149 Installation Codes do not require that you make special provisions for combustion and ventilation when furnace is in an "unconfined space" and the building is not of "unusually tight construction."

?? "Unconfined spaces" have a volume of at least 50 cubic feet per 1000 Btu per hour combined input rating of all appliances installed in the space. For example: a 100,000 Btu/hr furnace and a 40,000 Btu/hr water heater would require a volume of at least  $140,000 \times 50 \div 1,000$  or 7,000 cubic feet.

?? "Unusually tight construction" means windows and doors are either tight fitting or are sealed construction and that walls are covered with a continuous, sealed vapor barrier and drywall or similar materials having sealed joints.

If you meet the volume requirements for unconfined space, the building is not of unusually tight construction and there are no airborne contaminants, as listed above, you may install this furnace without making special provisions for combustion and ventilation. Otherwise, follow the instructions for "confined space installation" below.

### CONFINED SPACE INSTALLATION

A furnace installed in a confined space may take combustion and ventilation air from an unconfined space within the building or from outdoors. However, if the building is of unusually tight construction all combustion air must come from outdoors. Also, if return air is taken directly from a hallway or space next to furnace that communicates with furnace spaces, all combustion air must come from outdoors.



**WARNING:** You must provide permanent air openings to a confined furnace installation space from another area as described below. Failure to do so could result in inadequate combustion and ventilation air.

### ALL COMBUSTION AND VENTILATION AIR FROM INSIDE THE BUILDING

The confined furnace space must be provided with two permanent openings to an additional room of sufficient volume so that the combined volume of the spaces meet the criteria above for an unconfined space not of unusually tight construction. The total input of all gas appliances within the combined space must be considered in making this determination.

Each opening must have minimum free area of one square inch per 1,000 Btu per hour of the total combined input rating of all gas appliances within the confined furnace space, but not less than 100 square inches. One opening must be within 12 inches of the top and one opening within 12 inches of the bottom of the furnace space. The shortest side of each air opening must be at least 3 inches long. See Figure 11.

For example:

?? A 100,000 Btu/hr furnace and a 40,000 Btu/hr water heater would require free area openings of  $140,000 \div 1,000$  or 140 square inches.

?? A 40,000 Btu/hr furnace and a 40,000 Btu/hr water heater would require free area openings of 100 square inches.

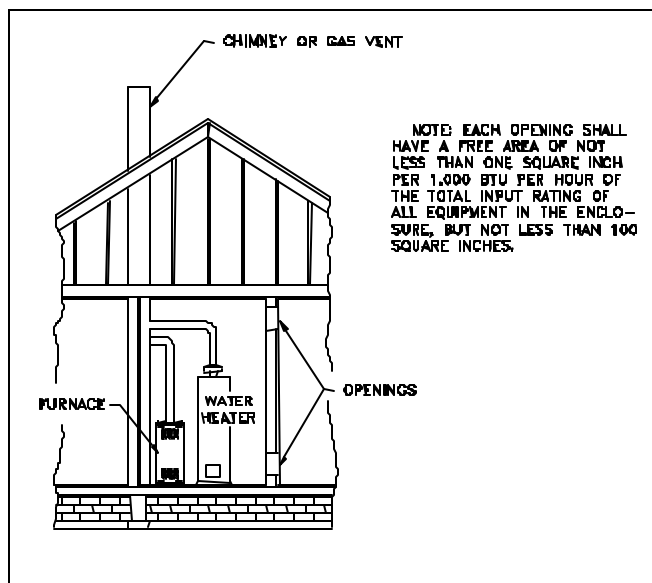


Figure 11. Confined Space, All Air From Inside The Building.

## ALL COMBUSTION AND VENTILATION AIR FROM OUTDOORS

The furnace space must be provided with two permanent air openings communicating directly, or by ducts, with the outdoors or spaces that freely access the outdoors. Well-ventilated attics or crawl spaces usually satisfy this requirement. These openings will give the furnace free access to fresh air for combustion and ventilation.

You must provide air sufficient for all gas appliances within furnace space. Locate one combustion and ventilation air opening within 12 inches of top of furnace space. Locate another within 12 inches of bottom of furnace space.

Ducts that supply air from outdoors must have the same cross-sectional area as the free area of openings to which they connect.

When directly communicating with the outdoors, each opening must have a minimum free area of one square inch per 4,000 Btu per hour of total combined input rating of all gas appliances within furnace space. For example: A 100,000 Btu per hour furnace requires two openings of at least  $100,000 \div 4,000$  or 25 square inches. See Figure 12 and Table 3.

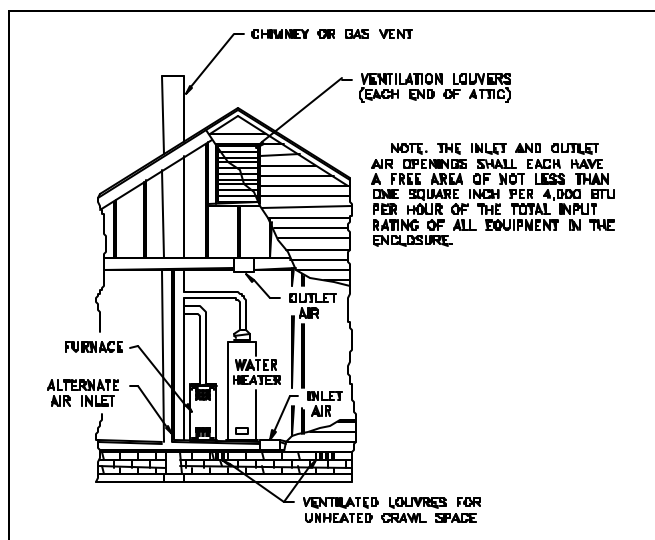


Figure 12. All Air Directly From Spaces That Freely Access The Outdoors.

Table 3. Free Opening Area Based On One Square Inch Per 4000 Btu/hr.

<b>Total input Btu/hr</b>	<b>Required Free Area Per Opening (square inches)</b>	<b>Minimum Round Pipe (inches dia.)</b>	<b>Maximum Btu/hr Input For Given Pipe Diameter</b>
40,000	10	4	50,000
60,000	15	5	78,000
80,000	20	6	113,000
100,000	25	6	113,000
120,000	30	7	153,000
140,000	35	7	153,000
160,000	40	8	201,000
180,000	45	8	201,000

When communicating with the outdoors through vertical ducts, such openings and ducts must have a minimum free

area of one square inch per 4,000 Btu per hour of total combined input rating of all gas appliances within furnace space. See Figure 13 and Table 3.

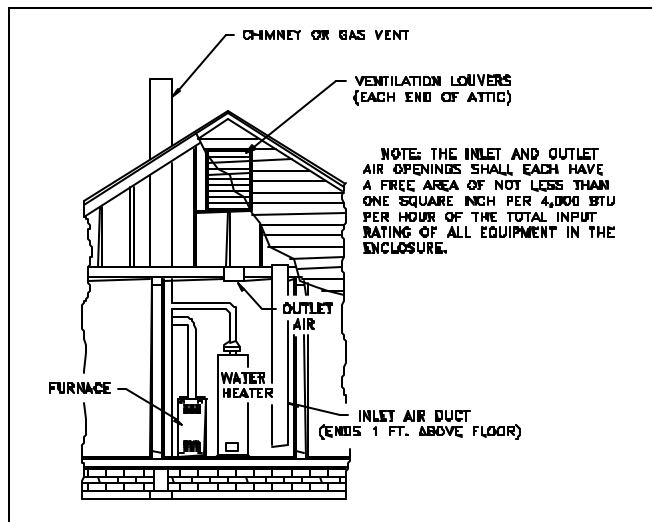


Figure 13. All Air Through Vertical Ducts From Spaces That Freely Access The Outdoors.

When communicating with the outdoors through horizontal ducts, such openings and ducts must have a minimum free area of one square inch per 2,000 Btu per hour of total combined input rating of all gas appliances within furnace space. See Figure 14 and Table 4.

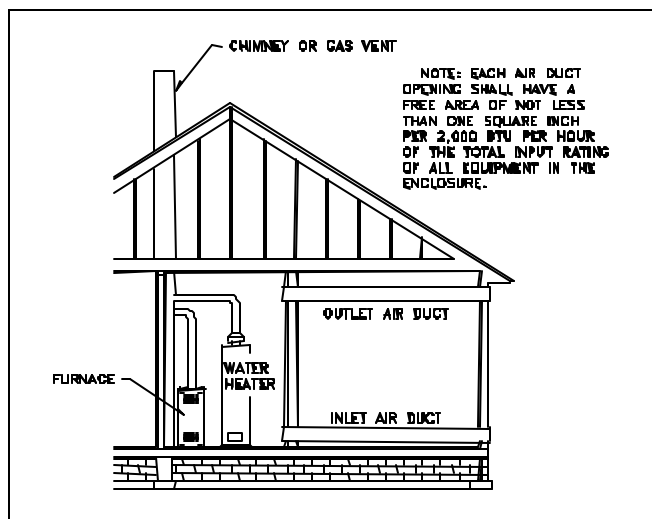


Figure 14. All Air From The Outdoors Through Horizontal Ducts.

Table 4. Free Opening Area Based On One Square Inch Per 2000 Btu/hr.

<b>Total input Btu/hr</b>	<b>Required Free Area Per Opening (square inches)</b>	<b>Minimum Round Pipe (inches dia.)</b>	<b>Maximum Btu/hr Input For Given Pipe Diameter</b>
40,000	20	6	56,000
60,000	30	7	76,000
80,000	40	8	100,000
100,000	50	8	100,000
120,000	60	9	127,000
140,000	70	10	157,000
160,000	80	11	190,000
180,000	90	11	190,000

Example: Furnace is 100,000 Btu per hour input and is to be installed in a confined space that contains no other gas appliances. Rectangular combustion and ventilation air ducts will run horizontally from outdoors to furnace space.

Calculate the free area required.

Because combustion and ventilation air ducts run horizontally, allow 2,000 Btu per hour.

$$\frac{\text{Furnace input (Btu/hr)}}{2,000 \text{ Btu/hr per square inch}} = \text{Free area required}$$

$$\frac{100,000}{2,000} = 50 \text{ square inches}$$

Both of the ducts must have a minimum cross sectional area of 50 square inches.

## LOUVERS, GRILLES AND SCREENS

If you are installing a louver, grille or screen over combustion and ventilation air openings, the free area of the louver or grille must be at least as big as the free area determined above. Louver, grille and screen manufacturers supply technical data that usually includes the "free area." If you do not know the free area, assume that wood louvers have 20 to 25% free area. Assume metal louvers and grilles have 60 to 75% free area.

You must fix combustion and ventilation air louvers and grilles in the open position or interlock them with furnace operation so that they open automatically. Do not use screen smaller than 1/4-inch mesh.

## SECTION 7. PROVIDING PROPER VENTING

This furnace must be connected to a venting system adequate to remove flue and vent gases to the outside atmosphere. It must be vented in accordance with Part 7, Venting of Equipment, of the National Fuel Gas Code ANSI Z223.1, or Section 7, Venting Systems and Air Supply for Appliances, of the CAN/CGA B149 Installation Codes. It must also be vented in accordance with local building codes and vent manufacturer's instructions.

The furnaces covered by this manual are design-certified as Category I appliances. Category I appliances must operate

at negative vent static pressure with a vent gas temperature high enough to avoid condensation in the vent. Category I appliances rely on the buoyancy of combustion products to vent and must be vented vertically or nearly vertically, unless equipped with an approved mechanical venter.

In most cases, proper venting is achieved by using a conventional vertical vent or chimney. However, it is not uncommon to have an installation where venting through a sidewall becomes necessary. For information on venting through a sidewall using a mechanical (power) venter, see Section 8, "Sidewall Venting". This furnace must not be vented with plastic pipe.

To supplement national and local codes, instructions for venting as Category I are contained in this manual and in an addendum, "Venting Tables For Category I Venting".

## DEFINITIONS

"Vent" and "Chimney" refer to open passageways that convey vent gases from the furnace, or its vent connector, to the outside. Vents and chimneys usually run vertically or nearly vertical. When they serve only one gas appliance, they are called "dedicated" vents or chimneys. When they serve multiple gas appliances, they are called "common" vents or chimneys.

"Vent Connector" refers to a pipe or duct that connects the furnace to a vent or chimney. Vent connectors usually run directly from the furnace's vent collar to the vent or chimney. Vent connectors may have vertical and horizontal runs.

"Venting System" refers to a continuous open passageway from the vent collar to the outside. Venting systems usually have a vent connector(s) and a vent or chimney. Venting systems commonly serve a single furnace or a single furnace and a water heater. Other multiple-appliance venting systems are less common.

"Fan-Assisted Combustion System" refers to an appliance equipped with an integral mechanical means to either draw or force products of combustion through the combustion chamber and/or heat exchanger. This furnace uses a draft inducer to draw combustion products through the heat exchanger and is considered to have a fan-assisted combustion system. Category I furnaces with fan-assisted combustion systems must not be vented into single wall metal vents.

## GENERAL DESIGN CONSIDERATIONS

These instructions are for venting this furnace as a Category I appliance. Venting system components discussed in these instructions are not appropriate for Category III or IV appliances that have positive pressure venting systems.



**WARNING:** Do not connect this furnace to a vent system used by other Category III or IV appliances. Do not connect it to vents with mechanical draft systems operating at positive pressure. Improper venting could allow combustion products to collect in building during use, resulting in fire, nausea or asphyxiation.

You must connect furnace to a listed chimney or vent complying with a recognized standard or a suitably sized, constructed and lined masonry chimney. Chimney lining method and material must comply with local requirements. Use corrosion-resistant material meeting nationally recognized standards for vent construction.

This furnace must not vent into an unlined-masonry chimney or an unlined-concrete chimney and must not single appliance vent into a tile-lined chimney. However, this furnace may be common vented into a tile-lined masonry chimney provided (1) the chimney is currently serving at least one drafthood equipped appliance and (2) the vent connectors and chimney are sized in accordance with the appropriate vent table.



**WARNING:** Select appropriate venting materials and clearances. Inadequate vent or chimney could allow combustion products to collect in building, resulting in fire, nausea or asphyxiation.



**WARNING:** Do not use unlined masonry chimneys. These increase risk of condensate formation, which may cause chimney to deteriorate, allowing combustion products and condensate to collect in building.

Multistory and common venting with other Category I appliances is permitted. The venting system must be in accordance with the National Fuel Gas Code ANSI Z223.1/NFPA 54 and/or current CAN/CGA B149 Installation Codes, local codes and approved engineering practices.

Vent this furnace separately from any appliance designed to burn solid fuel, such as wood or coal. If a fireplace chimney flue is used to vent this appliance, the fireplace opening must be permanently sealed.

Avoid over-sizing furnace for your application. Select a furnace model with a rated heating output close to the calculated heating load. This extends the firing period, decreasing the potential for condensate formation in the vent.

The designer must consider the building's orientation, answering two questions: Will the vent terminate outside the building where its operation could be adversely affected by winds? Could any adjacent buildings adversely affect vent operation? Allowing for these factors can reduce the possibility of down draft conditions.

If your local experience indicates possible condensation problems, provide for draining and disposal of venting system condensate.

## VENT SIZING AND INSTALLATION

Proper vent size can be determined from these instructions and "Venting Tables For Category I Venting" included as an addendum to these instructions, the National Fuel Gas Code ANSI Z223.1/NFPA 54 and/or current CAN/CGA B149 Installation Codes. Venting tables include instructions for single appliance venting and multiple appliance (common) venting.

Refer to venting tables for correct size vent. An undersized vent cannot adequately carry all combustion products outdoors. An oversized vent will not heat up rapidly enough to avoid condensation.

Vents and chimneys usually extend vertically with offsets not exceeding 45 degrees from vertical. Consider vent pipe runs more than 45 degrees from vertical as horizontal runs. Include their length in the total horizontal run.

Vent height must be a minimum of five feet for Category I vent systems. Minimize vent connector horizontal runs to the extent possible for best performance. Horizontal portions of the venting system must be supported at each joint using hinges, straps or equivalent to prevent sagging. Slope horizontal portions upward from furnace at least 1/4 inch per foot.

Sometimes the horizontal distance from the furnace to the vent or chimney is already given. This is known as the horizontal vent connector run. The vent or chimney height is also usually given as is the Btu per hour input of the gas appliances served by the vent. Check these parameters to be sure the venting system will work. Use venting addendum, these instructions, part 7 of current National Fuel Gas Code ANSI Z223.1/NFPA 54 and/or CAN/CGA B149 Installation Codes. Use vent capacity tables in venting addendum to check existing or new vent sizes for Category I furnaces.

Install vent materials following their listing terms, manufacturer's instructions, these instructions and local codes.

A gas vent passing through a roof must extend through roof flashing, jack or thimble. It must terminate above roof surface.

Designer and installer must provide an appropriately sized common vent for all appliances connected to it. See venting addendum for single appliance venting and multiple appliance (common) venting. For multistory installations, refer to current National Fuel Gas Code ANSI Z223.1/NFPA 54 and/or CAN/CGA B149 Installation Codes.

## VENT CONNECTORS

Vent connectors must be made of listed single-wall or Type B double-wall components. They must be thick enough to withstand physical damage and be readily accessible for inspection, cleaning and replacement.

Use Type B vent connectors in or through attics, crawl spaces, or other cold areas. Install thimbles that meet local codes when vent connectors pass through walls or partitions of combustible material.

Keep vent connectors as short as possible by locating furnace as close as practical to vent or chimney. Avoid unnecessary turns or bends that create resistance to flow of vent gases. Adding an elbow adds resistance.

You may increase vent connector diameter to overcome installation limitations and obtain connector capacity equal to furnace input. Make this increase as close as possible to furnace vent collar, allowing for necessary adapters and fittings. Do not increase vent size more than two sizes

larger than vent collar. Minimum vent connector diameter from furnace to vent or chimney is same as vent collar.

If you join two or more vent connectors before they enter the vertical vent or chimney, use caution. See venting addendum for details on properly sizing vent connectors.

Do not connect vent connector to a chimney flue serving a fireplace unless you permanently seal fireplace flue opening.

Attach vent connector to furnace vent collar. Make sure vent gasket is in place on vent collar and providing a seal. Use minimum of three equally spaced sheet metal screws around connection. Connect all other vent pipes using three equally spaced screws at each joint. The only exception is when you use Type B vent pipe with self-locking connections.



**WARNING:** Unsecured vent pipe connections may loosen. This can allow combustion products to collect in building.

### LINED CHIMNEYS

Furnace is suitable for venting into a properly sized and lined masonry chimney. Consult National Fuel Gas Code ANSI Z223.1/NFPA 54 and/or CAN/CGA B149 Installation Codes for construction details. Consider using chimney as a pathway for suitably sized Type B vent liner. Seal all connections where vent connectors enter chimney. See Figure 15.

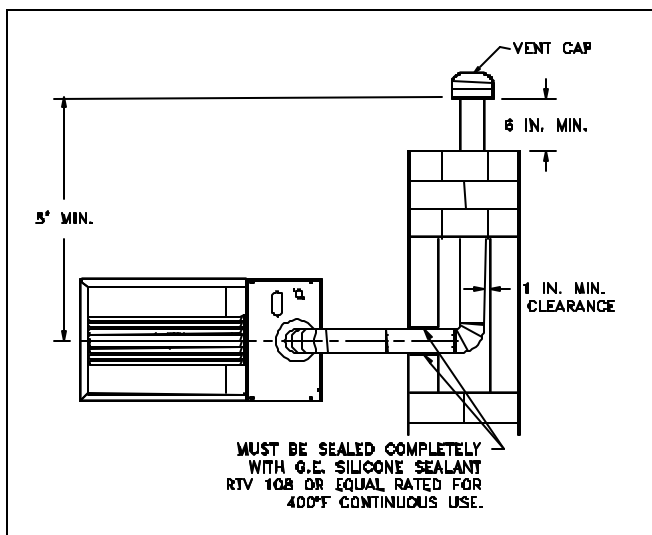


Figure 15. Type B Vent Liner.



**WARNING:** Provide support when using a Type B vent liner in masonry chimney. Maintain at least a 1 inch clearance on all sides to reduce possibility of condensate in vent. Condensate may cause vent to deteriorate allowing combustion products to collect in building, which could result in injury or death. See Figure 16.

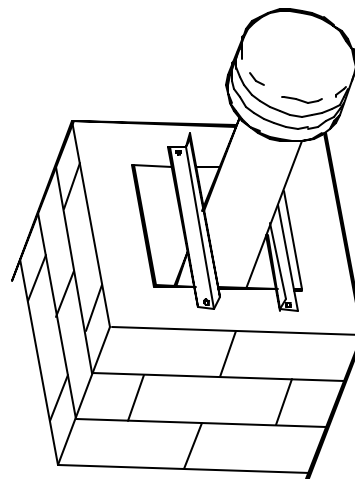


Figure 16. Supporting Type B Vent Liner.

### VENT TERMINATION

Terminate all vertical vents with a listed vent cap or roof assembly unless local codes require otherwise. See vent cap or roof-assembly manufacturer's instructions. Locate vent termination (vent cap or roof assembly) in an area without positive wind pressures or eddy currents. Eddy currents occur when air swirls over roof peaks. They can cause downdrafts and adversely affect vent operation. See Figure 17.

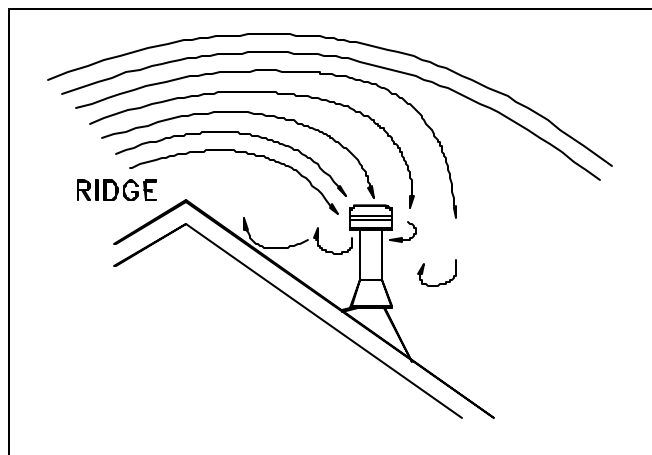


Figure 17. Eddy Currents Around Termination Cap.

Some vent termination or caps protect against eddy currents and downdrafts. Consult their manufacturer's instructions. Vent terminations or caps should usually be at least the same size as the vent. They may be larger if the installation warrants.

Vent systems must end at least five feet above the highest gas appliance connection. Vent pipe must extend at least three feet above the point where it passes through the roof. Vent termination must be at least two feet higher than any portion of building within a horizontal distance of ten feet. See Figures 18 and 19. Some vent cap manufacturers offer vent caps that allow reduced clearances. Consult their instructions.



**WARNING:** Failure to properly terminate vent or chimney systems could allow combustion products to collect in building.

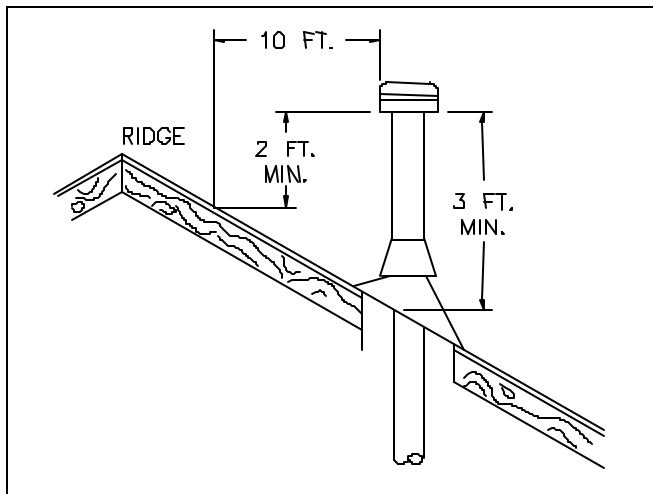


Figure 18. Termination More Than Ten Feet From Ridge.

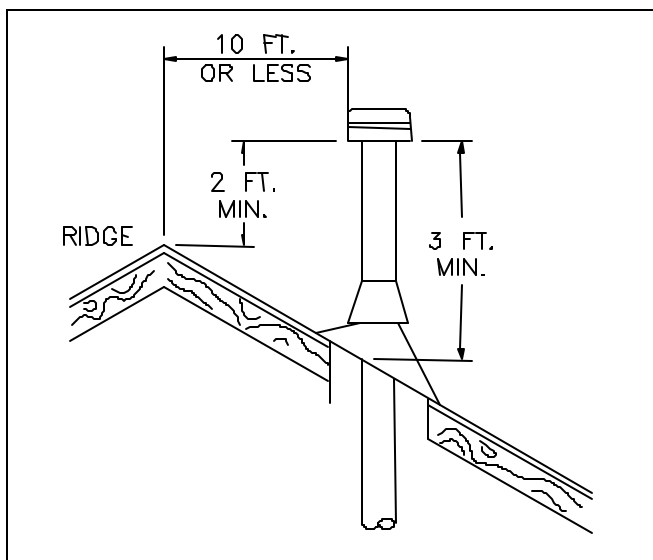


Figure 19. Termination Less Than Ten Feet From Ridge.

### EXISTING VENT CONSIDERATIONS

Masonry chimneys must be lined with suitable liner. See "Lined Chimneys".

Make sure existing vent or chimney is proper size and construction for appliances that will use it. The best way to do this is to size as if it were a new installation. Compare the existing vent to your calculations and make the necessary corrections.

Examine vent or chimney clean-outs to make sure they remain tightly closed when not in use. Make sure vent or chimney passageway is clear and free of obstructions. Look for evidence of condensate or deterioration in vent or chimney. Either of these means an inadequate vent.

If you find an inadequate vent or chimney, do not leave it as is. Repair or replace it. A new vent must meet these instructions and the National Fuel Gas Code ANSI Z223.1/NFPA 54 and/or CAN/CGA B149 Installation Codes.



**WARNING:** An inadequate vent or chimney could allow combustion products to collect in building.

When an existing furnace is removed or replaced, the venting system may no longer be properly sized to vent the attached appliances. An improperly sized venting system may promote the formation of condensate, leakage or spillage.

The following steps shall be followed with each appliance connected to the venting system placed in operation, while any 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 CAN/CGA B149 Installation Codes and these instructions. Determine that there is no blockage or restriction, leakage, corrosion and other deficiencies that could cause an unsafe condition;
3. In so far as is practical, close all building doors and windows and all doors between space in which appliance(s) connected to the venting system are located and other spaces of 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 shall operate at maximum speed. Do not operate a summer exhaust fan.
6. Follow the lighting instructions. Place the appliance being inspected in operation. Adjust thermostat so appliance shall operate continuously;
7. Test for drafthood equipped appliance spillage at the drafthood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle;
8. 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-burning appliance to their previous conditions of use;
9. If improper venting is observed during any of the above tests, the venting system must be corrected. Follow the National Fuel Gas Code, ANSI Z223.1/NFPA 54 and/or CAN/CGA B149 Installation Codes and the venting tables provided with the furnace to correct improper vent operation. Any "common vent" re-sizing must approach minimum size determined using the venting tables.



## SECTION 8. SIDEWALL VENTING

In most cases, proper venting is achieved by using a conventional vertical vent or chimney. However, it is not uncommon to have an installation where venting through a sidewall becomes necessary. This section contains information on venting through a sidewall using a mechanical (power) venter. A mechanical (power) venting system operates at negative pressure to draw the furnace flue products from the structure.

This furnace must not be vented with high temperature plastic pipe.

### IN THE UNITED STATES

Any mechanical (power) venting system is acceptable as long as it has been certified by a nationally recognized testing agency and meets all state and local codes. The venter must be installed according to the mechanical (power) venter manufacturer's installation instructions. It must be sized appropriately for the furnace and be capable of maintaining a negative vent pressure of -0.1 to -0.5 inches W.C. in the vent pipe leaving the furnace under all operating conditions. Because this system operates at negative pressure, any single wall or Type B vent pipe may be used; however, Type B-1 pipe is recommended.

In addition to the venter manufacturer's instructions, the furnace manufacturer requires use of a secondary safety switch that will act to turn off the furnace in the event that the vent pressure becomes positive. These devices are available through the mechanical (power) venter manufacturer.

### IN CANADA

The mechanical (power) venter must be CGA certified for each furnace model. At this time, there is one system approved for use on this furnace in Canada. The system is manufactured by The Field Controls Company and includes:

- ?? Power Venter model SWG-4HD
- ?? Secondary Safety Switch model WMO-1
- ?? Control Kit model CK-43 or
- ?? Control Kit model CK-91 (for common venting with a water heater)

The SWG-4HD is certified with this furnace for up to forty feet and four elbows of type B-1 vent pipe. The venter must be installed according to the mechanical (power) venter manufacturer's installation instructions. Adjust the power venter to provide a negative pressure of -0.1 to -0.5 inches W.C. in the vent pipe leaving the furnace.

## SECTION 9. INSTALLING GAS PIPING

### PREPARATION

Refer to the current National Fuel Gas Code ANSI Z223.1/NFPA 54 and/or CAN/CGA B149 Installation Codes and local codes for gas piping requirements and sizing. Pipe size running to furnace depends on:

- ?? Length of pipe
- ?? Number of fittings
- ?? Specific gravity of gas
- ?? Input requirements (Btu per hour) of all gas-fired appliances attached to same main supply line.

Plan furnace gas supply piping so it will not interfere with removal of burner assembly, front door or blower door for servicing.

Make sure gas piping is large enough for all appliances connected to it to operate at once without lowering gas supply pressure. Failure to do so could cause lighting or burning problems on any of the appliances.

Always use a pipe thread compound that is resistant to propane (LP) gas solvent action. Sparingly apply thread compound to all joints on male threads only, starting two threads from the end.

### GAS ENTRY LOCATION

Choose the best gas line entry location for your installation. This furnace has six possible gas entry locations.

- ?? As shipped, 1/2" NPT pipe can be attached to the furnace gas control through the 1 1/2-inch hole in the right side of the casing.
- ?? For gas line entry through the knockout in the left side of the casing, reverse the furnace gas control inlet elbow, as shown in Figure 20. 1/2" NPT pipe can now be attached to the furnace gas control from the left side. See instructions below for changing furnace gas control inlet elbow.
- ?? For gas line entry through the knockout in the top plate, remove the furnace gas control inlet elbow, shown in Figure 20. 1/2" NPT pipe can now be attached directly to the furnace gas control.
- ?? For gas line entry through either of the upper knockouts located in the right and left sides of the casing, remove the furnace gas control inlet elbow, shown in Figure 20. 1/2" NPT pipe can now be attached directly to the furnace gas control. See instructions below for changing furnace gas control inlet elbow.

Some large electronic air cleaners will interfere with incoming gas line. Install air cleaner on opposite furnace side from gas entry or route gas pipe over top of air cleaner through one of alternate knockouts.

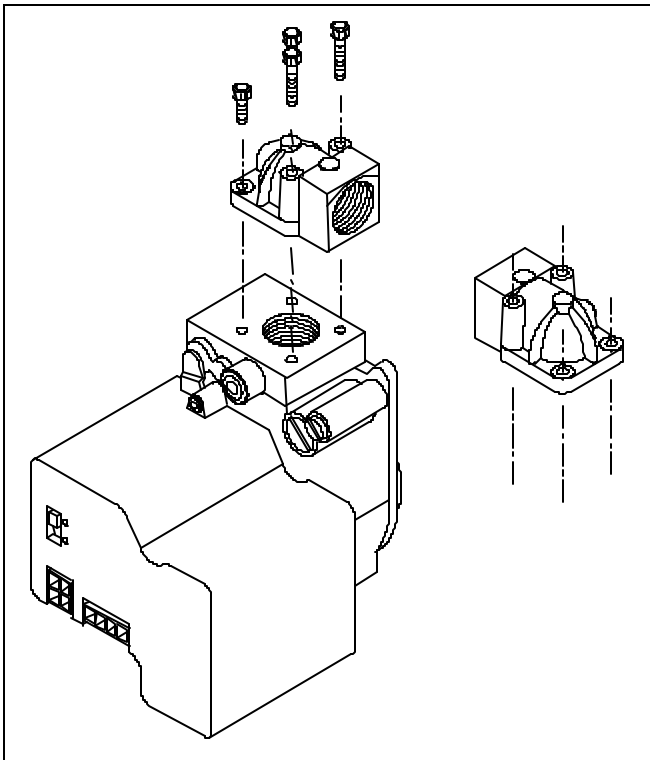


Figure 20. Changing direction of gas-control-inlet elbow.

#### CHANGING FURNACE GAS CONTROL INLET ELBOW

1. To remove or to change direction of the furnace gas control inlet elbow, use a 9/64" allen wrench to remove the four screws.
2. Check that O-ring is in bottom of gas inlet elbow.
3. Rotate elbow to desired position.
4. Alternately tighten four screws to 25 inch pounds to form a gas tight seal.

Use a commercial soap solution made to detect leaks and check all gas piping connections. Bubbles indicate gas leakage. Seal all leaks before proceeding.

#### INSTALLATION

1. Install gas pipe to inlet side of furnace gas control. If no inlet elbow is used, use a backup wrench on the square ends of the gas control. If the inlet elbow is used, place backup wrench on the square ends of the inlet elbow rather than on gas control.



**WARNING:** Do not thread gas pipe too far. Doing so may cause a gas leak or malfunction of furnace gas control resulting in a fire or explosion.

2. When using black iron gas pipe, install a ground joint union immediately upstream of the furnace to allow for easy servicing of burner assembly and furnace gas control. Ground joint union must be listed by a nationally recognized testing laboratory.
3. After ground joint union install a drip leg (sediment trap). A convenient way to make a drip leg is by using

a 1/2" NPT to 1" NPT tee. Then install a 1-1/2 inch long, 1" NPT nipple in tee with a 1" NPT pipe cap to complete drip leg.

4. Install an equipment shut-off valve in the gas supply line immediately upstream of the drip leg tee. Equipment shut-off valve must be listed by a nationally recognized testing laboratory.
5. Install a 1/8-inch NPT plugged tapping in the gas supply line immediately upstream of the equipment shut-off valve. The 1/8-inch NPT plugged tapping must be accessible for test gauge connection.

#### TESTING FOR LEAKS

Isolate furnace and its gas control from gas supply line during leak checks. Gas supply line test pressure determines how you isolate gas control.

The furnace and its gas control must be disconnected from the gas supply piping system at the ground joint union during any pressure testing of the system at test pressures greater than 1/2 psi (14 inches W.C.).

The furnace must be isolated from the gas supply piping system by turning off the equipment shut-off valve during any pressure testing of the system at test pressures equal to or less than 1/2 psi (14 inches W.C.).



**WARNING:** When test pressure is above 1/2 psi (14 inches W.C.), completely disconnect furnace and gas control from gas supply line. Failure to isolate furnace and gas control from test pressure could damage them, causing gas to leak, resulting in fire or explosion.

Use a commercial soap solution made to detect leaks and check all gas piping connections. Bubbles indicate gas leakage. Seal all leaks before proceeding.

## SECTION 10. INSTALLING ELECTRICAL WIRING

**CAUTION:** Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation. When replacing original wire, use same type, color, or equivalent wire. Remember to renumber wire ends. Verify proper operation after servicing.

#### 115 VOLT WIRING

Wire furnace according to the Field Wiring Diagram shown in Figure 21, local codes and current National Electrical Code ANSI/NFPA 70 or Canadian Electrical Code CSA C22.1. Also, see Furnace Wiring Diagram in Figure 22.

Install proper electrical grounding by attaching grounding source to green wire in furnace junction box. Follow local codes or in the absence of local codes, the current National Electrical Code ANSI/NFPA 70 and/or Canadian Electrical Code CSA C22.1.





**WARNING:** Failure to provide a proper electrical ground could result in electric shock or fire.

Provide furnace with its own separate electrical circuit and means of circuit protection. Furnace must have an electrical disconnect switch located at the furnace.



**WARNING:** Failure to provide the above shut-off means could result in electrical shock or fire.

Use electrical wiring that meets current National Electrical Code ANSI/NFPA 70 and/or Canadian Electrical Code CSA C22.1 and local codes. Use Type T (63 degrees C rise) wire or equivalent.

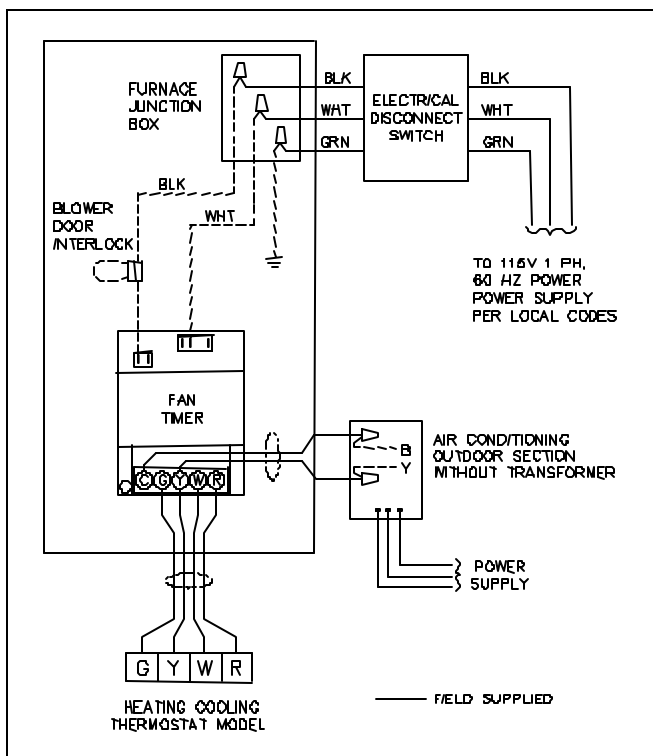


Figure 21. Field Wiring Diagram.

## 24-VOLT WIRING

Select a location for the room thermostat on a draft-free interior wall that is away from supply and return air registers, lights, television, direct sunlight, or other heat sources.

Install thermostat following field wiring diagram in Figure 21 and thermostat manufacturer's instructions. Thermostat wire should be 18 AWG wire for best results. NOTE: For proper cooling operation, "Y" wire must be connected to the Fan Timer. "Y" wire controls cooling speed blower operation.

Set the thermostat's heat anticipator following instructions provided with the thermostat. This furnace will have heat anticipator current of approximately 0.4 amps.

**CAUTION:** Unapproved 24 VAC accessories that draw power from the furnace's transformer should not be installed on this furnace. Addition of such accessories may cause improper furnace operation and limit transformer life.

## SECTION 11. SEQUENCE OF OPERATION

### HEATING MODE

1. Thermostat calls for heat ("R" and "W" terminals connected). Fan Timer verifies that burner limits, primary-limit and pressure switch are in normally closed (NC) position.
2. Draft inducer relay is energized. Draft inducer motor starts and pressure-switch normally open contacts close, energizing the gas control.
3. Gas control provides power to igniter and pilot valve to light pilot. After proving pilot flame, the main valve opens and igniter turns off.

**NOTE:** If the gas control does not sense a pilot flame within 30 seconds, it will turn off the igniter while continuing to purge the gas line. After 30 seconds, the igniter will turn on again. If a pilot is not sensed in the next 30 seconds, the gas control will turn off for 5 minutes. This sequence will continue as long as there is a call for heat.

4. Fan Timer energizes main blower in 30 seconds.
5. After thermostat is satisfied, gas control is de-energized. After a 5 second post-purge, draft inducer de-energizes and returns pressure switch to normally closed (NC) position.
6. Main blower remains energized for 60 to 180 seconds depending on heating blower off-delay setting.

**NOTE:** This furnace will lock-out if the main blower fails in heating mode. During lock-out the Fan Timer's diagnostic light signal will be 4 flashes. The furnace's Fan Timer can be reset by cycling 115-volt power to the furnace.

**NOTE:** On each heating cycle, this furnace verifies that the pressure switch did not stick closed on the previous cycle. This condition is detected by checking the pressure switch's normally closed circuit. If the normally closed circuit is open, the furnace will not operate and the Fan Timer's diagnostic light signal will be 3 flashes.

### COOLING MODE

Thermostat calls for cooling ("R", "Y" and "G" terminals connected). Condensing unit contactor closes, energizing condensing unit. Fan Timer energizes main blower on cooling speed after a short delay. After thermostat is satisfied, condensing unit contactor is de-energized. Main blower remains energized for 60 seconds.

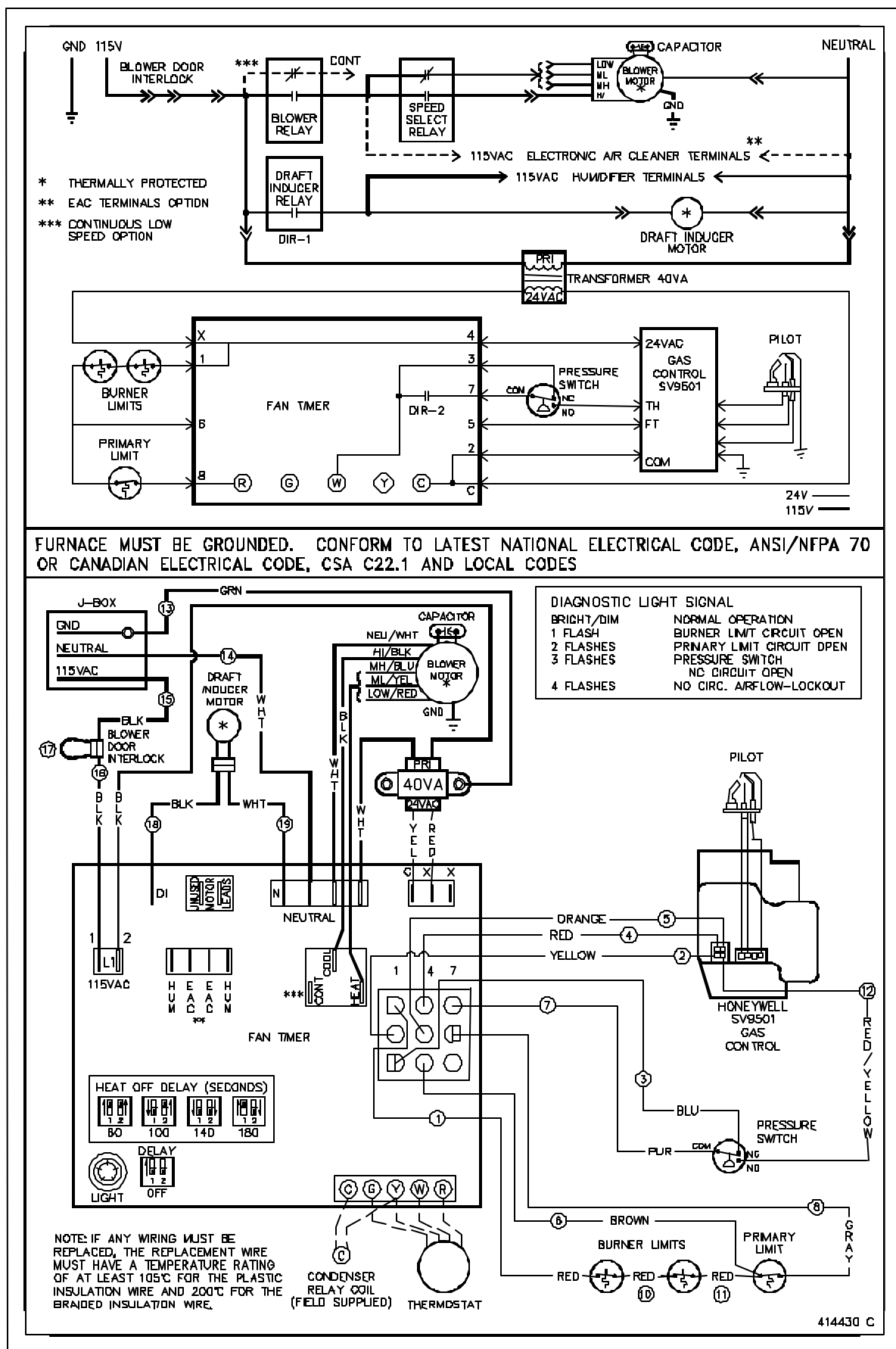


Figure 22. Furnace Wiring Diagram.

## CONSTANT FAN MODE

Thermostat calls for constant fan ("R" and "G" terminals connected). Fan Timer energizes main blower on heating speed.

A call for cooling mode while in constant fan mode causes the main blower to change from heating to cooling speed. 60 seconds after the call for cooling mode ends, the main blower changes back to heating speed. A call for heating mode while in constant fan mode does not effect main blower operation. The main blower runs constantly on heating speed.

## CONTINUOUS LOW-SPEED FAN OPTION

Some models are equipped with a fan timer that allows continuous low-speed fan as an option. When available, this option can be used to operate the blower on low speed anytime the blower is not otherwise running on heating or cooling speed. These models do not have electronic air cleaner terminals on the fan timer.

To use this option, follow these steps:

1. Disconnect electrical power
2. Remove insulator cap from "CONT" terminal on Fan Timer.
3. Plug blower low-speed wire (red wire) into "CONT" terminal.
4. Place insulator cap on "UNUSED MOTOR LEAD" terminal on Fan Timer.
5. Reconnect power. Motor will start on low speed immediately.

## ELECTRONIC AIR CLEANER OPTION

For models with Electronic Air-Cleaner (EAC) terminals, the Fan Timer "EAC" terminals are energized with 115 VAC when the main blower is energized. "EAC" terminals are 1/4 inch quick connect tabs located under breakaway covers. Use insulated quick connects when connecting to "EAC" terminals. Limit total "EAC" current plus main blower current to 15 amps max.

## HUMIDIFIER

Fan Timer "HUM" terminals are energized with 115 VAC (1 amp. max.) when the draft inducer is energized. "HUM" terminals are 1/4 inch quick connect tabs located under breakaway covers. Use insulated quick connects when connecting to "HUM" terminals.

## BURNER LIMIT CIRCUIT OPEN

If the burner limit circuit opens: burners turn off, draft inducer stays on, main blower stays on, there is no 24-volt power on the "R" terminal and diagnostic light signal is 1 flash.

## PRIMARY LIMIT CIRCUIT OPEN

If the primary limit circuit opens: burners turn off, draft inducer turns off, main blower stays on, there is no 24-volt power on the "R" terminal and the diagnostic light signal is 2 flashes.

# SECTION 12. INSTALLING DUCT SYSTEM

Properly size duct system based on heat loss and heat gain calculations to assure good heating and cooling installations, potentially fewer call-backs and delivery of required circulating air. Install duct system to meet current Standard for Installations of Warm Air Heating and Air Systems ASHRAE/NFPA 90 and local codes.

**CAUTION:** Failure to follow these standards could reduce airflow or increase air leakage, resulting in reduced system performance or furnace damage.

Design duct system so furnace will operate at a static pressure of 0.50 inches W.C. or less. This static pressure limitation includes the total pressure losses on both the supply air side and the return air side of the system. Supply side pressure loss includes the cooling coil, ducts and room registers. Return side pressure loss includes the return grilles and ducts. Pressure losses are calculated based on 400 cfm per ton of cooling.

## SUPPLY AIR DUCT WORK

Supply air duct (plenum) connections must be at least as big as the furnace supply opening. Attach to furnace duct flanges. Seal supply air ductwork to furnace casing, walls, ceilings or floors it passes through. End ductwork outside furnace space.

On furnaces not equipped with a cooling coil, a removable access panel that is large enough to allow viewing of the heat exchanger should be provided in the supply duct. The access panel should be accessible when the furnace is installed. Seal access panel cover to prevent leaks.

If you install furnace in horizontal position with a cooling coil, an eighteen-inch long transition between furnace and cooling coil may be needed to allow free airflow into the coil. Also, consult cooling coil installation instructions.

## RETURN AIR DUCT WORK

When furnace is installed so that supply air ducts carry air to areas outside the space containing the furnace, return air must be handled by a duct(s) sealed to furnace casing and terminating outside the space containing furnace.



**WARNING:** Failure to seal return air ductwork could allow combustion products to enter circulating air stream resulting in injury or death by asphyxiation.

When furnace is installed in an upflow position, air delivery above 1800 cfm requires that both sides of furnace be used for return air or a combination of one side and bottom or bottom only.

If bottom return air is not used, you must attach a solid bottom closure panel to bottom return air opening. Bottom closure panel is available from manufacturer. See Table 5 for bottom closure part numbers.

Table 5. Bottom Closure Part Numbers.

<b>GAS INPUT* (Btu/Hr)</b>	<b>MOTOR* HORSE- POWER.</b>	<b>BOTTOM CLOSURE PART NUMBER</b>
40,000	1/4, 1/3	4045900
60,000	1/4, 1/3	
60,000	1/2	4045901
80,000	1/4, 1/3	4045900
80,000	1/2	4045901
80,000	3/4	4045902
100,000	1/3, 1/2	4045901
100,000	3/4	4045902
120,000	1/2, 3/4	
140,000	3/4, 3/4	4045903

\* GAS INPUT and MOTOR HP can be found on furnace rating plate.



**WARNING:** Failure to install bottom closure panel could allow combustion products to enter circulating air stream, resulting in injury or death by asphyxiation.

Downflow installations use top return or top and side return. Horizontal installations use end return or end and top return.

In upflow position, return air duct must be a minimum depth of 23-31/32 inch. See Figure 23.

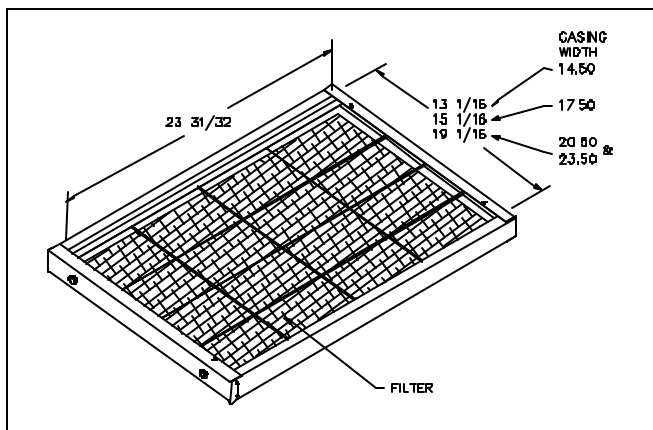


Figure 23. Bottom Filter Cabinet

In downflow position, return air duct must be a minimum 19-7/8 inch inside depth. See Figure 24.

NOTE: A combustible floor base, available from the manufacturer, is required for downflow furnace installation on wood flooring. See Section 5, "Allowing For Clearances."

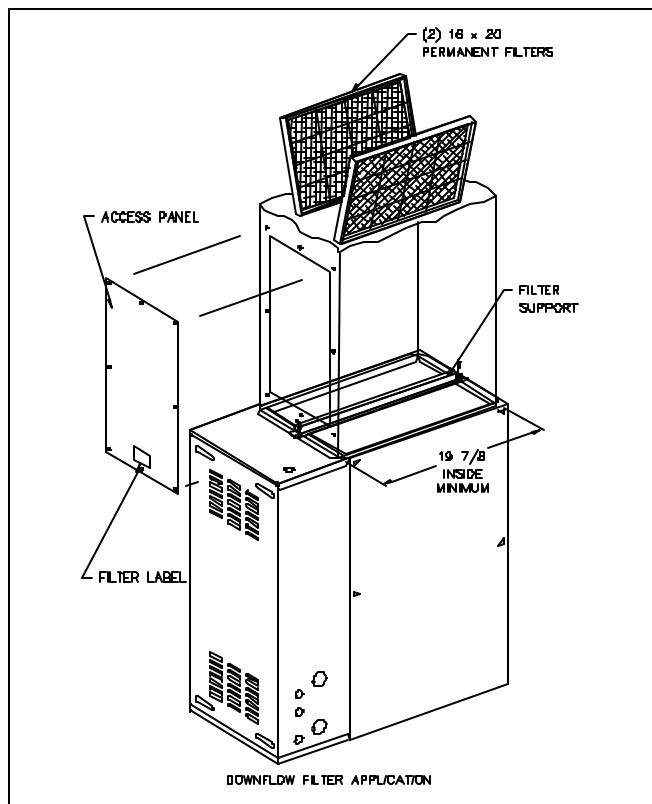


Figure 24. Downflow Filter Application

## DUCT DAMPERS

You may balance airflow with dampers installed in each branch run duct and adjust for even temperature throughout the heated space. For proper furnace operation, make sure:

- ?? Supply air registers and return air grilles are open;
- ?? Rugs, carpets, drapes or furniture are clear of registers and grilles;
- ?? Size and shape of supply air plenum is correct;
- ?? Number of supply air ducts is correct.

## LOCATION OF COOLING COIL

If furnace will share common duct system with a separate cooling unit, install furnace parallel to or upstream of cooling unit. This avoids condensation in heating element. Do not install cooling coil in return air ductwork. With parallel flow, dampers or other means must prevent chilled air from entering furnace. If dampers or other means are not in full heat or cool position, furnace or cooling unit must not operate.

# SECTION 13. SELECTING AND INSTALLING FILTER CABINETS

Properly installed air filters keep blower motor, blower wheel and cooling coil (if installed) clean. Filters and filter cabinets are not supplied with this furnace because of its

many installation positions and configuration options. Filters and filter cabinets must be field supplied or obtained from the manufacturer. The manufacturer has bottom filter cabinets, side filter cabinets and downflow filter kits available.

This furnace was designed for an external filter(s). Do not install air filters inside furnace casing. Obtain and install proper filter frames and correctly sized filters. To inspect, clean or replace air filters, follow the instructions in the User's Information Manual.

**CAUTION:** You must install air filters to keep blower motor, blower wheel and cooling coil (if installed) clean. Dirty equipment may reduce system efficiency or cause erratic control performance and can result in damage to blower motor, heat exchanger or air conditioner (if installed).

Undersized filters reduce airflow and can adversely affect furnace and cooling system operation. Follow these instructions and the filter manufacturer's instructions for minimum size and quantity recommendations. Air velocity must not exceed 300 feet per minute through low velocity disposable filters. Air velocity must not exceed 650 feet per minute through high velocity washable filters.

See Table 6 for recommended filter size for bottom return installations. Side return filters must be at least 16" X 25" X 1", high velocity, washable filters. Downflow filters (2) must be at least 16" X 20" X 1", high velocity, washable filters.

Filter cabinets that provide correct filter spacing to assure designed airflow are available from the manufacturer. Manufacturer's filter cabinets and kits include recommended high velocity, washable filters.

Table 6. Recommended Filter Size - Bottom Return.

<b>GAS INPUT*</b> (Btu/Hr)	<b>MOTOR*</b> <b>HORSE- POWER</b>	<b>DISPOSABLE AIR FILTER (two required)</b>	<b>HIGH VELOCITY WASHABLE AIR FILTER</b>
40,000	1/4, 1/3	14 X 25 X 1	14 X 25 X 1
60,000	1/4, 1/3	14 X 25 X 1	14 X 25 X 1
60,000	1/2	16 X 25 X 1	16 X 25 X 1
80,000	1/4, 1/3	14 X 25 X 1	14 X 25 X 1
80,000	1/2	16 X 25 X 1	16 X 25 X 1
80,000	3/4	20 X 25 X 1	20 X 25 X 1
100,000	1/3, 1/2	16 X 25 X 1	16 X 25 X 1
100,000	3/4	20 X 25 X 1	20 X 25 X 1
120,000	1/2, 3/4	20 X 25 X 1	20 X 25 X 1
140,000	3/4, 3/4	20 X 25 X 1	20 X 25 X 1

\*GAS INPUT and MOTOR HP can be found on furnace rating plate.

## UPFLOW FILTER CABINETS

For upflow installations, use a bottom filter cabinet, side filter cabinet or return air filter grille. Field fabricated filter cabinets should allow 1 inch spacing between filter and furnace. Placing a field supplied filter directly against furnace bottom or side will decrease airflow and adversely affect furnace operation. Filter cabinets that provide correct filter spacing to assure designed airflow are available from the manufacturer.

Manufacturer's bottom filter cabinet and upflow side filter cabinets are shown in Figures 25 and 26 respectively. See Figure 27 for floor cutout dimensions for bottom filter cabinet.

For upflow, air delivery above 1,800 cfm requires returns on both sides, a combination of side and bottom or bottom only. Use appropriate filter cabinets with these combinations.

## HORIZONTAL FILTERS

Horizontal position should use an appropriately sized and installed filter grille or installer fabricated air filter frame.

## DOWNFLOW FILTERS

For downflow installations, install filter support in return air plenum as shown in Figure 24 or use return air filter grille. Downflow Filter Kit that includes filters (2) and support is available from manufacturer.

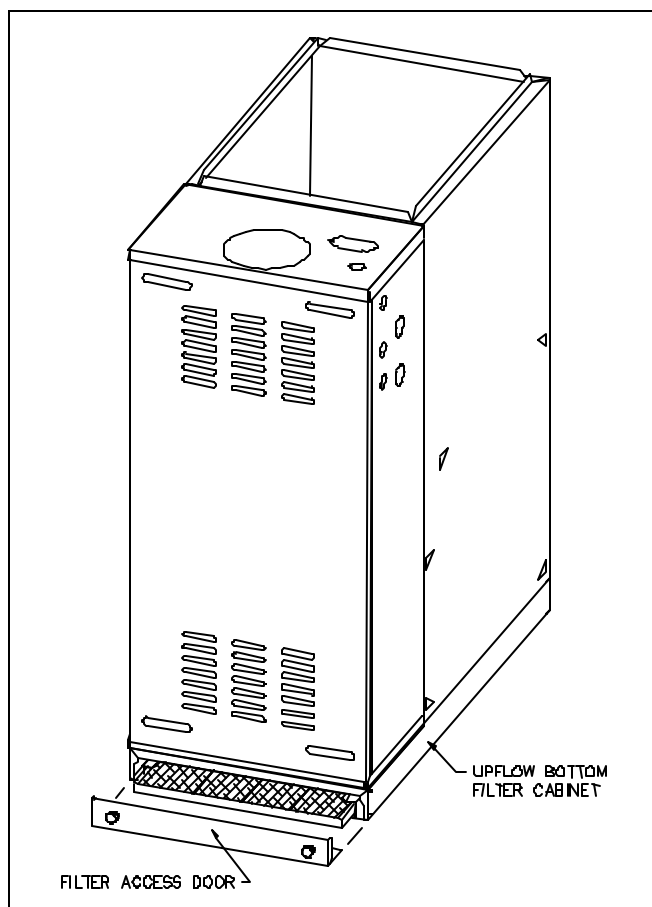


Figure 25. Bottom Filter Cabinet.

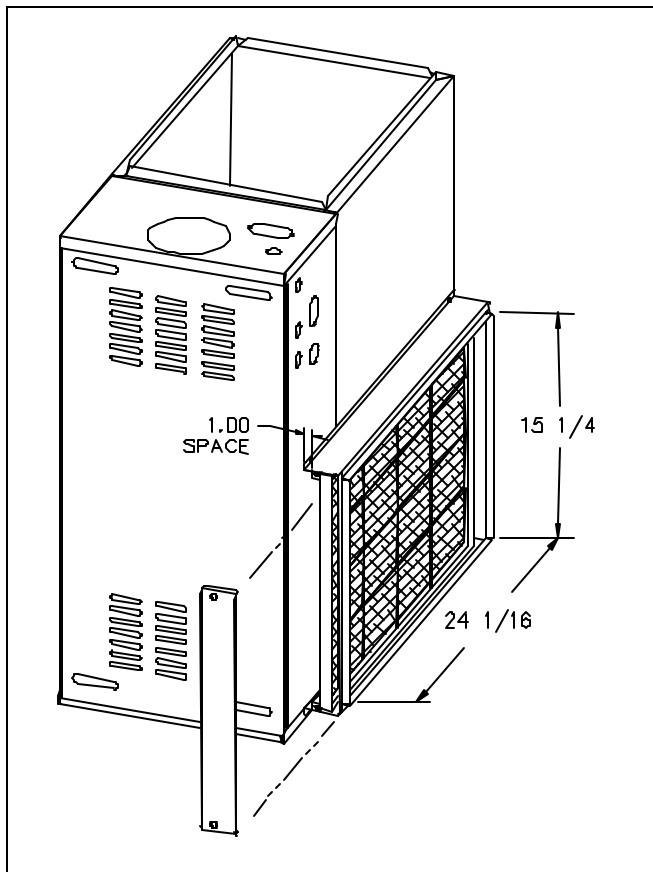


Figure 26. Side Filter Cabinet.

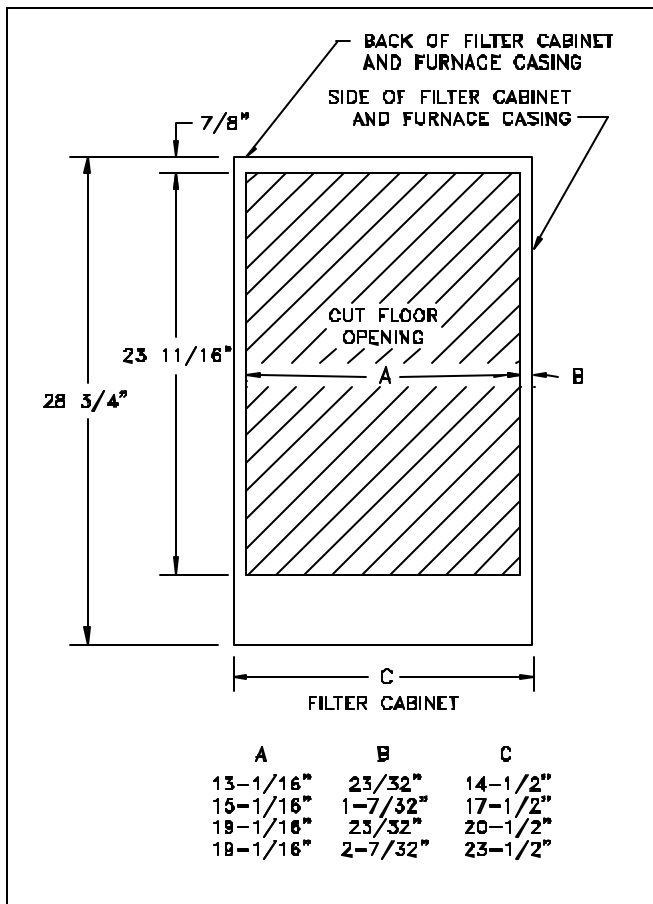


Figure 27. Floor Cutout Dimensions.

## SECTION 14. CHECKS BEFORE STARTING FURNACE

Before starting furnace for the first time, be sure you can answer "Yes" to each of these questions:

1. Is furnace properly equipped to operate with available fuel?
2. Is furnace level?
3. Have you cleared away all loose construction and insulation materials?
4. Is furnace installed with proper clearances to combustible materials?
5. If furnace is in crawl space, is it sufficiently elevated above the ground?
6. Does furnace have sufficient combustion and ventilation air?
7. Does vent system meet current National Fuel Gas Code ANSI Z223.1/NFPA 54 and/or CAN/CGA B149 Installation Codes and local codes?
8. Is vent connector securely fastened to vent collar?
9. Did you completely check gas pipe and controls for gas leaks?
10. Does electrical wiring follow current National Electrical Code ANSI/NFPA 70 or Canadian Electrical Code CSA C22.1 as well as local codes?
11. Is furnace electrically grounded?
12. Is room thermostat properly installed and heat anticipator set correctly?
13. Is duct system correctly sized and sealed?
14. Are proper air filter frames or filter supports installed?
15. Are air filters in place and correctly sized?
16. On furnace installations above a 2,000-foot elevation, is furnace derated properly?

## SECTION 15. GAS SUPPLY PRESSURE AND PILOT ADJUSTMENT

You will need a 0 to 15 inch water manometer with 0.1 inch resolution and a 1/8" NPT manual shut-off valve to measure actual gas pressure.



**WARNING:** You must have correct gas supply and pilot pressure for proper pilot ignition and burner operation. Failure to accurately adjust pressure could cause a fire or explosion.

## CHECKING GAS SUPPLY PRESSURE

1. Turn off gas at equipment shut-off valve in gas supply line just ahead of furnace.
2. Remove inlet pressure plug from gas control.
3. Install 1/8" NPT manual shut-off valve in hole vacated by plug. Make sure valve is in off position.
4. Attach manometer to 1/8" NPT manual shut-off valve just installed.
5. Slowly open equipment shut-off valve in gas supply line just ahead of furnace.
6. Slowly open 1/8" NPT manual shut-off valve leading to manometer.
7. Turn on all gas appliances attached to gas supply line.
8. With furnace operating, read gas supply pressure on manometer.
  - ?? Natural gas supply pressure must be between 5 and 7 inches W.C.
  - ?? Propane gas (LP) supply pressure must be between 11 and 13 inches W.C.
9. If gas supply pressure is not within these limits, call gas supplier.
10. Turn off all gas appliances attached to gas supply line.

## PILOT FLAME ADJUSTMENT

Before adjusting pilot flame, confirm that gas supply pressure is correct, as explained above.

NOTE: Pilot flame adjustment was checked at the factory and should not require adjustment. However; pilot adjustment is possible if necessary.

1. Start furnace following "Operating Instructions" on front door.
2. Pilot flame should cover 1/2 inch of tip of flame sensor as shown in Figure 28.
3. If you need to adjust pilot flame, remove pilot adjustment cover screw on gas control. Save cover screw for re-installation. Turn inner adjustment screw clockwise to decrease pilot flame; counter-clockwise to increase pilot flame. Install cover screw and tighten to torque of 5 inch-pounds to prevent gas leakage.
4. Shut off furnace.
5. Turn off gas at equipment shut-off valve in gas supply line just ahead of furnace. Remove shut-off valve from gas-control-inlet pressure tap. Install pressure tap plug. Turn on gas.
6. Check pilot-adjustment-cover screw and gas control inlet pressure tap plug for gas leaks. Use a commercial soap solution made for leak detection.

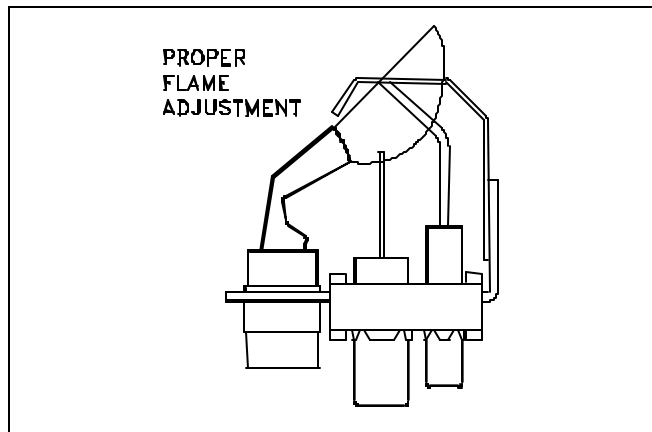


Figure 28. Pilot Flame Adjustment.

## SECTION 16. MANIFOLD PRESSURE ADJUSTMENT

You will need a 0 to 15 inch water manometer with 0.1 inch resolution and a 1/8" NPT manual shut-off valve to measure actual manifold pressure.



**WARNING:** Correct manifold pressure is necessary for proper ignition and burner operation. Failure to accurately adjust pressure could cause heat exchanger failure.

Check gas supply pressure first. Follow instructions in Section 15.

1. Turn off gas at equipment shut-off valve in gas supply line just ahead of furnace.
2. Remove plug from outlet pressure tap in gas control.
3. Install 1/8" NPT manual shut-off valve in hole vacated by plug. Make sure shut-off valve is in off position.
4. Attach manometer to 1/8" NPT manual shut-off valve just installed.
5. Slowly open equipment shut-off valve in gas supply line just ahead of furnace. Start furnace following "Operating Instructions" on front door.
6. Slowly open 1/8" NPT manual shut-off valve leading to manometer.
7. Read manifold pressure on manometer.
8. Adjust manifold pressure by turning gas control regulator adjusting screw clockwise to increase pressure or turning counter-clockwise to decrease pressure. Manifold pressure must be within allowable range below:
  - ?? Natural gas manifold pressure must be between 3.2 and 3.8 inches W.C.
  - ?? Propane gas (LP) manifold pressure must be between 9.7 and 10.3 inches W.C.



NOTE: For natural gas, if gas flow rate can't be properly set within these pressure ranges then you must change main burner orifices to obtain proper gas flow rate.

9. Shut off furnace. Turn off gas at equipment shut-off valve in gas supply line just ahead of furnace. Install outlet pressure tap plug in gas control. Turn on gas.
10. Check regulator adjustment cover screw and gas control plug for gas leaks. Use a commercial soap solution made for leak detection.

## SECTION 17. CHECKING GAS INPUT RATE

It is the installer's responsibility to see that the Btu input rate of the furnace is properly adjusted. Under-firing could cause inadequate heat, excessive condensation or ignition problems. Over-firing could cause sooting, flame impingement or overheating of heat exchanger.



**WARNING:** Failure to adjust furnace to the proper firing rate could cause heat exchanger failure.

Depending on your local gas heating value and elevation, you may need to adjust manifold pressure or change orifices to get proper gas input rate. Check with your local gas supplier to determine heating value (Btu/cu.ft.) of natural gas in your area.

NOTE: If furnace is being installed at an altitude of more than 2000 feet above sea level, you must derate the furnace. See Section 18, "Derating For High Altitude."

### NATURAL GAS INPUT RATE

Natural gas heating value (Btu/cu.ft.) can vary significantly. Before starting natural gas input check, obtain gas heating value at your location from local supplier. You will need a stopwatch to measure actual gas input.

1. Gas supply pressure must be between 5 and 7 inches W.C. for natural gas. See Section 15, "Gas Supply Pressure and Pilot Adjustment."
2. Turn off all other gas appliances. You may leave pilots on.
3. Start furnace following "Operating Instructions" on front door.
4. Let furnace warm up for 6 minutes.
5. Locate gas meter. Determine which dial has the least cubic feet of gas and how many cubic feet per revolution it represents. This is usually one-half, one or two cubic feet per revolution.
6. With stopwatch, measure time it takes to consume two cubic feet of gas.

?? If dial is one-half cubic foot per revolution, measure time for four revolutions.

?? If dial is one cubic foot per revolution, measure time for two revolutions.

?? If dial is two cubic feet per revolution, measure time for one revolution.

7. Divide this time by two. This gives average time for one cubic foot of gas to flow through meter. Example: If it took 58 seconds for two-cubic feet to flow, it would take 29 seconds for one-cubic foot to flow.

8. Calculate gas input using this formula:

$$\text{Gas input} = \frac{\text{Gas Heating Value (Btu/cu.ft.)} \times 3,600 \text{ sec/hr}}{\text{Time (Seconds for one cubic foot of gas)}} = \text{Btu/hour}$$

Example:

Assume it took 29 seconds for one cubic foot of gas to flow and heating value of 1,000 Btu/cu.ft.

$$\text{Gas Input} = \frac{1,000 \times 3,600}{29} = 124,138 \text{ Btu per hour}$$

If you left no other pilots on, this is the furnace gas input.

9. If you left water heater, dryer or range pilots on, allow for them in calculating correct furnace gas input. A quick way is to allow 1,000 Btu per hour for a water heater, 500 Btu per hour for dryer and 500 Btu per hour for each range burner pilot.

Example:

If you left gas water heater, dryer, two range burner pilots and one oven pilot on, allow:

Water heater pilot	1,000 Btu per hour
Dryer pilot	500 Btu per hour
2 range burner pilots	1,000 Btu per hour
1 range oven pilot	500 Btu per hour
<hr/>	
3,000 Btu per hour	

Subtracting 3,000 Btu per hour from 124,138 Btu per hour measured above equals 121,138 Btu per hour. This would be the correct furnace gas input after allowing for pilots left on.

10. Manifold pressure may be adjusted within the range of 3.2 inches W.C. to 3.8 inches W.C. to get rated input  $\pm$  2 percent. See Section 16, "Manifold Pressure Adjustment." If you cannot get rated input with manifold pressure within the allowable range, you must change orifices. See Section 20, "Changing Main Burner Orifices."



## PROPANE (LP) GAS INPUT RATE



**WARNING:** Propane (LP) gas installations do not have gas meters to double check input rate. Measure manifold pressure with an accurate manometer. Failure to accurately adjust pressure could cause heat exchanger failure, asphyxiation, fire or explosion, resulting in damage, injury or death.

1. Make sure you have correct pilot orifice and main burner orifices.
2. Gas supply pressure must be between 11 and 13 inches W.C. for propane (LP) gas. See Section 15, "Gas Supply Pressure and Pilot Adjustment."
3. Start furnace following "Operating Instructions" on front door.
4. Let furnace warm up for 6 minutes.
5. Adjust manifold pressure to 10.0 inches W.C.  $\pm$  0.3 inches W.C. See Section 16, "Manifold Pressure Adjustment."



**WARNING:** Do not set Propane (LP) manifold pressure at 11.0 inches W.C. It could cause heat exchanger failure.

NOTE: NOx reducing screens must be removed from each tube of California NOx furnaces when converting to propane (LP) gas. See Figure 29.

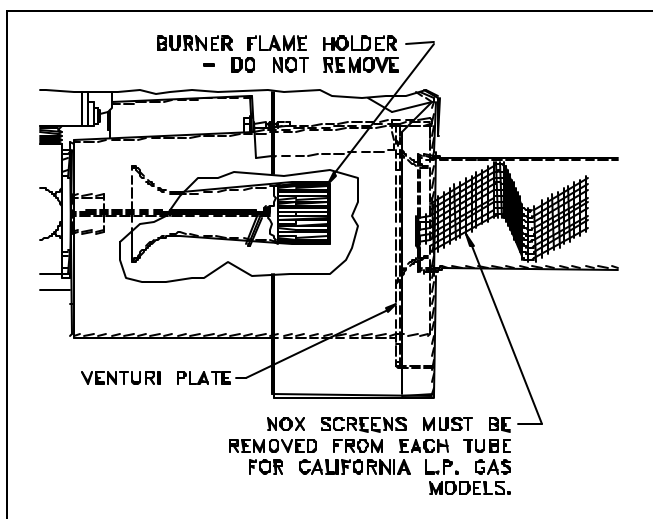


Figure 29. California NOx Screen Removal.

## SECTION 18. DERATING FOR HIGH ALTITUDE

At higher altitudes, the density of the air is reduced. Therefore, for proper combustion, the quantity of gas burned in the furnace must also be reduced. This is called derating. Furnaces must be derated when installed at altitudes greater than 2,000 feet above sea level.

Derating the furnace by adjusting the manifold pressure lower than the range specified in the Section 16, "Manifold Pressure Adjustment" is considered to be an improper procedure.

At elevations above 2,000 feet, the furnace must be derated 4% for each 1,000 feet above sea level. It is the installer's responsibility to see that the furnace input rate is adjusted properly. Derating must be achieved by reducing the size of the main burner orifices. Choose the proper orifices for your altitude and gas heating value from orifice size Table 8 or 9. In Canada, high-altitude models may be available which are rated for 2,000 to 4,500 feet above sea level.

## SECTION 19. DETERMINING CORRECT ORIFICE SIZE

Table 7 shows original factory installed orifice sizes. See Table 8 or Table 9 to determine correct orifice size. Natural gas and propane (LP) gas orifice kits are available through your supplier. Individual orifices are also available in convenient lot sizes. To assure proper performance, use only manufacturer supplied orifices.

Table 7. Factory Installed Orifice Sizes.

<b>FURNACE MODEL</b>	<b>NATURAL GAS</b>	<b>PROPANE (LP)</b>
U.S. (except NOx models)	2.15 mm	1.30 mm
U.S. (California NOx models)	2.10 mm	NA
CAN. (0 to 2000 feet)	2.15 mm	1.30 mm
CAN. (2001 to 4500 feet)	2.05 mm	1.20 mm

Table 8. Natural Gas Orifice Size.

Gas Heat* Value Btu/cu. ft.	ELEVATION								
	Up to 2000 Feet	2001 to 4000 Feet	3001 to 4000 Feet	4001 to 5000 Feet	5001 to 6000 Feet	6001** to 7000 Feet	7001** to 8000 Feet	8001** to 9000 Feet	9001** to 10000 Feet
800-849	2.35mm	2.30mm	2.30mm	2.25mm	2.20mm	2.20mm	2.15mm	2.10mm	2.05mm
850-899	2.30mm	2.25mm	2.20mm	2.20mm	2.15mm	2.10mm	2.10mm	2.05mm	2.00mm
900-949	2.25mm	2.20mm	2.15mm	2.15mm	2.10mm	2.05mm	2.05mm	2.00mm	1.95mm
950-999	2.20mm	2.15mm	2.10mm	2.05mm	2.05mm	2.00mm	1.95mm	1.95mm	1.90mm
1000-1049	2.15mm	2.10mm	2.05mm	2.05mm	2.00mm	2.00mm	1.95mm	1.90mm	1.85mm
1050-1099	2.10mm	2.05mm	2.00mm	2.00mm	1.95mm	1.90mm	1.90mm	1.85mm	1.85mm
1100-1149	2.05mm	2.00mm	2.00mm	1.95mm	1.95mm	1.90mm	1.85mm	1.85mm	-----
1150-1199	2.00mm	1.95mm	1.95mm	1.90mm	1.90mm	1.85mm	-----	-----	-----

\*At standard conditions: 30.0 inches Mercury, 60°F, Saturated.

\*\*Above 6000 feet, a separate high altitude kit must be used.

NOTE: Shaded orifices above are available separately.

Table 9. Propane (LP) Gas Orifice Size.

Gas Input (Btu/Hr)	ELEVATION								
	Up to 2000 Feet	2001 to 3000 Feet	3001 to 4000 Feet	4001 to 5000 Feet	5001 to 6000 Feet	6001* to 7000 Feet	7001* to 8000 Feet	8001* to 9000 Feet	9001* to 10000 Feet
40,000-140,000	1.30mm	1.25mm	1.25mm	1.20mm	1.20mm	1.20mm	1.15mm	1.15mm	1.10mm

\*Above 6000 feet, a separate high altitude kit must be used.

NOTE: All orifices above are included in propane gas orifice kit.

## SECTION 20. CHANGING MAIN BURNER ORIFICES



**WARNING:** To prevent electrical shock and gas leaks, turn off electrical power and gas before changing orifices.

Follow this procedure:

- Set room thermostat to its lowest or off setting.
- Turn off electricity at electrical disconnect switch next to furnace.
- Turn off equipment shut-off valve in gas supply line just ahead of furnace.
- Turn gas control switch to "OFF" position.
- Starting with burner farthest from gas control, remove burner screws and burners. Note how the burner mounting flange of burners farther from the gas control overlap the burner-mounting flange of the adjacent burner. See Figure 30.
- Remove original gas orifices.
- Carefully, hand thread new orifices into manifold. Do not cross-thread. Tighten to torque of 50 inch-pounds.
- Replace burners in reverse order, starting with the burner closest to the gas control. Remember: burner-mounting flange of burners farther from the gas control overlap the burner mounting flange of the adjacent burner.
- Check burner carry-over alignment. Burner carry-overs may touch but not overlap adjacent burner carry-overs. Replace screws.
- Turn gas control switch to "ON" position.
- Open equipment shut-off valve in gas supply line just ahead of furnace.
- Set room thermostat to highest setting.
- Turn on electricity at electrical disconnect switch located next to furnace. Furnace will light.
- Check for gas leaks using commercial soap solution made for leak detection.
- Check gas input following Section 17, "Checking Gas Input Rate."

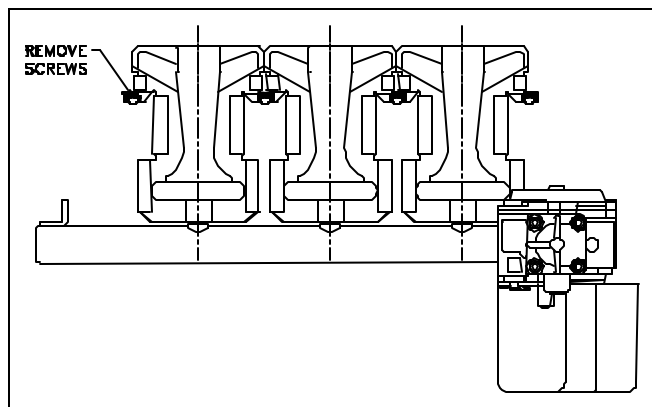


Figure 30. Main Burner Removal.

## SECTION 21. ADJUSTING BLOWER SPEED

Determine initial heating and cooling speeds in system design stage. See Product Data Sheet for airflow data. Depending on tests performed in following sections, you may need to change blower motor speed.

**CAUTION:** Heating speed tap should not be reduced below factory setting. Doing so may result in inadequate air circulation, and could cause excessive air temperature rise through furnace. This could cause a high-temperature limit switch to cycle burners on and off, reducing furnace efficiency and shortening life of heat exchanger and blower motor.

Follow this procedure:

1. Turn off electricity at electrical disconnect switch located next to furnace.



**WARNING:** To prevent electric shock, turn off electrical power to furnace before changing blower motor speed.

2. All models have these four motor speed designations:

High Speed (HI)	Black wire
Medium High Speed (MH)	Blue wire
Medium Low Speed (ML)	Yellow wire
Low Speed (LO)	Red wire

3. To change cooling speed, move the desired motor lead to the terminal marked 'COOL' on the Fan Timer. See Figure 31. Initial factory setting for cooling is high speed (black wire).

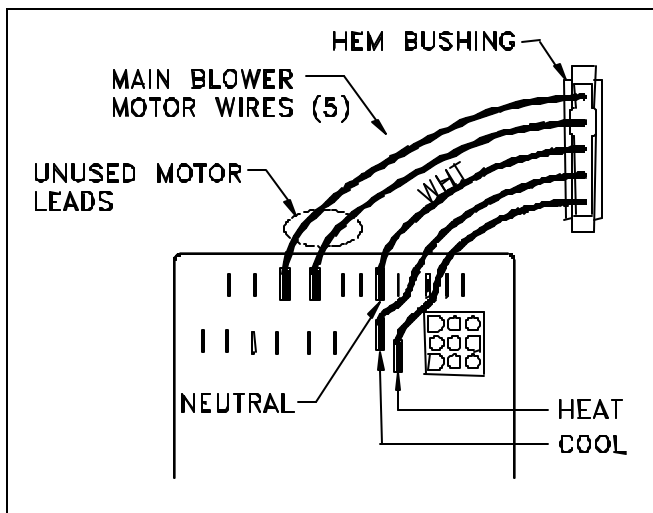


Figure 31. Main Blower Speed Selection.

4. To change the heating speed, move the desired motor lead to the terminal marked 'HEAT' on the Fan Timer. See Figure 31. Factory setting for heating is listed in Table 10. Heating speed should not be reduced below factory setting.
5. Connect the two unused motor leads to the terminals marked "UNUSED MOTOR LEADS" on the Fan Timer. See Figure 31.



**WARNING:** Failure to properly terminate unused motor leads could cause electrical shock.

6. Turn on the electricity at electrical disconnect switch located next to furnace.

Table 10. Factory Heating Speed and Temperature Rise.

*Gas **Input (Btu/Hr)	/ Motor Size (H.P.)	Air Temperature Rise Range (°F)	Heating Operation *Speed Tap/ Wire Color
40,000	/ 1/4	50-80	LO/RED
40,000	/ 1/3	30-60	LO/RED
60,000	/ 1/4	45-75	ML/YEL
60,000	/ 1/3	45-75	LO/RED
60,000	/ 1/2	35-65	LO/RED
80,000	/ 1/4	50-80	MH/BLUE
80,000	/ 1/3	40-70	MH/BLUE
80,000	/ 1/2	50-80	LO/RED
80,000	/ 3/4	40-70	LO/RED
100,000	/ 1/3	55-85	MH/BLUE
100,000	/ 1/2	50-80	ML/YEL
100,000	/ 3/4	40-70	ML/YEL
120,000	/ 1/2	45-75	MH/BLUE
120,000	/ 3/4	45-75	MH/BLUE
140,000	/ 3/4	45-75	MH/BLUE
140,000	/ 3/4	50-80	MH/BLUE

\*These are initial Factory Settings.  
\*\*GAS INPUT and MOTOR HP can be found on furnace rating plate.

Table 11. Cooling Speed Selection.

*Gas Input (Btu/Hr)	/ Motor Size (H.P.)	Air Conditioning Tonnage							
		1.5	2	2.5	3	3.5	4	5	
40,000	/ 1/4	MH	HI	--	--	--	--	--	
40,000	/ 1/3	--	ML	MH	HI	--	--	--	
60,000	/ 1/4	MH	HI	--	--	--	--	--	
60,000	/ 1/3	--	ML	MH	HI	--	--	--	
60,000	/ 1/2	--	--	--	ML	MH	HI	--	
80,000	/ 1/4	HI	HI	--	--	--	--	--	
80,000	/ 1/3	LO	ML	HI	HI	--	--	--	
80,000	/ 1/2	--	--	--	ML	MH	HI	--	
80,000	/ 3/4	--	--	--	--	ML	MH	HI	
100,000	/ 1/3	LO	ML	HI	HI	--	--	--	
100,000	/ 1/2	--	LO	MH	MH	HI	--	--	
100,000	/ 3/4	--	--	--	LO	MH	MH	HI	
120,000	/ 1/2	--	--	--	LO	ML	HI	HI	
120,000	/ 3/4	--	--	--	LO	ML	HI	HI	
140,000	/ 3/4	--	--	LO	ML	HI	HI	--	
140,000	/ 3/4	--	--	--	LO	ML	HI	HI	

\*GAS INPUT and MOTOR HP can be found on furnace rating plate.

This table only gives initial speed tap settings for installations with ductwork static pressure of 0.5" W.C. figuring 400 CFM per ton of air conditioning. Ductwork with higher than 0.5" W.C. static pressure will cause reduced airflow and these speed tap settings will not be correct. To determine correct speed tap settings at ductwork static pressures above 0.5" W.C., see Product Data Sheet.

## SECTION 22. MEASURING DUCT SYSTEM STATIC PRESSURE

System airflow can be determined from the Product Data Sheet when duct system static pressure is known. Improper airflow in heating mode may result in poor heating performance and reduced heat exchanger life. Improper airflow in cooling mode may cause poor cooling performance or air-conditioning coil freeze-up.

High duct system static pressure is an indication of an overly restrictive duct system. Static pressure in excess of 0.5 inches W.C. indicates a need for duct system redesign to ensure proper volume of airflow.

You will need a 0 to 1 inch W.C. slope gauge with 0.01 inch resolution and two pressure measurement taps.

Follow this procedure:

1. Open supply air registers and return air grilles. Make sure the registers and grilles are free of obstruction from rugs, carpets, drapes or furniture.
2. Set balancing dampers in supply duct system.
3. Check ductwork for obstructions or leaks.
4. Make sure filters are clean and in place.
5. Make sure that blower speed taps are set for proper heating and cooling. Refer to Section 21, "Adjusting Blower Speed." Heating speed should be set according to Table 10. Cooling speed should be set to meet cooling equipment requirements. See Table 11 for cooling airflow capacities at 0.5 inch W.C.
6. Place slope gauge near furnace, level and adjust scale to read 0.00 inches W.C.
7. Insert one static pressure tap into supply air transition duct between furnace and cooling coil or in the supply air plenum for heating only systems. Connect this pressure tap to positive pressure side of slope gauge. See Figure 32.
8. Insert other static pressure tap in return air plenum. Connect this pressure tap to negative pressure side of slope gauge. See Figure 32.

9. Start blower.

?? Blower heating speed can be run by jumping terminals "R" and "G" on 24-volt terminal block located on Fan Timer.

?? Blower cooling speed can be run by jumping terminals "R" and "Y" on 24-volt terminal block located on the Fan Timer.

NOTE: On cooling speed, there is a short on-delay before the blower starts and a 60-second off-delay before the blower stops.

10. Read duct system static pressure from slope gauge.

NOTE: If air filter location is upstream of return air pressure tap, static pressure must be adjusted to exclude filter pressure drop. Do this by subtracting 0.08 inches W.C. from the measured static pressure.

Duct System Static Pressure = Measured Pressure - 0.08 inches W.C.

11. Remove jumper wire from 24-volt terminal strip. Remove pressure taps and seal holes in ductwork.

NOTE: Failure to seal holes could result in reduced system performance.

## SECTION 23. MEASURING AIR TEMPERATURE RISE

Air temperature rise (supply air temperature minus return air temperature) must be within allowable air temperature rise range specified on furnace rating plate and in Table 10.

You will need 2 thermometers with 1 degree resolution capable of reading up to 200 degrees F.

Follow this procedure:

1. Open supply air registers and return air grilles. Make sure the registers and grilles are free of obstruction from rugs, carpets, drapes or furniture.
2. Set balancing dampers in supply duct system.
3. Check ductwork for obstructions or leaks.
4. Make sure filters are clean and in place.
5. Make sure that blower speed taps are set for proper heating and cooling. Refer to Section 21, "Adjusting Blower Speed." Heating speed should be set according to Table 10. Cooling speed should be set to meet cooling equipment requirements. See Table 11 for cooling airflow capacities at 0.5 inch W.C.
6. Place one thermometer in supply air plenum approximately 2 feet from furnace. Locate thermometer tip in center of plenum to ensure proper temperature measurement.
7. Place second thermometer in return air duct approximately 2 feet from furnace. Locate thermometer tip in center of duct to ensure proper temperature measurement.

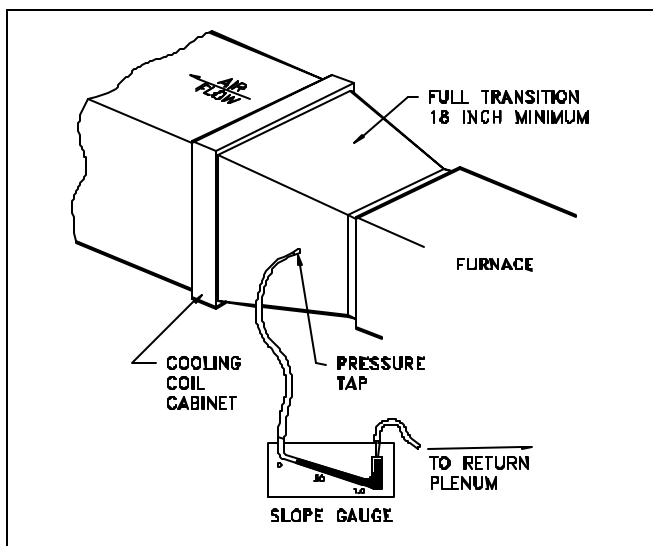


Figure 32. Measuring Duct System Static Pressure.

8. Set room thermostat on highest temperature setting. Operate furnace 6 minutes. Record supply air and return air temperatures.
9. Calculate air temperature rise by subtracting return air temperature from supply air temperature.

?? If air temperature rise is above the temperature rise range specified in Table 10, furnace is overfired or has insufficient airflow. Check gas input following the instructions in Section 17, "Checking Gas Input Rate." If air temperature rise is still above temperature rise range specified, more heating airflow is needed. Change blower heating speed to a higher setting following instructions in Section 21, "Adjusting Blower Speed."

?? If air temperature rise is below the temperature rise range specified in Table 10, furnace is underfired or has too much airflow. Check gas input following the instructions in Section 17, "Checking Gas Input Rate." If air temperature rise is still below temperature rise range specified, less heating airflow is needed. Change blower heating speed to a lower setting following instructions in Section 21, "Adjusting Blower Speed."

?? After making adjustments, you must check air temperature rise to verify that resulting air temperature rise is within allowable range. If air temperature rise is still outside the temperature rise range specified in Table 10, check duct system design with a qualified heating engineer. It may be necessary to re-size the ductwork. Recheck air temperature rise after revising duct systems.

10. Set room thermostat to desired setting.
11. Remove thermometers and seal ductwork holes.

NOTE: Failure to seal holes could result in reduced system performance.

## SECTION 24. CHECKING CONTROLS

Before leaving the work site, check to see that all controls are functioning properly.

You will need a 0 to 15 inch water manometer with 0.1 inch resolution and a 1/8" NPT manual shut-off valve.

Follow this procedure:

1. Turn off electricity at electrical disconnect switch next to furnace.
2. Turn gas control switch to "OFF" position.
3. Connect a manometer to gas control outlet (manifold) pressure tap.
4. Set room thermostat to its highest temperature.

5. Turn on electricity at electrical disconnect switch located next to furnace.
6. Diagnostic light on Fan Timer should be on and cycling bright-dim-bright-dim...
7. Draft inducer should run and pilot igniter should glow but pilot burner should not light. Manifold pressure should remain at zero.
8. Turn off electricity at electrical disconnect switch located next to furnace. Turn gas control switch to "ON" position.
9. Turn on electricity at electrical disconnect switch located next to furnace. Draft inducer should run, pilot igniter should glow, pilot burner should light and ignite main burners. It may take several minutes to purge the gas line before the pilot burner lights. Wait 30 seconds after main burner ignition for main blower to start.
10. Cycle electrical disconnect switch next to furnace on and off. Watch at least three ignition cycles. Pilot should ignite main burners smoothly.
11. Burner flames should look the same with circulation blower on and off.
12. Turn gas control switch to "OFF" position.
13. Remove manometer from gas control and replace outlet pressure tap. Turn gas control switch to "ON" position.
14. Use a commercial soap solution made to detect leaks and check all gas piping connections. Bubbles indicate gas leakage. Seal all leaks before proceeding.
15. Set room thermostat to desired setting.

## SECTION 25. SETTING BLOWER TIMINGS

Heating blower on-delay is fixed at 30 seconds from when the main valve opens. It is not adjustable.

Heating blower off-delay is adjustable to one of four times: 60, 100, 140 or 180 seconds. Heating blower off-delay is factory set at 140 seconds. If a different blower off-delay is desired:

1. Find two small switches located near the 24-volt terminal strip on Fan Timer.
2. Determine switch settings for desired heating blower off-delay. See Figure 33.
3. Set switches on Fan Timer using a small screwdriver.

NOTE: Cooling blower off-delay is fixed at 60 seconds and is not adjustable.

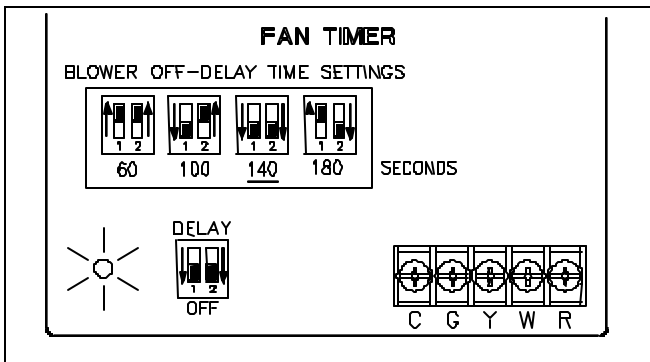


Figure 33. Heating Blower Off-Delay.

## SECTION 26. MAINTAINING FURNACE IN GOOD WORKING ORDER



**WARNING:** Use replacement parts listed in parts list only. Use of incorrect parts on this furnace could cause improper furnace operation, resulting in damage, injury or death.

Inspection and cleaning by a qualified service person should be performed once before each heating season begins and once during heating season. Make sure the inspection includes each of the items listed below.

Before inspecting furnace:

1. Turn room thermostat to its lowest or off setting.
2. Turn off equipment shut-off valve.
3. Wait at least five minutes for furnace to cool if it was recently operating.
4. Turn off furnace electrical power.



**WARNING:** Failure to disconnect electrical power before servicing furnace could result in electrical shock or death.

Inspect the following:

- ?? An operational check of the entire system. Assure that the furnace is operating properly and safely.
- ?? Vent connector and vent pipe must be in place, slope upward at least 1/4 inch per foot and must be physically sound, without holes or excessive corrosion.
- ?? All venting components including vent connector, vent pipe, chimney and vent cap must be clear and free of obstructions.
- ?? Furnace-room or closet combustion and ventilation air openings must be clear and free.

- ?? Furnace combustion air openings must be clear and free.
- ?? Return air duct must be physically sound, sealed to the furnace casing and ending outside the space containing the furnace.
- ?? Supply air ducts and return air ducts must be clear and free, and without air leaks.
- ?? Registers and return grilles must be open and unobstructed by rug, carpet or furniture.
- ?? The furnace must be well supported without sagging, cracks, gaps, etc. around the base.
- ?? There must be no obvious signs of deterioration of the furnace. Inspection must include burners, pilot, heat exchanger, inducer pan and draft inducer.
- ?? Inspect all electrical wiring and connections, including electrical ground.
- ?? Gas pipes must be checked for leaks using a commercial soap solution made to detect leaks.
- ?? Main burners and pilot burner must be in good adjustment as shown in the User's Information Manual. Main burner flame must be clear blue and centered within the heat exchanger openings.
- ?? Flame holders, located inside each main burner, should be checked for lint and debris.
- ?? Check the furnace area for combustible materials, flammable liquid near the furnace, corrosive materials, insulation material within 12 inches of the furnace and signs of high water levels.
- ?? Inspect, clean, or repair as needed the following items: blower housing, blower motor, blower wheel, air filters, draft inducer and cooling coil.

NOTE: Blower motor and inducer motor do not require oiling.

## SECTION 27. BLOWER ASSEMBLY REMOVAL

Follow these steps to remove blower assembly:

1. Turn off furnace electrical power.
2. On downflow furnaces, remove vent pipe inside furnace.
3. Disconnect room thermostat wires from 24-volt terminal strip on Fan Timer.
4. Locate the five blower motor wires that feed through the casing hem.
5. Label blower motor wires for proper replacement.
6. Disconnect blower motor wires from Fan Timer. See Figure 31.

7. Remove 2 screws holding blower door in place. Remove blower door.
8. Pull blower motor wires through casing hem.
9. Remove power-disconnect assembly located in the middle of the blower deck.
10. Remove 2 screws holding blower assembly to blower deck.
11. Slide blower assembly out.
12. After cleaning blower assembly, re-assemble in reverse order making sure speed selections are in original positions.

## SECTION 28. ACCESSORIES

**THERMOSTATS:** These are quality thermostats with the Consolidated Industries name. Choose from the T87 (round w/subbase), T834 (heating and cooling) or the T8699 (Chronotherm III). Available in white only.

**NATURAL GAS TO PROPANE CONVERSION KIT (BELOW 6,000 ft):** Includes propane regulator spring kit, propane pilot orifice and main-burner orifices.

**PROPANE TO NATURAL GAS CONVERSION KIT (BELOW 6,000 ft):** Includes natural gas regulator spring kit, natural gas pilot orifice and main-burner orifices.

**U.S. HIGH-ALTITUDE NATURAL GAS TO PROPANE CONVERSION KIT (ABOVE 6,000 ft):** Includes propane regulator spring kit, propane pilot orifice, main-burner orifices, and high-altitude pressure switch.

**U.S. HIGH-ALTITUDE PROPANE TO NATURAL GAS CONVERSION KIT (ABOVE 6,000 ft):** Includes natural gas regulator spring kit, natural gas pilot orifice, main-burner orifices, and high-altitude pressure switch.

**BOTTOM FILTER CABINET:** Four sizes - one size for each furnace casing size. Includes one high velocity, washable filter.

**SIDE FILTER CABINET:** Attaches to either side of the furnace. One size fits all. Includes one 16" x 25" x 1" high velocity, washable filter.

**BOTTOM CLOSURE:** Seals bottom of furnace when only side return is used. **DOWNFLOW FILTER KIT:** Filter support mounts between furnace and downflow return plenum. Requires an access panel in plenum. Includes two 16" x 20" x 1" high velocity, washable filters.

**FILTERS:** High velocity, washable filters, available in cartons of 10. Sizes include 14 x 25 x 1, 16 x 25 x 1, 20 x 25 x 1, and 16 x 20 x 1 inches.

**COMBUSTIBLE FLOOR BASE:** Allows downflow installation on wood flooring. One size fits all.

## SECTION 29. OTHER INFORMATION AND PUBLICATIONS

These publications can help you install the furnace. You can usually find these at your local library or buy them directly from the publisher. Be sure to consult current edition of each standard.

National Fuel Gas Code      ANSI Z223.1/NFPA 54

Canadian Installation Codes      CAN/CGA B149

National Electrical Code      ANSI/NFPA Code 70

Canadian Electrical Code      CSA C22.1

Standard For The Installation Of Warm Air Heating And Air Conditioning Systems.      ASHRAE/NFPA 90

Standard for Chimneys, Fireplaces, Vents, and Solid Fuel Burning Appliances      NFPA 211.

For more information, contact these publishers:

**ANSI:**      **AMERICAN NATIONAL STANDARDS INSTITUTE INC.**  
1430 Broadway  
New York, New York 10018  
(212) 642-4900

**CSA:**      **CANADIAN STANDARDS ASSOCIATION**  
178 Rexdale Boulevard  
Rexdale, Ontario  
Canada. M9W 1R3  
(416) 447-4044

**ASHRAE:**      **AMERICAN SOCIETY OF HEATING REFRIGERATION AND AIR-CONDITIONING ENGINEERS, INC.**  
1791 Tullie Circle N.E.  
Atlanta, GA 30329  
(404) 636-8400

**NFPA:**      **NATIONAL FIRE PROTECTION ASSOCIATION**  
1 Batterymarch Park  
Quincy, MA 02269  
(617) 770-3000