

## HORIZONTAL GAS FURNACES INSTALLERS' INFORMATION MANUAL

To assure both safe and proper operation, please carefully follow the instructions in this manual to correctly install this new furnace.

**ATTENTION, INSTALLER!** After installing furnace, give the user:

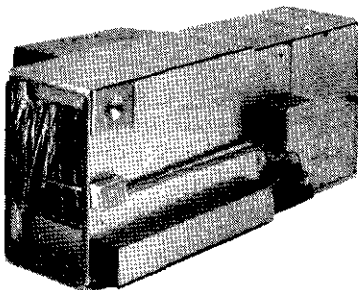
- Users' Information Manual;
- Parts List;
- Installers' Information Manual;
- Warranty Information.

**ATTENTION, USER!** Your furnace installer should give you four important documents relating to your furnace. Keep these as long as you keep your furnace. Pass these documents on to later furnace purchasers or users. If any of the four documents is missing or damaged, contact your installer or furnace manufacturer for replacement. For efficient service, please give your furnace model and serial number, listed in Section 1 of your Users' Information Manual. Throughout this Installers' Information Manual we frequently use the word "you" when referring to the person responsible for application, installation and service of your furnace. Please remember to have only qualified service technicians perform these services.

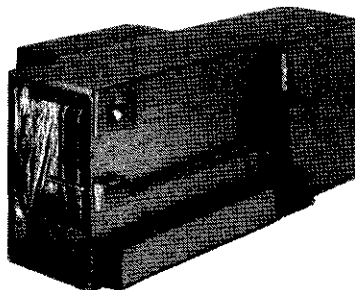
**WARNING:** INDIVIDUALS WHO INSTALL THIS FURNACE, MUST HAVE THE TRAINING AND EXPERIENCE NECESSARY TO INSTALL HORIZONTAL GAS FURNACES. THEY MUST ALSO HAVE TRAINING AND EXPERIENCE NECESSARY TO INSTALL RELATED COMFORT AIR CONDITIONING APPLIANCES. IMPROPER INSTALLATION COULD CREATE A HAZARD, RESULTING IN DAMAGE, INJURY OR DEATH.

While we have written these instructions as accurately and thoroughly as possible, they may not cover every system variation or contingency. Also, questions of interpretation may arise. For more information, solutions to particular problems or clarification contact your local distributor or the manufacturer. See the furnace rating plate for who to contact.

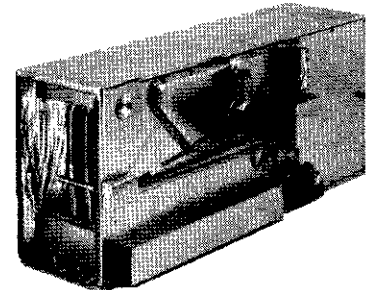
Furnace installation must follow all applicable NATIONAL, STATE and LOCAL CODES.



STANDING PILOT MODELS  
(4-012)



ELECTRONIC IGNITION MODELS  
(4-013)



INDUCED DRAFT MODELS  
(4-014)

**NOTE:** See Section 1 to identify furnace model you are installing.

**WARNING: FOR YOUR SAFETY, 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 THE BUILDING;
- IMMEDIATELY CALL YOUR GAS SUPPLIER FROM A NEIGHBOR'S PHONE; FOLLOW GAS SUPPLIER'S INSTRUCTIONS;
- IF YOU CANNOT REACH GAS SUPPLIER, CALL FIRE DEPARTMENT.

**IMPORTANT SAFETY NOTE:** After installing the furnace, show the user how to turn off gas and electricity to furnace. Point out control and switch locations for turning off gas and electricity. Go over Section 6 of Users' Information Manual and Section 31 in this manual with user. Warn user to keep insulating materials away from furnace and combustion and ventilation air openings into furnace space. Explain to user that these openings provide fresh air to furnace, which is important for proper operation. Make sure user understands the importance of following all safety precautions.

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## SECTION 1—PREPARING TO INSTALL FURNACE

**CAUTION:** To avoid potential furnace damage, remove cardboard shipping support from inside the blower wheel. It is opposite the blower motor.

### A. Signal Words.

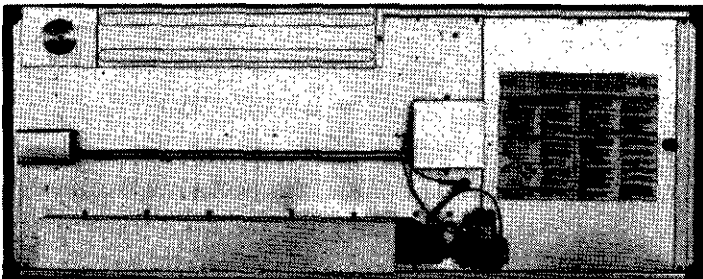
To alert you to potential hazards, we use the signal words "WARNING" and "CAUTION" throughout this manual. "WARNING" alerts you to situations that could cause serious injury or death.

"CAUTION" alerts you to situations that could cause minor or moderate injury or property damage.

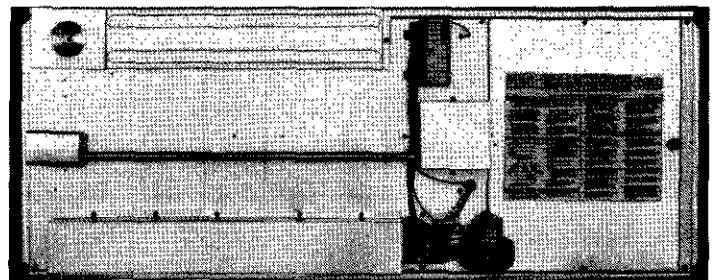
To help you, we use the words "must" and "should" in this manual. "Must" is mandatory. "Should" is advisory.

### B. Identifying Furnace.

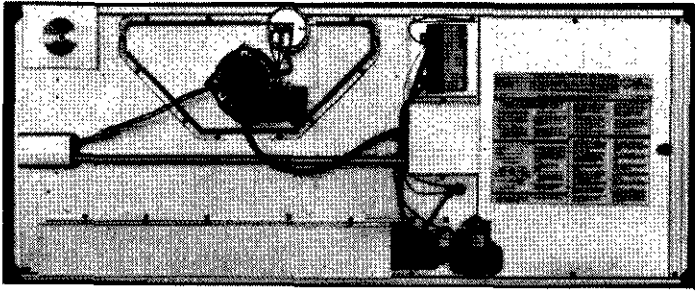
From these photographs, identify whether the furnace you are installing is a Standing Pilot, Electronic Ignition or Induced Draft model.



**STANDING PILOT MODEL**  
(4-015)



**ELECTRONIC IGNITION MODEL**  
(4-016)



**INDUCED DRAFT MODEL**  
(4-017)

**C. Locate all furnace parts.**

Review this manual, Users' Information Manual and Parts List. Complete Section 1 of Users' Information Manual, "Furnace Rating Plate Information." After installing furnace, give this Installers' Information Manual, Users' Information Manual, Warranty and Parts List to user.

You may have questions as you install the furnace. If you need clarification on any of the installation instructions or other matters relating to the furnace, contact the office where you purchased the furnace. You may also refer to the furnace rating plate for a contact name.

**D. Become familiar with furnace as-shipped.**

The blower compartments of Standing Pilot and Electronic Ignition models contain the draft diverter and heat deflectors. The vent limit switch (VLS) needed on Standing Pilot and Electronic Ignition models is located in the manual pack envelope. Be sure to locate and install these parts.

The blower compartments of Induced Draft models contain the heat deflector, draft inducer assembly, gasket and pressure switch. Be sure to locate and install these parts.

All other controls and components are factory wired, requiring only line voltage wiring of 115 volts to furnace. Wire room thermostat (24 volts) to terminal strip on furnace junction box. All wiring must conform to wiring diagram and to all applicable codes.

**E. Review procedures for moving furnace controls, draft diverter and draft inducer, if so equipped, to opposite side.**

For Standing Pilot and Electronic Ignition models, you may place controls on either furnace side. Draft diverter with VLS may also be on either side. Choose the sides best suiting your installation. See Section 12 for more information. You may also move components on Induced Draft models. Controls, draft inducer and pressure switch must be on the same side of the furnace. See Section 13 for more information.

**SECTION 2—FOLLOWING SAFETY RULES**

**WARNING:** READ AND EXACTLY FOLLOW THESE RULES. FAILURE TO DO SO COULD CAUSE IMPROPER FURNACE OPERATION, RESULTING IN DAMAGE, INJURY OR DEATH.

A. Use only the type of gas approved for this furnace; refer to furnace rating plate.

**WARNING:** ONLY USE NATURAL GAS IN FURNACES DESIGNED FOR NATURAL GAS. ONLY USE PROPANE (LP) GAS WITH FURNACES DESIGNED FOR PROPANE (LP) GAS. MAKE SURE FURNACE WILL OPERATE PROPERLY ON GAS TYPE AVAILABLE TO USER. DO NOT USE THIS FURNACE WITH BUTANE. USING WRONG GAS COULD CAUSE IMPROPER BURNER OPERATION, WHICH COULD RESULT IN NAUSEA, ASPHYXIATION, FIRE OR EXPLOSION.

B. DO NOT install this furnace outdoors or in a mobile home, trailer or recreational vehicle. It is not A.G.A. design-certified for these installations. This furnace is suitable for a home built on site or a manufactured home completed at final site.

C. Carefully choose furnace installation site. DO NOT directly expose furnace to drafts, wind or other outdoor conditions. See Section 8 for more information.

D. Provide adequate combustion and ventilation air to space where furnace is being installed. See Section 8 for more information.

E. Connect this furnace to an approved vent system, venting combustion products outdoors. See Section 9 for more information.

F. Never test for gas leaks with an open flame. Use a commercial soap made specifically for leak detection to check all connections. See Section 11 for more information.

G. Always install duct system with furnace. Be sure duct system has external static pressure within allowable furnace range. See Section 17 for more information.

H. Completely seal supply and return air ducts to furnace casing. Duct work must run to an area outside furnace air space. Seal duct work wherever it runs through walls, ceilings or floors. See Section 17 for more information.

**SECTION 3—MEETING CODES**

Before installing furnace, make sure you know all applicable codes. National, state and local codes take precedence over any instructions in this manual. Be sure to consult:

- Authorities having jurisdiction over furnaces;
- Local code authorities for information on electrical wiring, gas piping and vent pipe;
- Current National Fuel Gas Code ANSI Z223.1/NFPA 54;
- Current National Electrical Code ANSI/NFPA 70.

See Section 31 for information on obtaining copies of these codes.

**SECTION 4—DETERMINING BEST FURNACE LOCATION**

You may install the furnace in an attic, basement, crawl space, garage or alcove. Always install it with duct work. Refer to Section 17 for more information.

This furnace is suitable for installation in a home built on site or a manufactured home completed at final site. See Section 7 for proper attachment to manufactured home.

Select furnace location to meet all requirements in this manual, making sure to refer to:

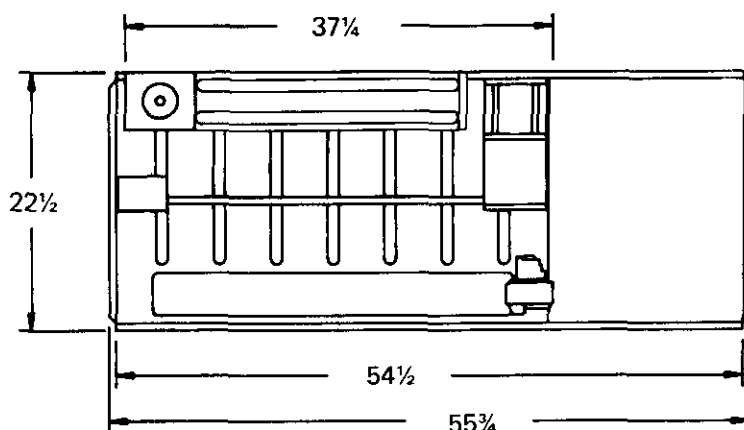
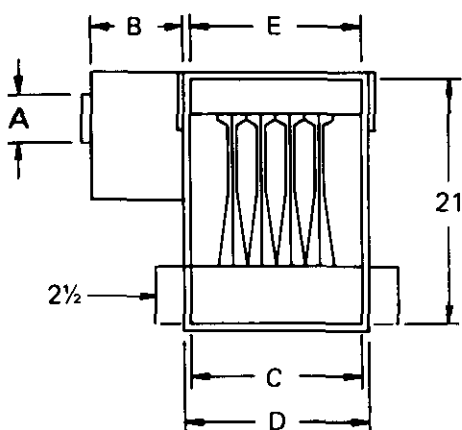
- Section 6 for minimum clearances;
- Section 7 for furnace suspension;
- Section 8 for combustion and ventilation air;
- Section 9 for venting;
- Section 11 for gas piping;
- Section 12 for location of controls, draft diverter and vent limit switch on Standing Pilot and Electronic Ignition models;
- Section 13 for location of controls, draft inducer and pressure switch on Induced Draft models;
- Section 14 for electrical wiring;
- Section 17 for duct work;
- Section 18 for filters.

Consult local code authorities for additional location requirements.

Carefully plan these important aspects to save time and money now and throughout the life of the furnace.

### SECTION 5—IDENTIFYING DIMENSIONS AND SPECIFICATIONS

Use this information to plan your furnace installation. First, identify whether the furnace is a Standing Pilot, Electronic Ignition or Induced Draft model. Then refer to the appropriate dimensional drawing and specifications table, either Figure 1 or Figure 2.

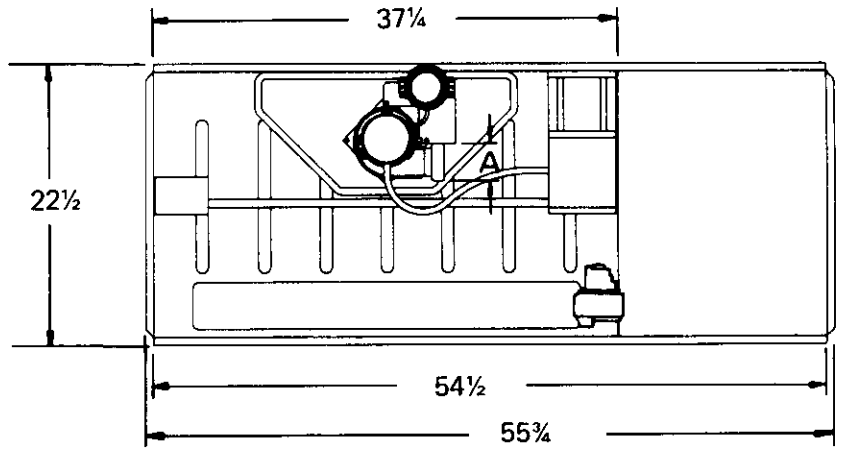
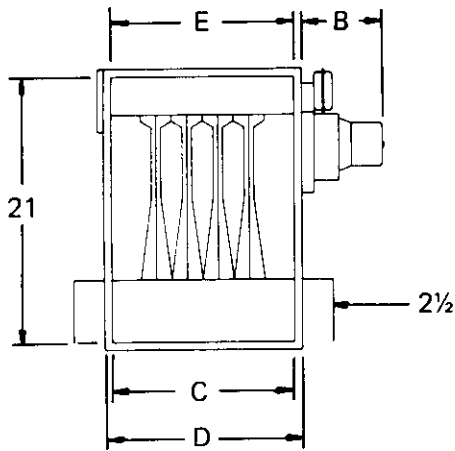


#### STANDING PILOT AND ELECTRONIC IGNITION

BTUH INPUT	HP	MOTOR TYPE	SPEEDS	VENT PIPE ("A")	DIVERTER DEPTH ("B")	PLENUM SIZE (21" X C")	FURNACE WIDTH ("D")	SUSPENSION LOCATION (37-1/4" X "E")	BLOWER SIZE	TEMP RISE (DEG.F)	MAXIMUM C.F.M. @ .50" W.C.
40,000 & 50,000	1/4	PSC	3	4"	8"	9-3/4"	11"	9-1/2"	10-4	25-55	1210
60,000 & 75,000	1/4	PSC	3	4"	8"	12-1/4"	13-1/2"	12"	10-6	30-60	1420
60,000 & 75,000	1/3	PSC	3	4"	8"	14-3/4"	16"	14-1/2"	10-8	25-55	1650
75,000	1/6	SP	1	4"	8"	12-1/4"	13-1/2"	12"	10-6	50-80	N/A
80,000 & 100,000	1/3	PSC	3	5"	8"	14-3/4"	16"	14-1/2"	10-8	35-65	1630
80,000 & 100,000	1/2	PSC	3	5"	8"	17-1/4"	18-1/2"	17"	10-10	25-55	1975
100,000	1/5	SP	1	5"	8"	14-3/4"	16"	14-1/2"	10-8	50-80	N/A
120,000	1/2	PSC	3	5"	11"	17-1/4"	18-1/2"	17"	10-10	35-65	1955
140,000	1/2	PSC	3	6"	11"	19-3/4"	21"	19-1/2"	10-10	40-70	1985

#### STANDING PILOT AND ELECTRONIC IGNITION MODELS

Figure 1 (4-001 & 4-002)



INDUCED DRAFT

BTUH INPUT	HP	MOTOR TYPE	SPEEDS	FLUE PIPE ("A")	DIVERTER DEPTH ("B")	PLENUM SIZE (21" X C")	FURNACE WIDTH ("D")	SUSPENSION LOCATION (37-1/4" X "E")	BLOWER SIZE	TEMP RISE (DEG.F)	MAXIMUM C.F.M. @ .50" W.C.
40,000	1/4	PSC	3	3"	7-1/4"	9-3/4"	11"	9-1/2"	10-4	35-65	1200
60,000	1/4	PSC	3	3"	7-1/4"	12-1/4"	13-1/2"	12"	10-6	30-60	1420
80,000	1/3	PSC	3	3"	7-1/4"	14-3/4"	16"	14-1/2"	10-8	30-60	1600
100,000	1/2	SP	3	3"	7-1/4"	17-1/4"	18-1/2"	17"	10-10	35-65	1950
120,000	1/2	PSC	3	3"	7-1/4"	19-3/4"	21"	19-1/2"	10-10	45-75	1950

INDUCED DRAFT MODELS

Figure 2 (4-034)

SECTION 6—ALLOWING FOR CLEARANCES

A. Establishing clearances from combustble material.

**WARNING:** DO NOT INSTALL THIS FURNACE IN A CLOSET. A FIRE COULD OCCUR, RESULTING IN DAMAGE, INJURY OR DEATH.

**WARNING:** THIS FURNACE IS A.G.A. DESIGN-CERTIFIED FOR DIRECT INSTALLATION ON WOOD FLOORING. DO NOT INSTALL ON CARPETING, TILE OR OTHER COMBUSTIBLE MATERIAL. A FIRE COULD OCCUR, RESULTING IN DAMAGE, INJURY OR DEATH.

**WARNING:** FURNACE INSTALLATION MUST MEET ALL MINIMUM CLEARANCES FROM COMBUSTIBLE MATERIAL SPECIFIED IN THIS MANUAL AND ALL APPLICABLE CODES. FAILURE TO PROVIDE REQUIRED CLEARANCE BETWEEN FURNACE AND COMBUSTIBLE MATERIALS COULD CAUSE A FIRE, RESULTING IN DAMAGE, INJURY OR DEATH.

To determine the required clearances from combustibles, you will need to answer questions about the size of the furnace installation space. Information to help you answer each question follows. For further information, consult current National Fuel Gas Code ANSI Z223.1/NFPA 54, Section 6.3.1.

1. Is installation space large compared to furnace size?

Compare total installation space volume to furnace volume. If installation space volume is at least 12 times furnace volume, consider it large.

CLEARANCES FROM COMBUSTIBLE MATERIAL FOR FURNACES WITH LARGE INSTALLATION SPACES

Top	2"
Outlet Air End*	6"
Inlet Air End	6"
Front	18"
Draft Diverter	6"
Draft Inducer	6"
Back	6"
Vent Connector	
Single Wall	6"
Type B1	1"

\*Clearance from supply ducts within 3 feet of plenum must not be less than 2". No clearance applies beyond this distance.

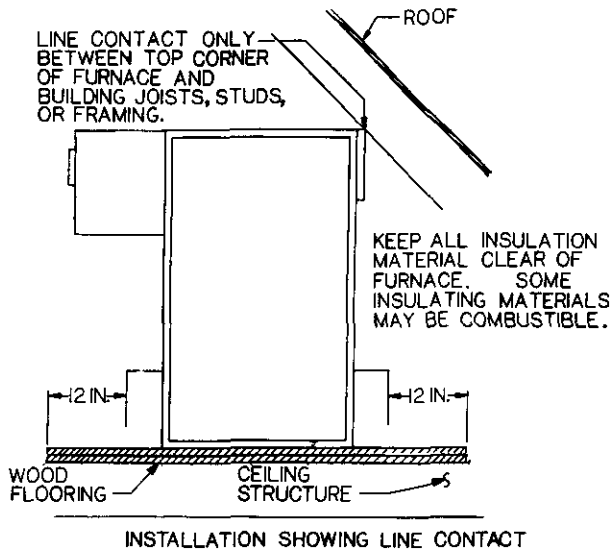
If installation space is large, use clearances above for clearances to combustibles.

You may install the furnace with less clearance from combustibles if you first protect combustibles or the furnace itself. See current National Fuel Gas Code ANSI Z223.1/NFPA54, Sections 6.3.1 and 6.3.2.

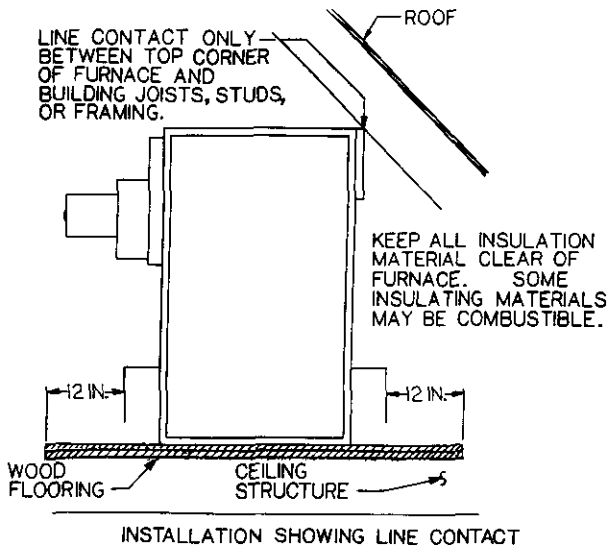
2. Is installation space in attic with line contact?

Installation spaces in attics are usually large compared to the furnace. Installation space may also require line contact.

Line contact to combustible material is permissible for furnaces installed in an attic. The intersection of the furnace top and sides forms a line; this line may be in contact with combustible material. Maintain a 6" clearance to vent connection. Refer to Figures 3 and 4.



**STANDING PILOT AND ELECTRONIC IGNITION MODELS**  
Figure 3 (4-004)



**INDUCED DRAFT MODELS**  
Figure 4 (4-039)

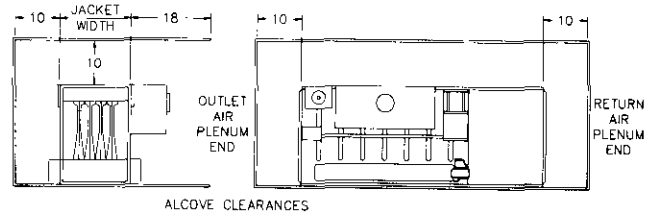
For attic installations, use a platform under the furnace area. The platform should extend at least 12" beyond the furnace on all four sides. This helps prevent insulation from being drawn into the combustion chamber. Refer to Figures 3 and 4.

**WARNING:** WHEN A FURNACE IS INSTALLED IN AN ATTIC OR OTHER INSULATED SPACE, KEEP ALL INSULATING MATERIALS AT LEAST 12" AWAY FROM FURNACE AND ALL BURNER COMBUSTION AIR OPENINGS. FAILURE TO DO SO COULD CAUSE NAUSEA, ASPHYXIATION OR FIRE, RESULTING IN DAMAGE, INJURY OR DEATH.

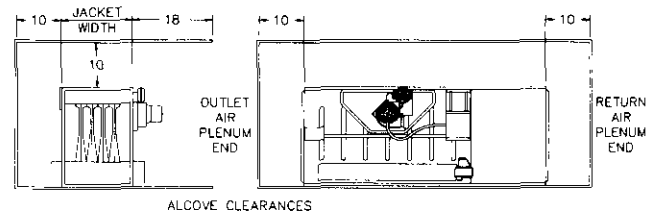
**NOTE:** Level furnace from front to back and from left to right within 1/4" per four feet.

3. Is installation space an alcove or small space compared to furnace size?

Horizontal furnaces are rarely installed in alcoves or small spaces. When the installation space is in an alcove or small space, the clearances for combustible materials are listed in Figures 5 and 6.



**STANDING PILOT AND ELECTRONIC IGNITION MODELS**  
Figure 5 (4-003)



**INDUCED DRAFT MODELS**  
Figure 6 (4-040)

4. Is the furnace going to be installed in a residential garage or a repair garage?

If the furnace is to be installed in a residential garage, burners and ignition sources must be at least 18" above the floor. Install the furnace to prevent it being hit by vehicles.

If the furnace is to be installed in a repair garage, select a location that is well protected from vehicles that will enter the garage. Some repair garages dispense or transfer fuel within the garage. If this is the case, additional furnace installation requirements apply. Refer to current National Fuel Gas Code ANSI Z223.1/NFPA 54, Section 5.1.10.b. for details.

**NOTE:** Level furnace from front to back and from left to right within 1/4" per four feet.

**B. Establishing clearances for service.**

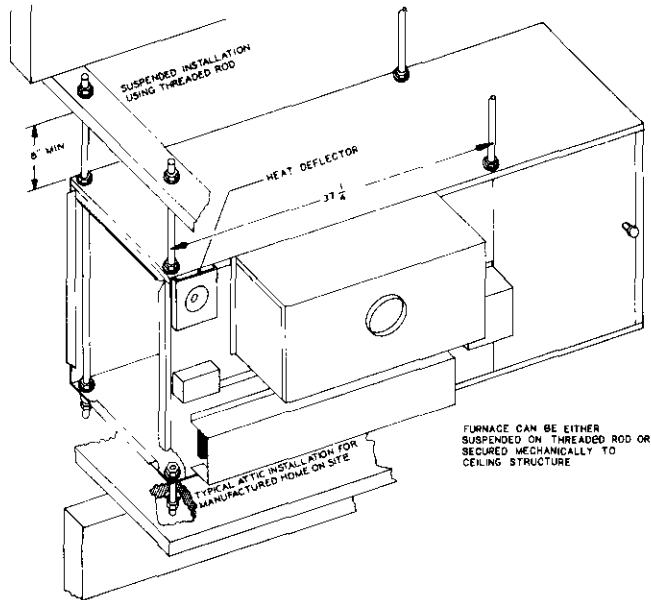
To permit easy access for cleaning of all heating surfaces, these clearances are desirable (but not required):

- Allow 48" between front of furnace (the side containing controls) and an adjacent wall or other appliances.
- Allow 24" between rear of furnace (the opposite side from the controls) and an adjacent wall or other appliances.

## SECTION 7—SUSPENDING FURNACE

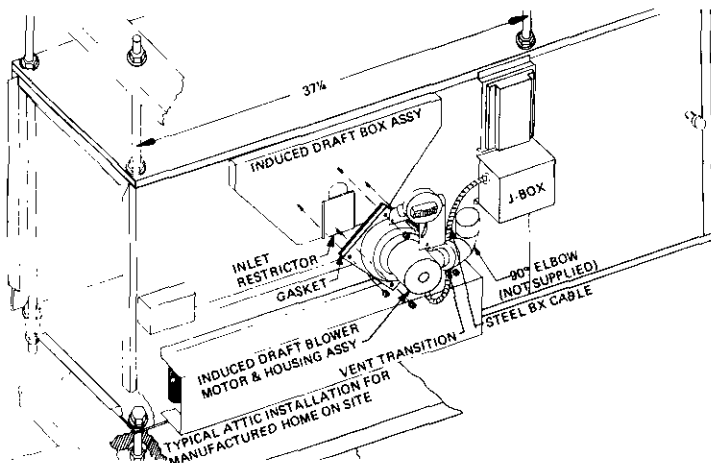
Suspend furnace from rafters or joists. A convenient way to do this is to insert 3/8" threaded rods through holes provided in furnace top and bottom panels. Secure them with washers and nylon lock nuts or equivalent. Refer to Figures 7 and 8. Alternate suspension means may be used.

**NOTE:** Level furnace from front to back and from left to right within 1/4" per four feet.



**STANDING PILOT AND ELECTRONIC IGNITION MODELS**

**Figure 7 (4-005)**



**INDUCED DRAFT MODELS**

**Figure 8 (4-046)**

When not suspended in a crawl space, elevate furnace off ground to minimize potential for water damage and allow clearance for air conditioning coil drain.

**NOTE:** Furnace must be level from front to back and from left to right within 1/4" per four feet.

Dwg. No. 21X146100 PO2

## SECTION 8—PROVIDING FOR COMBUSTION AND VENTILATION AIR

Before you begin installing furnace, plan to provide enough combustion and ventilation air following:

- Current National Fuel Gas Code ANSI Z223.1/NFPA 54, Section 5;
- Local code authorities.

Refer to Section 31 of this manual for these codes.

Ventilation is the process of replacing air which is required for furnace operation. The amount of ventilation air provided within structure must equal all requirements of the gas appliances in the building plus any air quantities removed by range hoods, exhaust fans, etc.

Another reason to supply fresh outdoor air for combustion and ventilation is that it dilutes contaminants found in indoor air. These contaminants include bleaches, cements, cleaning solutions, detergents, solvents, spray can propellants and most refrigerants.

**WARNING:** FURNACE AND ANY OTHER FUEL-BURNING APPLIANCES MUST HAVE ENOUGH FRESH AIR FOR PROPER COMBUSTION AND VENTILATION. LACK OF ADEQUATE COMBUSTION AND VENTILATION AIR COULD CAUSE NAUSEA OR ASPHYXIATION, RESULTING IN INJURY OR DEATH.

**WARNING:** DURING CONSTRUCTION, DO NOT USE AIR FROM INSIDE STRUCTURE FOR COMBUSTION AND VENTILATION. VAPORS FROM SOME CONSTRUCTION ADHESIVES AND MATERIALS CAN BECOME CORROSIVE IN THE PRESENCE OF A FLAME. THIS COULD CAUSE FAILURE OF HEAT EXCHANGER OR VENT SYSTEM, RESULTING IN DAMAGE, INJURY OR DEATH.

**WARNING:** COMBUSTION AND VENTILATION AIR THAT CONTAINS CHLORINE, FLUORINE, BROMINE AND IODINE COULD CAUSE HEAT EXCHANGER OR VENT SYSTEM FAILURE, RESULTING IN DAMAGE, INJURY OR DEATH.

**WARNING:** WHEN INSTALLING A FURNACE IN AN ATTIC OR OTHER INSULATED SPACE, KEEP IT FREE AND CLEAR OF ALL INSULATING MATERIALS. MAKE SURE ALL INSULATION IS AT LEAST 12" AWAY FROM BURNER COMBUSTION AIR OPENINGS AND WELL AWAY FROM OPENINGS INTO FURNACE SPACE THAT SUPPLY AIR FOR COMBUSTION AND VENTILATION. FAILURE TO DO THIS COULD CAUSE NAUSEA, ASPHYXIATION OR FIRE, RESULTING IN DAMAGE, INJURY OR DEATH.

Provide adequate combustion and ventilation air by considering volume of furnace installation space. Use the instructions that follow and current National Fuel Gas Code ANSI Z223.1/NFPA 54 to determine whether the furnace is in an unconfined space or a confined space. Do not install furnace where any combustion or ventilation air openings will allow outside air to blow directly against it.

**WARNING:** DRAFTS BLOWING DIRECTLY AGAINST FURNACE COULD CAUSE IMPROPER IGNITION. THIS COULD CAUSE HEAT EXCHANGER FAILURE OR FIRE, RESULTING IN DAMAGE, INJURY OR DEATH.

### A. Determining if your space is confined or unconfined.

Two factors determine whether a furnace installation space is confined or unconfined:

- Volume of installation space;
- Total gas input of appliances to be installed in that space.

To determine which your space is:

1. First calculate installation space volume in cubic feet.
2. Determine combined input rating (BTUH) of all gas appliances except furnace in furnace installation space. Then add furnace input (BTUH) for your total combined input rating.
3. Divide total combined input rating by 1,000. Then divide this number into installation space volume. Here's the formula:

$$\frac{\text{Space Volume}}{\text{Total input} \div 1,000} = \text{Ratio}$$

If ratio is less than 50, installation space is a confined space. If ratio is 50 or greater, installation space is an unconfined space.

### B. Installing furnace in unconfined space.

Refer to current National Fuel Gas Code ANSI Z223.1/NFPA 54 for more information. This code does not require that you make special provisions for combustion and ventilation air for a furnace installed in an unconfined space. However, it is always prudent to arrange for combustion and ventilation air as if installation space is a confined space.

In the past, infiltration through loose construction provided enough air for combustion and ventilation when furnace was in an unconfined space. Current construction methods may now prevent infiltration of air into unconfined space. These current methods include increased insulation, vapor barriers, tight fitting doors and windows and weatherstripping.

### C. Installing furnace in confined space.

1. Combustion and ventilation air openings.

For furnaces in confined spaces, you must provide two permanent air openings to the outdoors. These combustion and ventilation openings will give fresh air free access to furnace space for combustion and ventilation. You must also provide for all other gas appliances within furnace space. You can also duct combustion and ventilation air to furnace space. These ducts must freely access outdoors or spaces which access the outdoors. Well ventilated attics or crawl spaces usually satisfy this requirement.

**WARNING: YOU MUST PROVIDE PERMANENT AIR OPENINGS TO A CONFINED SPACE FROM ANOTHER AREA AS DESCRIBED ABOVE. FAILURE TO DO SO COULD RESULT IN INADEQUATE COMBUSTION AND VENTILATION AIR. THESE COULD CAUSE NAUSEA, ASPHYXIATION OR FIRE, RESULTING IN DAMAGE, INJURY OR DEATH.**

Wherever practical, locate one combustion and ventilation air opening within 12" of ceiling furnace space. Locate another within 12" of floor. In all cases, provide openings of required minimum free area listed below.

If combustion air ducts will run vertically, each opening must have a minimum free area of one square inch per 4,000 BTU/HR total combined input rating. You must consider all gas appliances within the furnace space.

If combustion air ducts will run horizontally, each opening must have a minimum free area of one square inch per 2,000 BTU/HR total combined input rating. You must consider all gas appliances within the furnace space.

2. Louvers, grilles and screens

Sometimes louvers, grilles or screens cover combustion and ventilation air openings. If so, you must provide larger openings than those calculated above. This is necessary because louvers, grilles and screens block and reduce an opening's free area.

Louver, grille and screen manufacturers supply technical data on their products, which usually includes the "free area." Sizing the openings with louvers, grille or screen in place will provide minimum free area to furnace space as calculated above. Do not use screen smaller than 1/4" mesh. If you do not know free area, assume that wood louvers have 20 to 25% free area. Assume metal louvers and grilles have 60 to 75% free area. Refer to current National Fuel Gas Code ANSI Z223.1/NFPA 54.

Example: Furnace is 100,000 BTU/HR input and is to be installed in a confined space that contains no other gas appliances. Combustion and ventilation air ducts will run horizontally to furnace space.

- a. Calculate free area required

Because combustion and ventilation ducts run horizontally, allow 2,000 BTU/HR.

$$\frac{\text{Furnace Input BTU/HR}}{2,000 \text{ BTU/HR per square inch}} = \text{Free Area Required}$$

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

Each opening must have a free area of 50 square inches.

- b. Calculate overall area of openings to give needed free area once you cover them to keep out rain and other outside elements.

Example: If you will use wood louvers to cover combustion and ventilation air openings and you do not know free area of wood louvers, use 20%, as suggested in ANSI Z223.1/NFPA 54.

$$\frac{100 \times \text{Free area from a) above}}{\text{Louver free area, expressed as a percentage.}} = \text{overall area of openings with wood louvers installed}$$

$$\frac{100 \times 50}{20} = 250 \text{ square inches}$$

Each of the two combustion and ventilation air openings must have a total area of 250 square inches. This is when wood louvers cover openings for a 100,000 BTU/HR input furnace and combustion and ventilation air ducts run horizontally.



**WARNING:** YOU MUST FIX COMBUSTION AND VENTILATION AIR LOUVERS AND GRILLES IN OPEN POSITION OR INTERLOCK THEM WITH FURNACE OPERATION. FURNACE OPERATION WITH LOUVERS OR GRILLES CLOSED COULD CAUSE INADEQUATE COMBUSTION OR VENTILATION AIR, RESULTING IN INJURY OR DEATH.

### 3. Ducts.

When ducts introduce combustion and ventilation air from outside structure into furnace space, they must have the same cross sectional area as the free area of openings which they connect. In paragraph 2) above, the free area required from the first example was 50 square inches per opening. Let's say you choose a rectangular duct with one dimension of 3". Other duct dimension must be at least 16-2/3". This is calculated by dividing the 50 square inches by 3", which equals 16-2/3".

### D. Allowing for exhaust fan operation.

1. When furnace is in a ventilated attic, crawl space, residence garage or outside the heated space, exhaust fan drafts can adversely affect its operation. These drafts can come from kitchens, bathrooms, clothes dryers or anywhere within the heated space.

**WARNING:** EXHAUST FANS THAT BLOW AGAINST FURNACE COULD CAUSE HEAT EXCHANGER FAILURE OR FIRE, RESULTING IN DAMAGE, INJURY OR DEATH.

2. When furnace is in a repair garage or inside the heated space, exhaust fans can adversely affect its operation. Exhaust fans in kitchens, 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 furnace. A fireplace also reduces amount of combustion and ventilation air. You must allow for these reductions.

**WARNING:** YOU MUST ALLOW FOR REDUCTION OF AIR AVAILABLE FOR COMBUSTION AND VENTILATION BY EXHAUST FANS AND FIREPLACES. FAILURE TO DO SO COULD RESULT IN INADEQUATE COMBUSTION AND VENTILATION AIR. THIS COULD CAUSE NAUSEA, ASPHYXIATION OR FIRE, RESULTING IN DAMAGE, INJURY OR DEATH.

3. Exhaust fan air may contain compounds of chlorine, fluorine, bromine and iodine. If used for combustion, this contaminated air will adversely affect furnace operation.

**WARNING:** IF USED FOR COMBUSTION AND VENTILATION, CONTAMINATED EXHAUST FAN AIR COULD CAUSE HEAT EXCHANGER OR VENT SYSTEM FAILURE, RESULTING IN DAMAGE, INJURY OR DEATH.

## SECTION 9—PROVIDING FOR PROPER VENTING

Vent furnace using these instructions and Part 7 and Appendix G of current National Fuel Gas Code ANSI Z223.1/NFPA 54. Also, meet requirements of local utilities and other local code authorities. You must connect furnace to a vent or factory-built chimney or a suitably sized, constructed and lined masonry chimney. Vent or factory-built chimney must meet a recognized standard. Chimney lining method

and material must comply with local requirements. Use corrosion-resistant material meeting nationally recognized standards for vent construction.

**WARNING:** INADEQUATE VENT OR CHIMNEY COULD ALLOW COMBUSTION PRODUCTS TO COLLECT IN STRUCTURE, RESULTING IN INJURY OR DEATH.

**WARNING:** VENT THIS FURNACE SEPARATELY FROM ANY APPLIANCE DESIGNED TO BURN SOLID FUEL, PARTICULARLY WOOD-BURNING OR COAL-BURNING APPLIANCES. IMPROPER VENTING COULD ALLOW COMBUSTION PRODUCTS TO COLLECT IN STRUCTURE, RESULTING IN DAMAGE, INJURY OR DEATH.

### A. Venting category.

The furnaces covered by this manual are design-certified as CATEGORY 1 for venting. CATEGORY 1 furnaces have non-positive vent static pressure and rely on the heat content of combustion products to vent. Our Induced Draft models have draft inducers. Our Standing Pilot and Electronic Ignition models do not have draft inducers. Sidewall venting of our furnace is not allowed unless you add a power venter manufactured by others. Install in accordance with their instructions.

On the other hand, CATEGORY 3 and 4 furnaces do have positive vent static pressure. Heat content of combustion products alone is not enough to vent properly. Most CATEGORY 3 and 4 furnaces have draft inducers. These furnaces rely on mechanical or other positive means to vent properly. This means some CATEGORY 3 and 4 appliances may be sidewall vented.

A reminder: Some gas appliances operate with non-positive vent static pressure and are classified as CATEGORY 1, as are our furnaces. You may common vent CATEGORY 1 appliances. Other gas appliances operate with positive vent static pressure, such as CATEGORY 3 and 4 furnaces. You may not common vent CATEGORY 3 and 4 furnaces. You also may not common vent our CATEGORY 1 furnaces and CATEGORY 3 and 4 appliances.

### B. Types of vent systems.

These definitions will help you understand the terms we use.

1. "Vent" and "chimney" refer to open passageways. These passageways convey vent gases from vent connectors to the outside. Gases begin their final ascent at the vent or chimney. 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.
2. A "vent connector" connects a gas appliance to a vent or chimney. Vent connectors usually run directly from the furnace draft diverter collar or draft inducer collar to vent or chimney. Vent connectors may have vertical and horizontal runs.
3. A "venting system" is a continuous open passageway from the draft diverter collar or draft inducer collar to the outside. Venting systems usually have 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.

**C. Design considerations.**

**1. General considerations.**

Avoid oversizing 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.

- a. Too small a vent cannot carry all combustion products outdoors. Too large a vent will not vent combustion products rapidly enough to avoid potential for condensation. An old rule of thumb, "When in doubt, use next larger vent size," should now be, "When in doubt, refer to manufacturer's instructions and current National Fuel Gas Code ANSI Z223.1/NFPA 54."
- b. Vent height must be a minimum of five feet. Minimize vent connector horizontal runs to the extent possible for best performance. On Standing Pilot and Electronic Ignition models, horizontal runs should not exceed two-thirds of the vent or chimney's vertical height. On Induced Draft models, vent connector horizontal runs must not exceed ten feet.
- c. The designer must consider the building's orientation, answering these 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.
- d. If your local experience indicates possible condensation problems, provide for draining and disposal of venting system condensate.
- e. Because horizontal furnaces are usually located in unoccupied spaces such as attics or crawl spaces, single-wall vent pipe is seldom used. When it is, refer to Section 7 of current National Fuel Gas Code ANSI Z223.1/NFPA 54.

**2. Vent sizing.**

- a. Sometimes the horizontal distance from 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 BTUH input of other gas appliances served by the vent. Check these parameters to be sure the venting system will work. Use approved engineering practices, these instructions, and Part 7 and Appendix G of current National Fuel Gas Code ANSI Z223.1/NFPA 54. Use vent capacity tables to check existing or new vent sizes for CATEGORY 1 furnaces.
- b. Figure 9 is a vent capacity table for Type B vent serving a single appliance. For single appliance situations not covered in the table, compute using the listed values. For multiple appliance (common venting) and multi-story installations, refer to current National Fuel Gas Code ANSI Z223.1/NFPA 54.
- c. Minimum vent connector diameter from furnace to vent or chimney is same as draft diverter collar or draft inducer collar.

**Capacity of Type B Double-Wall Vent with Type B Vent Connectors Serving a Single Appliance**

Vent Height M	See Below	Horizontal Run L	Vent Diameter-D			
			3"	4"	5"	6"
Maximum Input Rating in 1000s BTUH						
6'	*	0'	46	86	141	205
	*	2	36	67	105	157
	*	4	34	64	103	153
	*	6	32	61	100	149
8'	*	0'	50	94	155	235
	*	2	40	75	120	180
	*	5	38	71	114	173
	*	8	35	66	109	165
10'	*	0'	53	100	166	255
	*	2	42	81	129	195
	*	6	39	76	122	185
	*	10	36	70	115	175
15'	*	0'	58	112	187	285
	*	2	48	93	150	225
	*	5	45	90	145	219
	*	10	43	83	136	208
	*	15	37	76	128	198
20	*	0'	61	119	202	307
	*	2	51	100	166	249
	*	10	44	89	150	228
	*	12	42	87	147	224
	*	20	35	78	134	206
25		0'	62	123	211	321
		2	54	106	176	265
		10	48	96	162	246
		16	42	84	151	231
		25	NR	NR	135	222
30'	*	0'	64	128	220	236
	*	2	56	112	185	280
	*	20	NR	90	154	237
	*	30	NR	NR	NR	219

\*Values from National Fuel Gas Code, Appendix G. Other values are calculated from National Fuel Gas Code, Appendix G. All values in Figure 9 assume two 90-degree elbows. Each additional elbow reduces the capacity of the vent by 10%. (NR means not recommended.)

**Figure 9**

- d. There is a minimum area for a common vent or chimney. Calculate by taking the largest vent connector area and adding 50 percent of the additional flue collars, draft diverter collar and draft inducer collar areas. This is the minimum effective common vent area required. See Table G-7 in current National Fuel Gas Code ANSI Z223.1/NFPA 54.

**3. Vent connector.**

- a. Vent connectors must be made of noncombustible, corrosion-resistant material capable of withstanding vent gas temperatures. They must be thick enough to withstand physical damage and accessible for inspection, cleaning and replacement.

- b. Use Type B vent connectors in or through attics, crawl spaces or other cold areas. Induced draft models use a single wall elbow (field-supplied) at the inducer outlet. Install thimbles that meet local codes when vent connectors pass through walls or partitions of combustible material.
- c. Keep vent connectors as short as possible by locating furnace as close as practical to vent or chimney. Avoid unnecessary turns or bends which create resistance to flow of vent gases. Adding an elbow adds resistance. For example, adding a 6" elbow would be the equivalent of adding 20 feet of horizontal 6" pipe. 45-degree elbows have lower resistance than 90-degree elbows, and can work for most vent runs.
- d. 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 draft diverter collar or draft inducer collar, allowing for necessary adapters and fittings.
- e. If you join two or more vent connectors before they enter the vertical vent or chimney, use caution. See Section 7.10.3.d. of current National Fuel Gas Code ANSI Z223.1/NFPA 54 for details.

- f. Do not connect CATEGORY 1 furnaces to any portion of a vent system which operates under positive pressure. Positive pressure would result with CATEGORY 3 and 4 appliances connected to the vent.

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

4. Vertical vent or chimney.

- a. Vents and chimneys usually extend vertically with offsets not exceeding 45-degrees. Consider vent pipe runs more than 45-degrees as horizontal runs. Include their length in the total horizontal run above.
- b. Designer and installer must provide an appropriately sized common vent for all appliances connected to it. Consult current National Fuel Gas Code ANSI Z223.1/NFPA 54 for common vent sizes for multiple gas appliances and multi-story installations.

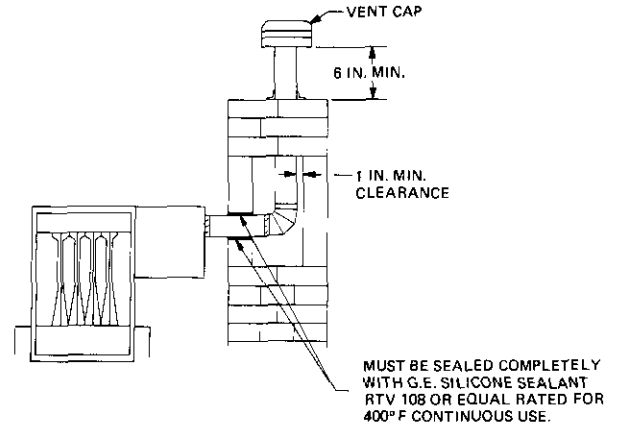
Connect this CATEGORY 1 furnace only to vent systems with other CATEGORY 1 appliances.

**WARNING: DO NOT CONNECT THIS CATEGORY 1 FURNACE TO A VENT SYSTEM USED BY CATEGORY 3 AND 4 APPLIANCES. DO NOT CONNECT IT TO VENTS WITH MECHANICAL DRAFT SYSTEMS OPERATING AT POSITIVE PRESSURE. IMPROPER VENTING COULD ALLOW COMBUSTION PRODUCTS TO COLLECT IN STRUCTURE DURING USE, RESULTING IN DAMAGE, INJURY OR DEATH.**

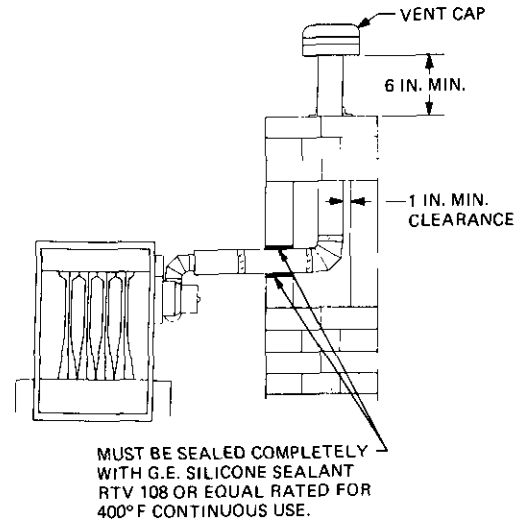
5. Chimney.

Furnace is suitable for venting into a properly sized and lined masonry chimney. Consult current National Fuel Gas Code ANSI Z223.1/NFPA 54 for construction details. If chimney is

oversized, liner is inadequate or evidence of condensate exists, consider using chimney as a pathway for a suitably sized type B vent liner. See Figure 10 and 11.



**STANDING PILOT AND ELECTRONIC IGNITION MODELS**  
Figure 10 (4-006)



**INDUCED DRAFT MODELS**  
Figure 11 (4-041)

**WARNING: SUPPORT TYPE B VENT LINER IN MASONRY CHIMNEY. MAINTAIN AT LEAST A 1" CLEARANCE ON ALL SIDES TO REDUCE POSSIBILITY OF CONDENSATE IN VENT. CONDENSATE MAY CAUSE VENT TO DETERIORATE ALLOWING COMBUSTION PRODUCTS TO COLLECT IN STRUCTURE, WHICH COULD RESULT IN INJURY OR DEATH. SEE FIGURE 12.**

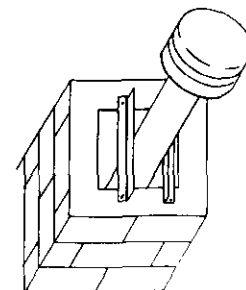


Figure 12 (4-009)

Sometimes you will use the remaining common vent free area for venting other appliances. When you do, check remaining area between Type B vent liner and masonry chimney. Be sure it is large enough to vent those appliances.

**WARNING: VENT LINER MUST NOT BLOCK OPENING WHERE OTHER APPLIANCES' VENT CONNECTORS ENTER CHIMNEY. BLOCKED OPENINGS COULD CAUSE COMBUSTION PRODUCTS TO COLLECT IN STRUCTURE, RESULTING IN DAMAGE, INJURY OR DEATH.**

**WARNING: DO NOT USE UNLINED MASONRY CHIMNEYS. THESE INCREASE RISK OF CONDENSATE FORMATION, WHICH MAY CAUSE CHIMNEY TO DETERIORATE, ALLOWING COMBUSTION PRODUCTS TO COLLECT IN STRUCTURE. THIS COULD RESULT IN DAMAGE, INJURY OR DEATH.**

6. Vent termination.

- a. 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 13.

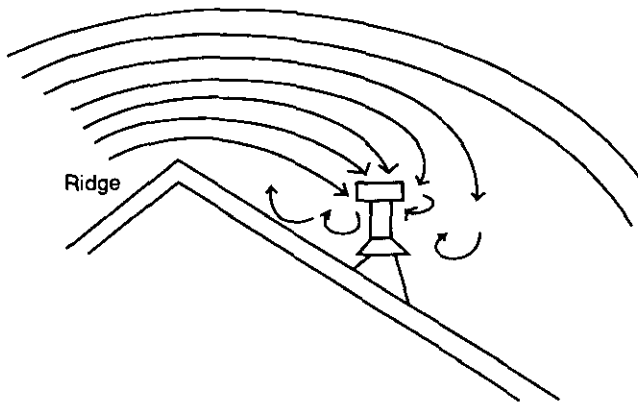
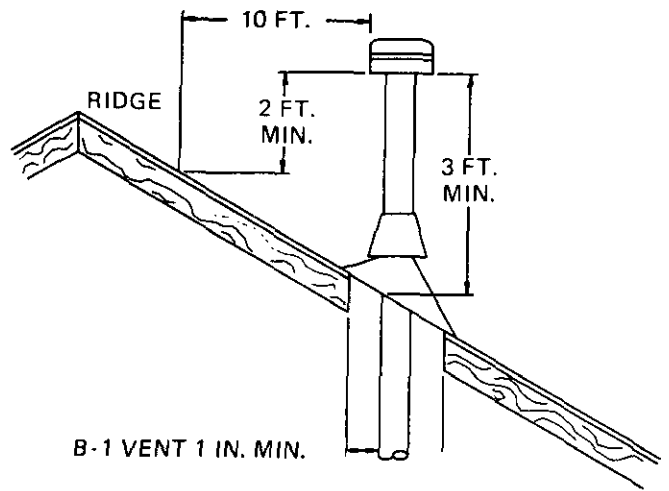


Figure 13 (4-009)

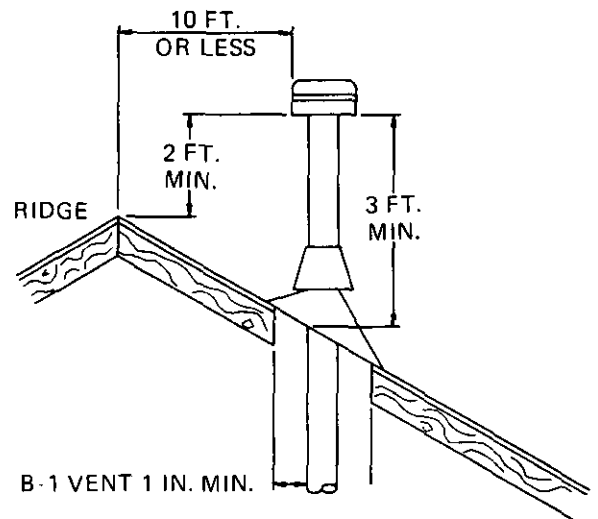
Some vent terminations or caps protect against eddy currents and down-drafts. Consult their manufacturer's instructions. Vent terminations or caps should usually be at least the same size as the vent. They may be larger if the installation warrants.

- b. 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 roof. Vent termination must be at least two feet higher than any portion of building within ten feet horizontal and vent termination must be at least two feet higher than roof peaks within ten feet horizontal. See Figures 14 and 15. Some vent cap manufacturers offer vent caps that allow reduced clearances. Consult their instructions.



TERMINATION MORE THAN 10 FEET FROM RIDGE.

Figure 14 (4-007)



TERMINATION 10 FT. OR LESS FROM RIDGE.

Figure 15 (4-008)

**WARNING: FAILURE TO PROPERLY TERMINATE VENT OR CHIMNEY SYSTEMS COULD ALLOW COMBUSTION PRODUCTS TO COLLECT IN STRUCTURE, RESULTING IN INJURY OR DEATH.**

- c. Terminate venting system at least three feet above any forced-air building inlet within ten feet. Consider doors, windows and gravity air building inlets. Locate vent termination at least four feet below, four horizontal feet from or one foot above any of these openings.
- d. Electronic Ignition and Standing Pilot models have a vent limit switch. Undersized or restricted vents can cause spillage at draft diverter, causing vent limit switch to open.

Oversized venting systems with excessive heat loss can cause vent gases to lose momentum. Gases may linger in the vent limit switch area long enough for it to open. In grossly oversized vents, the heat loss can overcome vent gas momentum resulting in continuous spillage and opening of the vent limit. If the vent limit switch has opened, correct the venting problem. Then reset the switch.

#### D. Installation.

##### 1. Vent connectors.

Attach vent connector at draft diverter collar or draft inducer collar. Use a minimum of three equally spaced screws around connection. Connect all other vent pipes the same way. 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 STRUCTURE WHICH COULD RESULT IN INJURY OR DEATH.**

Install vent connectors without any dips or sags. Slope them upward at least 1/4" per foot. To prevent sagging, at each joint support vent connectors and horizontal portions using hinges, straps or equivalent. Seal all connections to vent or lined chimney.

To avoid blockage, attach vent connector to a masonry chimney above the extreme bottom. For inspection ease, use thimble or slip joint to make vent connector removal easy. Firmly attach connector. Insert all vent connectors into, but not beyond, inside chimney wall.

##### 2. Vertical vent or chimney systems.

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.

#### E. Existing vent considerations.

Masonry chimneys previously used for venting solid fuel or oil burning equipment should be lined with suitable metal liner. Also provide an accessible cleanout per Section 7.5.7 of current National Fuel Gas Code ANSI Z223.1/NFPA 54.

##### 1. Inspection of vents (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 necessary corrections.
- Examine vent or chimney cleanouts 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 current National Fuel Gas Code ANSI Z223.1/NFPA 54. Rebuild a chimney to meet national standards.

**WARNING: AN INADEQUATE VENT OR CHIMNEY COULD ALLOW COMBUSTION PRODUCTS TO COLLECT IN STRUCTURE, RESULTING IN INJURY OR DEATH.**

- Sometimes you will replace a common vented appliance. Make sure common vent size is correct for all appliances connected to it. If you remove a furnace from a common vent without replacing it, the vent will likely be too large for remaining appliances.
- The following steps shall be followed with each appliance remaining connected to common venting system placed in operation, while other appliances remaining connected to common venting system are not in operation.
  - Seal any unused openings in common venting system.
  - Visually inspect venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion and other deficiencies which could cause an unsafe condition.
  - Insofar as is practical, close all building doors and windows and all doors between space in which appliances remaining connected to common venting system are located and other spaces of building. Turn on clothes dryers and any appliance not connected to common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.
  - Follow lighting instructions. Place appliance being inspected in operation. Adjust thermostat so appliance will operate continuously.
  - Test for spillage at draft hood relief opening after 5 minutes of main burner operation. Use flame of a match or candle.
  - After it has been determined that each appliance remaining connected to common 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.
  - If improper venting is observed during any of the above tests, common venting systems must be corrected.

**Note:** Follow current National Fuel Gas Code ANSI Z223.1/NFPA 54 to correct improper common vent operation. Any common vent resizing must approach minimum size determined using Appendix G of current National Fuel Gas Code ANSI Z223.1/NFPA 54.

## SECTION 10 —GATHERING THE TOOLS NEEDED FOR INSTALLATION

ITEM	TOOL DESCRIPTION	USED FOR
<b>A. Hand Tools</b>		
1.	Carton knife	Furnace removal from carton
2.	1/4" wrench (open or box end)	Junction box cover
3.	1/4" nut driver	Electronic ignition lockout module
4.	5/16" nut driver	Casing, draft diverter and blower
5.	3/8" nut driver	Blower and motor mounts
6.	1/4" x 8" straight-blade screwdriver	Wire terminals and clamps; manifold pressure adjustment
7.	1/8" x 6" straight-blade screwdriver	Pilot gas flow adjustment
8.	1/4" x 2" or 1/4" offset, straight-blade screwdriver	Terminal strip, if draft diverter and controls are on same side of furnace
9.	#2 x 8" Phillips screwdriver	Components in junction box, fan/limit control, gas control and pilot burner
10.	3/8" open end or tubing wrench	Thermocouple on standing pilot furnace
11.	7/16" open end or tubing wrench	Pilot line and main burner orifices
12.	1/2" open end wrench	Pilot tubing to pilot housing backup
13.	2-8" to 14" pipe wrenches	Gas control relocation and gas pipe installation
14.	4" adjustable wrench	Blower wheel set screw tightening
15.	8" channel-lock pliers	Strain reliefs and knockouts
16.	3/16" Allen wrench	Inlet and outlet pressure tap plug removal from gas control
17.	Wire cutters	Motor speed change and controls reversing
18.	Wire strippers	Motor speed change and controls reversing
<b>B. Supplies</b>		
19.	Wire nuts	Motor speed change and controls reversing
20.	Pipe thread sealant suitable for use with propane (LP) gas	Gas pipe and controls
21.	Bottle of soap solution	Gas leak checking
22.	2-1/8" pipe, manual shutoff valves	Gas control inlet and outlet pressure checking
<b>C. Test Instruments</b>		
23.	Volt meter with 50 and 150 volt ranges	Electrical check of controls and power supply
24.	Clamp around ammeter with 10-amp and higher ranges	Amp draw of motors and control check

25.	10-turn coil of wire to fit on ammeter	Room thermostat heat anticipator setting
26.	"U" Tube Water Manometer with 0.1" resolution, 0" to 15" W.C. range	Gas pressure measurement
27.	Slope gauge with 0.01" resolution, pressure measurement taps and tubing, 0 to 1" W.C. range	Duct work static pressure
28.	2 thermometers with 1-degree Fahrenheit resolution, 50 degrees F to 175 degrees F range	Temperature rise measurement through furnace
29.	Stopwatch	Gas input meter timing
30.	Torque wrench (100 inch-pounds)	Proper screw installation

## SECTION 11— INSTALLING GAS PIPING

Equipment needed: Save time by getting these tools before you start: Item numbers 13, 20, and 21 listed in Section 10.

### A. Preparation.

Gas piping must meet requirements of current National Fuel Gas Code ANSI Z223.1/NFPA 54 and local codes. Size of pipe running to furnace depends on:

- Length of pipe;
- Number of fittings;
- Specific gravity of gas;
- Input requirements (BTU/HR) of all gas-fired appliances attached to same main supply line.

Refer to current National Fuel Gas Code ANSI Z223.1/NFPA 54 for correct gas pipe sizing information.

Plan furnace gas supply piping so it will not interfere with removal of manifold and burner rack from furnace for servicing. Always use a pipe thread sealant which is resistant to propane (LP) gas solvent action. Sparingly apply sealant to all joints on male threads only, starting two threads back from end.

### B. Installation.

1. Install A.G.A. listed manual shut-off valve as an in-line shut-off valve immediately upstream of furnace in gas supply line. Install 1/8" NPT plugged tapping accessible for test gage connection. Omit separate, plugged tapping if local area accepts plugged tapping in gas control inlet.
2. After in-line manual shut-off valve, install a drip leg (sediment trap) at gas supply line inlet connection to furnace. A convenient way to do this when you have reduced bottom clearance is to make drip leg by using a 1/2" to 1" NPT Tee. Then, install a 1-1/2" long, 1" NPT nipple in Tee with a 1" NPT pipe cap to complete drip leg.
3. When black iron gas pipe is used, install an A.G.A.-listed ground joint union between drip leg (sediment trap) and furnace gas control. Locate ground joint union to allow easy burner servicing.

4. Install gas pipe to inlet side of furnace gas control. Use projecting gas control boss for backup wrench application.

**WARNING:** ALWAYS USE A BACKUP WRENCH ON GAS CONTROL PROJECTING BOSS. DO NOT THREAD GAS PIPE TOO FAR. DOING SO MAY CAUSE BOSS TO SPLIT OR CRACK WHICH COULD CAUSE A GAS LEAK OR DISTORTION OR MALFUNCTION OF GAS CONTROL. THESE COULD CAUSE A FIRE OR EXPLOSION RESULTING IN DAMAGE, INJURY OR DEATH.

5. Isolate gas control from gas supply line pressure during leak check. Gas supply line test pressure determines how you isolate gas control.

**WARNING:** AT GAS SUPPLY LINE, TEST PRESSURE EQUAL TO OR LESS THAN 14 INCHES W.C. (1/2 PSI). ISOLATE GAS CONTROL FROM GAS SUPPLY LINE BY TURNING BROWN FURNACE GAS CONTROL KNOB CLOCKWISE TO OFF POSITION. UNEXPECTED SURGES COULD DAMAGE GAS CONTROL CAUSING GAS TO LEAK, RESULTING IN FIRE OR EXPLOSION.

**WARNING:** WHEN TEST PRESSURE IS ABOVE 14 INCHES W.C. (1/2 PSI), COMPLETELY DISCONNECT GAS CONTROL FROM GAS SUPPLY LINE. FAILURE TO ISOLATE GAS CONTROL FROM TEST PRESSURE COULD DAMAGE IT, CAUSING GAS LEAK WHICH COULD RESULT IN FIRE OR EXPLOSION.

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

**WARNING:** NEVER USE AN OPEN FLAME TO CHECK FOR GAS LEAKS. IF A LEAK DOES EXIST, A FIRE OR EXPLOSION COULD OCCUR, RESULTING IN DAMAGE, INJURY OR DEATH.

## SECTION 12—STANDING PILOT AND ELECTRONIC IGNITION MODELS ONLY--LOCATION OF GAS AND ELECTRICAL CONTROLS, DRAFT DIVERTER AND VENT LIMIT SWITCH

See Section 13 for Induced Draft models.

Equipment needed: Save time by getting these tools before you start: Item numbers 2, 4, 6, 8, 9, 10, 11, 12, 13, 15, 17, 18, 19, 20 and 30 listed in Section 10.

### A. Before you start.

Install furnace with gas and electrical controls in one of two positions. You may leave gas and electrical controls in as-shipped position as shown in position "A" in Figure 16, or you may relocate the controls to position "B" in Figure 16.

Install draft diverter in one of two positions: either as-shipped as shown in position "C" in Figure 16, or relocated to position "D" shown in Figure 16. Install vent limit switch (VLS) on draft diverter.

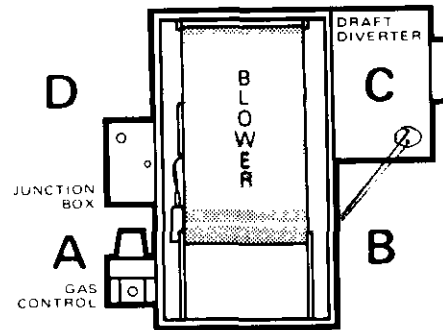


Figure 16 (4-012)

For alcove installations, place controls and draft diverter on front of furnace. Face them toward alcove opening for easier servicing.

You may want to move controls and draft diverter before placing furnace in attic or crawl space. Consider if there will be enough access after you install controls and draft diverter on furnace. Consider pull down attic stairs, door openings, rafters, floor joists, etc. If access will be difficult, install controls, draft inducer and pressure switch at final installation site.

### B. Selecting gas and electrical control locations.

If you want gas and electrical controls in as-shipped position, proceed to step E, "SELECTING DRAFT DIVERTER LOCATION".

You may move controls to position "B" shown in Figure 16. If you decide to move controls, first move the gas, then electrical controls. Starting position for controls is the front of furnace; ending position is rear of furnace.

### C. Relocating gas controls.

1. Remove low-voltage wires from gas control. On Electronic Ignition models, remove orange high-voltage ignition wire from electronic ignition lockout module.
2. Remove all burner covers, burner side shields and shipping supports. Replace bottom screw removed from shipping supports. Discard shipping supports. Save screws for reinstallation.
3. Lift burner rack up and pull out from front of furnace.
4. Disconnect pilot gas tubing at gas control. On Standing Pilot models, disconnect thermocouple at gas control. Remove pilot burner assembly from burner rack. Save screws for reinstallation.
5. Unscrew manifold bracket mounting screws. Remove manifold and gas control. Rotate gas control 180-degrees from its initial position. Always use backup wrench on manifold to keep it from twisting when rotating gas control. See Figure 17.

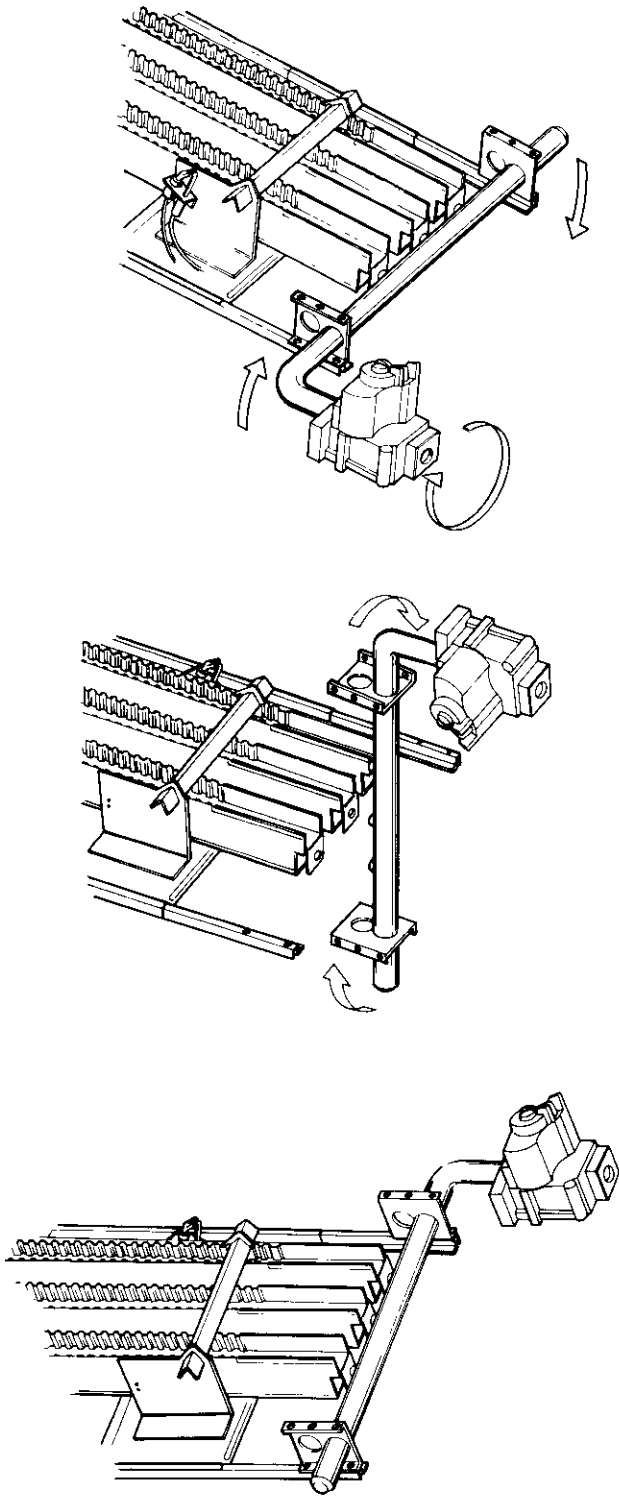


Figure 17 (4-016)

6. Install manifold with gas control on opposite side of burner rack. Make sure brown gas control knob is up. Install manifold mounting bracket screws to torque of 60 inch-pounds. See Figure 17.
7. Reshape pilot tubing. See Figure 18. On Standing Pilot models, also reshape thermocouple as shown in Figure 18. Be careful when you bend tubing and thermocouple. Do not kink. Install pilot burner on opposite side of burner rack using screws saved during removal.

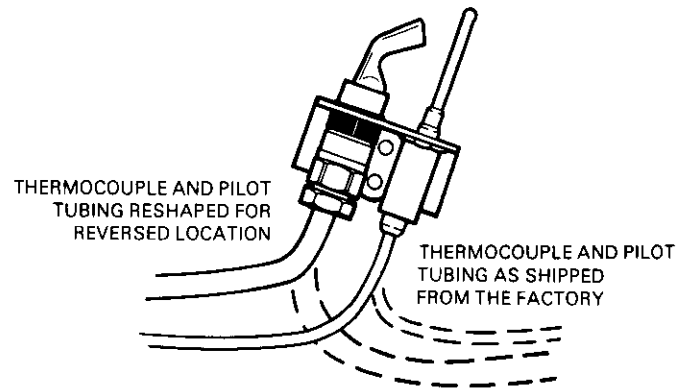


Figure 18 (4-017)

8. Connect pilot tube fitting to gas control and tighten to torque of 60 inch-pounds.
9. On Standing Pilot models, attach thermocouple to gas control until it is just finger-tight. Then tighten 1/4 turn with wrench.
10. Install burner rack, making sure gas control is next to blower door. Center burners beneath heat exchanger tubes. Properly located, the burner rack will nest snugly in furnace bottom, unable to move in any direction.

**WARNING:** FAILURE TO INSTALL BURNER RACK WITH GAS CONTROL AND BURNERS PROPERLY LOCATED COULD CAUSE HEAT EXCHANGER FAILURE, RESULTING IN DAMAGE, INJURY OR DEATH.

11. Install burner side shields, burner covers and screws around burner openings. Use screws saved during removal.

**WARNING:** INSTALL BURNER SIDE SHIELDS, BURNER COVERS AND SCREWS AROUND BURNER OPENINGS PROPERLY. FAILURE TO DO SO COULD CAUSE HEAT EXCHANGER FAILURE, RESULTING IN DAMAGE, INJURY OR DEATH.

12. Check for gas leaks using a commercial soap solution. Seal all leaks.

**WARNING:** NEVER USE AN OPEN FLAME TO CHECK FOR GAS LEAKS. IF A LEAK EXISTS, A FIRE OR EXPLOSION COULD OCCUR, RESULTING IN DAMAGE, INJURY OR DEATH.

#### D. Relocating electrical controls.

**NOTE:** Certain components must always be on the same side of furnace. These are:

- Junction box;
- Fan/limit control;
- Auxiliary limit control;
- Gas controls;
- Electronic ignition lockout module.

This assures that routing of electrical wiring meets all electrical codes.



1. Remove blower door containing operating or lighting instructions. Move pull knob from right to left side of door facing instructions. Knob will then be in proper position when you later move door to other side of furnace. Remove other door. Keep all screws.
2. Remove 3/4"-strain relief bushing from front of furnace below junction box. Remove similarly located bushing on rear of furnace.
3. Remove wire tie on blower motor wires in blower compartment. Find auxiliary limit control on upper portion of blower panel. Disconnect its blue wires. Route blue wire from burner limit switch over blower housing. Remove auxiliary limit control and hole plug on upper corners of blower panel and exchange locations. See Figure 19.

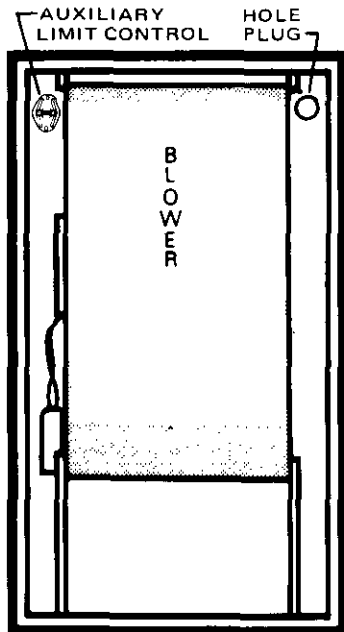


Figure 19 (4-018)

4. Remove junction box and fan/limit control covers.
5. For furnaces equipped with multi-speed blower motors, disconnect wires in junction box as follows.
  - a. **Line voltage wiring:** See Figure 20 to identify junction box components. Remove blower motor, red or blue wire from spliced fan/limit control brown wire. Remove blower motor black wire from blower relay, terminal "N.O." Remove blower motor white wire from spliced transformer primary, white wire. Remove fan/limit control, black wire from blower relay, terminal "N.C.". Remove 3/4"-strain relief busing from back of junction box.
  - b. **Low-voltage wiring:** Pull auxiliary limit control blue wire into junction box. Remove red wire from terminal strip, terminal "W". Remove fan/limit control's yellow wire from blower relay coil terminal.

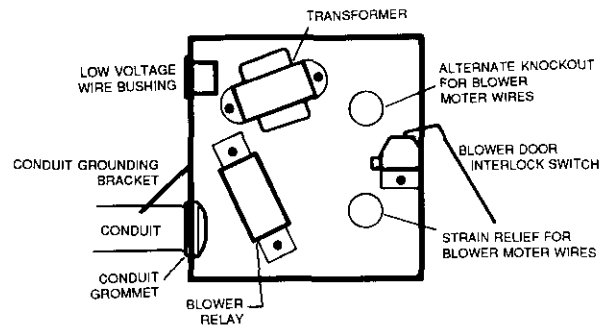


Figure 20 (4-019)

6. For furnaces equipped with single-speed blower motors, disconnect wires in junction box as follows.
  - a. **Line voltage wiring:** See Figure 20 to identify junction box components. Remove blower motor's black wire from spliced black and orange wires. Remove blower motor's white wire from transformer primary.
  - b. **Low-voltage wiring:** Within junction box, remove fan/limit control's red wire from terminal strip at terminal "W". Remove fan/limit control's yellow wire from terminal strip at terminal "C".
7. On Standing Pilot models, pull blue wire, disconnected from terminal "TR" of gas control earlier, into blower compartment to back of furnace and out through 3/4" casing opening.

On Electronic Ignition models disconnect electronic Ignition lockout module blue wire at terminal 24V". Pull it through 3/4" hole and into blower compartment. Route it under blower housing to other furnace side. Disconnect other electronic ignition lockout module blue wire and green ground wire. Save screws and wire for reinstallation.

8. Remove 3/4"-strain relief bushing from junction box. Pull blower motor wires from junction box into blower compartment. Push them across top of blower housing to opposite side of blower compartment.
9. Remove module with attached low-voltage wiring. Install on rear of furnace. Use holding screws in upper left and lower right corners of ignition module. Using screw next to electronic ignition lockout module, connect green ground wire to casing.
10. Unfasten and remove fan/limit control, conduit and wires from junction box. Save screws for reinstallation.
11. Plug hole left by fan/limit control with 7/8"-hole plug from rear of furnace.
12. Remove fan/limit control alternate knockout. Remove conduit and conduit grommet from original fan/limit control knockout. See Figure 21.

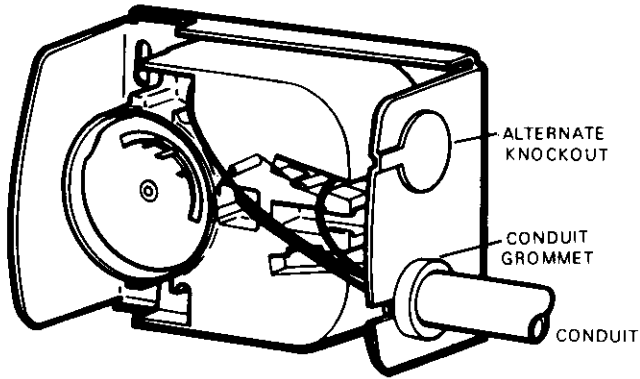


Figure 21 (4-020)

13. Slide wires out of original fan/limit control knockout and into alternate knockout. Do not disconnect any wires. Slide grommet off conduit. Push grommet into alternate knockout. Push conduit into grommet. Plug original fan/limit control knockout with 7/8"-hole plug, which you must supply.

**WARNING:** DO NOT PUSH CONDUIT ALL THE WAY THROUGH CONDUIT GROMMET. CONDUIT GROMMET DESIGN HAS A STEP IN IT TO INSULATE AND PROTECT WIRES FROM CONDUIT ENDS. CONDUIT END MUST NOT BE VISIBLE WITHIN FAN/LIMIT CONTROL. INCORRECT INSTALLATION OF CONDUIT COULD CAUSE AN ELECTRICAL SHORT, RESULTING IN DAMAGE, INJURY OR DEATH.

14. Remove junction box and 7/8"-insert bushing behind junction box. Save screws for reinstallation.
15. Plug hole vacated by junction box with 7/8"-hole plug removed from rear of furnace.
16. On side of junction box with terminal strip, reverse locations of conduit grommet and low-voltage wire bushing.
17. Rotate conduit grounding bracket 180-degrees so the open part of "V" points down towards relocated conduit bushing.
18. Remove junction box alternate knockout in back of junction box. See Figure 20 for location of alternate knockout.
19. At location "B" in Figure 22, install 7/8"-insert bushing in furnace casing. Install junction box with blower door interlock switch facing blower end of furnace. See Figure 20 for interlock switch location.

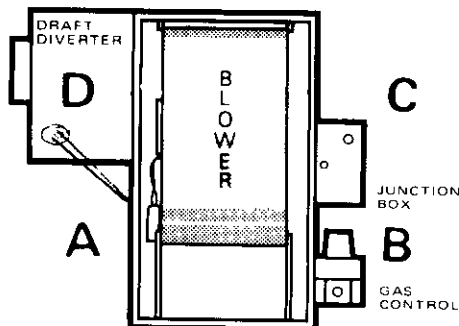


Figure 22 (4-024)

20. Install fan/limit control (with conduit and wiring attached) at new location on rear of furnace.
21. Push fan/limit control wiring through conduit grommet on side of junction box. Install conduit in grommet. Install fan/limit control and replace cover.

**WARNING:** DO NOT PUSH CONDUIT ALL THE WAY THROUGH CONDUIT GROMMET. CONDUIT GROMMET DESIGN HAS A STEP IN IT TO INSULATE AND PROTECT WIRES FROM CONDUIT ENDS. CONDUIT ENDS MUST NOT BE VISIBLE WITHIN JUNCTION BOX. INCORRECT INSTALLATION OF CONDUIT COULD CAUSE AN ELECTRICAL SHORT, RESULTING IN DAMAGE, INJURY OR DEATH.

22. Make sure conduit grounding bracket touches conduit. See Figure 20 for grounding bracket location.

**WARNING:** YOU MUST PROVIDE PROPER ELECTRICAL GROUND. FAILURE TO DO SO COULD CAUSE ELECTRICAL SHOCK OR FIRE, RESULTING IN DAMAGE, INJURY OR DEATH.

23. Within junction box, route fan/limit control blue wire through 7/8" opening at the back of junction box to the auxiliary limit control open terminal. Connect auxiliary limit control blue wire that was rerouted in Step 3) to the remaining auxiliary limit control open terminal.
24. Route blower motor wires from blower compartment through 7/8"-insert bushing into junction box. Install 3/4"-strain relief bushing on blower motor wires. Then install bushing in rear of junction box.
25. Within junction box, connect line voltage and low-voltage wires. Do this in reverse order from step 5, completing 5)b), then 5)a). Wiring must conform to wiring diagram on junction box cover.

**WARNING:** PROPERLY INSULATE UNUSED BLOWER MOTOR WIRES TO PREVENT ELECTRICAL SHOCK. SHOCK COULD RESULT IN DAMAGE, INJURY OR DEATH.

26. On Electronic Ignition models, connect electronic ignition lockout module wires to gas control terminals. Connect red wire to gas control at terminal "MV". Connect white wire to gas control at terminal "PV/MV". Connect black wire to gas control at terminal "PV". See wiring diagram on junction box cover. Connect orange high-voltage ignition wire to electronic ignition lockout module at high-voltage terminal.
27. On Electronic Ignition models, take blue wire from junction box terminal strip at terminal "C". Connect it to electronic ignition lockout module at upper terminal "24V(GND)".

On Standing Pilot models, connect blue wire from junction box terminal "C" to gas control at terminal "TH".

28. Install junction box cover.
29. Install blower doors, making sure operating instructions are next to controls. Move blower door, pull knob if not done already.

**E. Selecting draft diverter location.**

**WARNING:** INSTALL DRAFT DIVERTER WITHIN SAME ATMOSPHERIC PRESSURE ZONE AS BURNER COMBUSTION AIR INLETS. FAILURE TO DO SO COULD CAUSE IMPROPER BURNER OPERATION, RESULTING IN DAMAGE, INJURY OR DEATH.

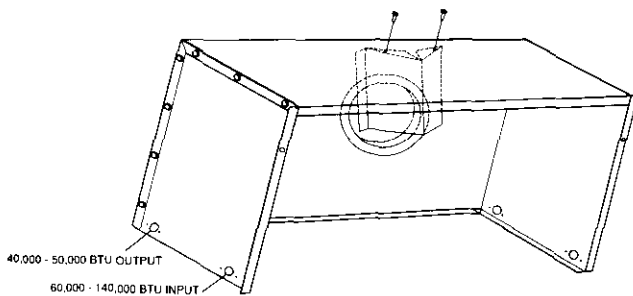
**1. Assembling draft diverter.**

Equipment Needed: Save time by getting tool number 3 listed in Section 10 before you start.

Attach draft diverter ends to draft diverter cover using screws from vent limit switch (VLS) plastic bag in manual pack envelope.

- Draft diverter ends are inside flange of draft diverter cover;
- Bottom flanges of draft diverter ends are inside flange of draft diverter cover;
- Bottom flanges are to the inside;
- Vent limit switch holes are to the bottom.

Use screws provided to attach down-draft baffle to draft diverter cover as shown in Figure 23.

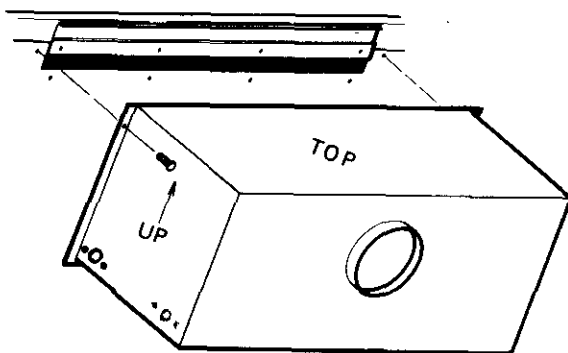


**Figure 23 (4-011)**

**2. Installing draft diverter in as-shipped position.**

Install draft diverter and vent limit switch (VLS) in position "C" shown in Figure 16.

- a. Find and remove two installed draft diverter mounting screws. See Figure 24. Save them for reinstallation.



**Figure 24 (4-014)**

- b. Slip draft diverter top flange between draft diverter support clip and furnace casing.
- c. Position draft diverter with vent outlet as shown in Figure 24. Align screw holes in draft diverter side flanges with screw holes in furnace casing. Attach draft diverter using screws saved in 2) a).

**WARNING:** FAILURE TO REPLACE ALL SCREWS AROUND HEAT EXCHANGER OPENINGS MAY ALLOW AIR LEAKAGE INTO HEAT EXCHANGER. THIS COULD CAUSE A FIRE, RESULTING IN DAMAGE, INJURY OR DEATH.

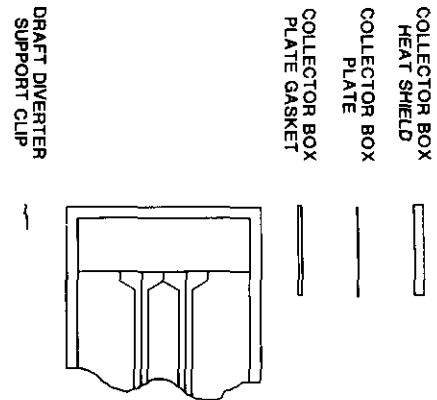
- d. Remove two heat deflectors from blower compartment. Using yellow-headed screws, install deflectors on furnace casing sides 3-1/4" from warm air supply end and 2-3/8" from top.

**WARNING:** FAILURE TO INSTALL HEAT DEFLECTORS MAY ALLOW HOT SURFACES TO TOUCH COMBUSTIBLE MATERIAL. THIS COULD CAUSE A FIRE, RESULTING IN DAMAGE, INJURY OR DEATH.

**3. Relocating draft diverter.**

To install draft diverter in position "D", Figure 22:

- a. Remove draft diverter support clip as shown in Figure 25 and all screws from collector box outlet on rear of furnace. Save screws for reinstallation.



**Figure 25 (4-022)**

- b. Carefully remove collector box heat shield, cover plate and fiberglass gasket from furnace. See Figure 25. Save screws. Properly align gasket, then install all on rear of furnace.
- c. Install four screws below collector box opening on front of furnace. Install draft diverter support clip on front of furnace with numbers stamped on side facing you. Numbers represent BTU/HR input furnace divided by 1,000. For example, "100" means a draft diverter support clip for a 100,000 BTU/HR input furnace.
- d. Install draft diverter following procedure outlined in steps 2) a) through 2) d) above, "INSTALLING DRAFT DIVERTER IN AS-SHIPPED POSITION".

**WARNING:** FAILURE TO REPLACE ALL SCREWS AROUND HEAT EXCHANGER OPENINGS MAY ALLOW AIR LEAKAGE INTO HEAT EXCHANGER. THIS COULD CAUSE A FIRE WHICH COULD RESULT IN DAMAGE, INJURY OR DEATH.

## F. Installing vent limit switch.

VLS kit, P/N 301108, is in a plastic bag located in manual pack envelope. See Figure 26 for VLS and hole cover locations in draft diverter. Always install VLS on side of draft diverter nearest blower door.

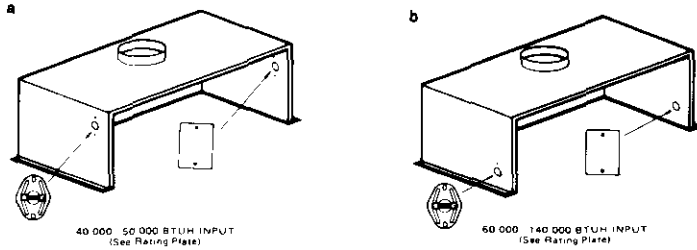


Figure 26 (4-013)

**NOTE:** VLS may have opened during shipping. Push red button in center of switch to make sure it is not open.

**WARNING:** VLS IS A SAFETY DEVICE. INCORRECT INSTALLATION COULD CAUSE COMBUSTION PRODUCTS TO COLLECT IN STRUCTURE, RESULTING IN DAMAGE, INJURY OR DEATH.

### 1. Draft diverter in as-shipped position.

a. If gas and electrical controls are "as-shipped", connect two VLS blue wires to VLS. Installation of gas and electrical controls, draft diverter and VLS is now complete.

b. If you moved gas and electrical controls, install VLS as follows:

1. Connect even ends of VLS blue wires to VLS terminals. See Figure 27.

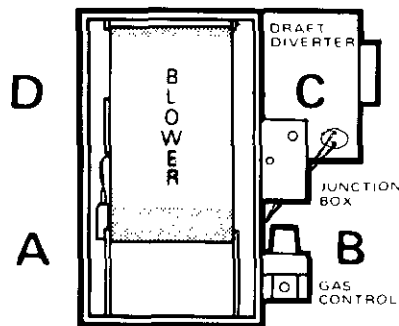


Figure 27 (4-015)

2. On Electronic Ignition models, connect VLS blue wire to open electronic ignition lockout module, terminal "24V". On Standing Pilot models, connect VLS blue wire to gas control, terminal "TR".

3. Install 3/4"-strain relief bushings in casing opening below junction box and on rear of furnace. Install blower door with door containing operating or lighting instructions on same side as controls. Installation of gas and electrical controls, draft diverter and VLS is now complete.

### 2. Draft diverter in relocated position.

a. If gas and electrical controls are "as-shipped", install VLS as follows. See Figure 28 for correct VLS and hole cover location if you moved draft diverter.

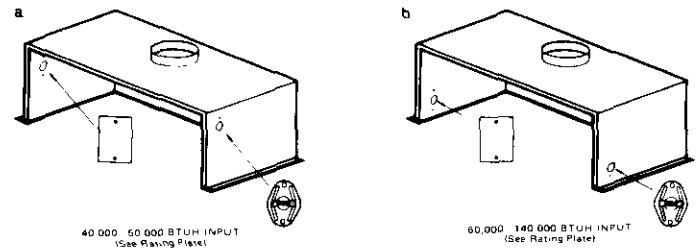


Figure 28 (4-023)

1. Remove both blower doors. Find junction box on front of furnace. Remove 3/4"-strain relief bushing (below junction box) holding VLS blue wire, auxiliary limit control blue wire, and burner limit switch blue wires. Remove other 3/4"-strain relief bushing from rear of furnace.

2. Pull VLS blue wire (connected to gas control, terminal "TR" on Standing Pilot models or to electronic ignition lockout module, terminal "24V" on Electronic Ignition models) into blower compartment from front of furnace.

3. Pull two VLS blue wires into blower compartment from rear of furnace. Route these wires through 3/4" casing opening below junction box to VLS on draft diverter. Connect VLS blue wires to VLS.

4. Install 3/4"-strain relief bushings in casing opening below junction box and on rear of furnace. Install blower doors with door containing operating or lighting instructions on same side as controls. Installation of gas and electrical controls, draft diverter and VLS is now complete.

b. If you moved gas and electrical controls, install VLS as follows:

1. Pull two VLS blue wires into blower compartment from rear of furnace. Route these wires through 3/4" casing opening on front of furnace to VLS on draft diverter. Connect VLS blue wires to VLS.

2. Route remaining VLS blue wire through 3/4" casing opening below junction box. On Electronic Ignition models, connect VLS blue wire to electronic ignition lockout module, terminal "24V". On Standing pilot models connect VLS blue wire to gas control, terminal "TR".

3. Install 3/4"-strain relief bushings in casing opening below junction box and on front of furnace. Install blower doors with door containing operating or lighting instructions on same side as controls. Installation of gas and electrical controls, draft diverter and VLS is now complete.

## SECTION 13—INDUCED DRAFT FURNACE ONLY—LOCATION OF GAS AND ELECTRICAL CONTROLS, DRAFT INDUCER AND PRESSURE SWITCH

Equipment needed: Items 3, 4, 6, 8 - 13, 15, 17, 20 & 30, listed in Section 10.

See Section 12 for Standing Pilot and Electronic Ignition models.

### A. Before you start.

Install furnace with gas and electrical controls, draft inducer and pressure switch in one of two positions. You may leave gas and electrical controls draft inducer and pressure switch in as-shipped position as shown in position "A" in Figure 29, or you may relocate the controls to position "B" in Figure 29.

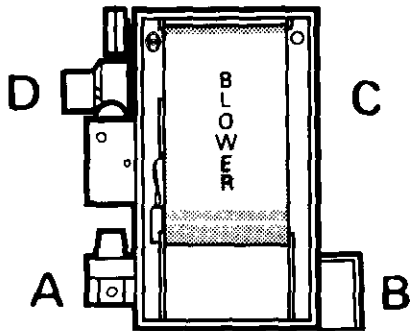


Figure 29 (4-042)

For alcove installations, place controls, draft inducer and pressure switch on front of furnace. Face them toward alcove opening for easier servicing.

You may want to move controls, draft inducer and pressure switch before placing furnace in attic or crawl space. Consider if there will be enough access after you install controls, draft inducer and pressure switch on furnace. Consider pull down attic stairs, door openings, rafters, floor joists, etc. If access will be difficult, install controls, draft inducer and pressure switch at final installation site.

### B. Selecting location of gas and electrical controls.

If you want gas and electrical controls in as-shipped position, proceed to E., "RELOCATING DRAFT INDUCER AND PRESSURE SWITCH".

You may move controls to position "B" shown in Figure 29. If you decide to move controls, first move gas, then electrical controls. Starting position for controls is front of furnace; ending position is rear of furnace.

### C. Relocating gas controls.

1. Remove low-voltage wires from gas control. Remove orange high-voltage ignition wire from electronic ignition lockout module.
2. Remove all burner covers, burner side shields and shipping supports. Replace bottom screw removed from shipping support. Discard shipping supports. Save screws for reinstallation.
3. Lift burner rack up and pull out from front of furnace.
4. Disconnect pilot gas tubing at gas control. Remove pilot burner assembly from burner rack. Save screws for reinstallation.
5. Unscrew manifold bracket mounting screws. Remove manifold and gas control. Rotate gas control 180-degrees from its initial position. Always use backup wrench on manifold to keep it from twisting when rotating gas control. See Figure 30.
6. Install manifold with gas control on opposite side of burner rack. Make sure brown gas control knob is up. Install manifold mounting bracket screws to torque to 60 inch-pounds. See Figure 30.

7. Reshape pilot tubing. See Figure 31. Be careful when you bend tubing. Do not kink. Install pilot burner on opposite side of burner rack using screws during removal.
8. Connect pilot tube fitting to gas control and tighten to torque of 60 inch-pounds.

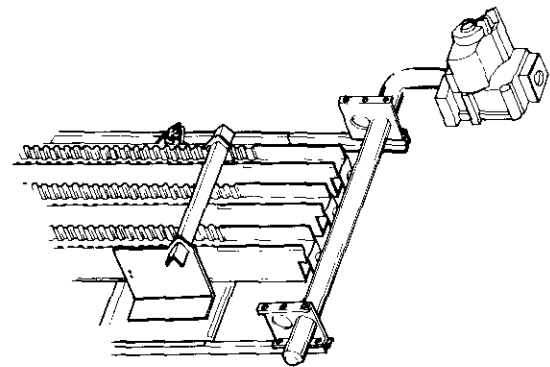
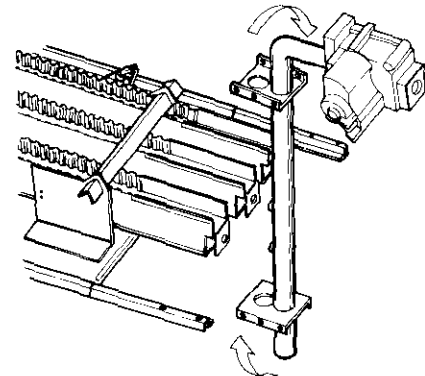
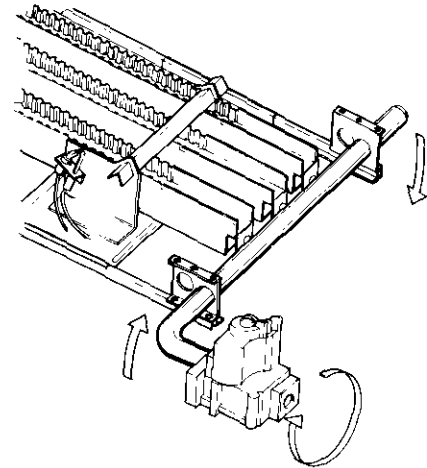


Figure 30 (4-016)

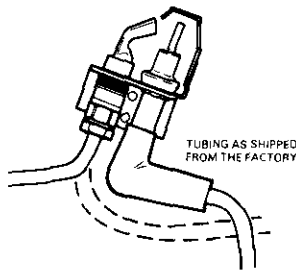


Figure 31 (4-047)

- Install burner rack, making sure gas control is next to blower door. Center burners beneath heat exchanger tubes. Properly located, the burner rack will nest snugly in furnace bottom, unable to move in any direction.

**WARNING:** FAILURE TO INSTALL BURNER RACK WITH GAS CONTROL AND BURNERS PROPERLY LOCATED COULD CAUSE HEAT EXCHANGER FAILURE, RESULTING IN DAMAGE, INJURY OR DEATH.

- Install burner side shields, burner covers, and screws around burner openings. Use screws saved during removal.

**WARNING:** PROPERLY INSTALL BURNER SIDE SHIELDS, BURNER COVERS AND SCREWS AROUND BURNER OPENINGS. FAILURE TO DO SO COULD CAUSE HEAT EXCHANGER FAILURE, RESULTING IN DAMAGE, INJURY OR DEATH.

- Check for gas leaks using a commercial soap solution. Seal all leaks.

**WARNING:** NEVER USE AN OPEN FLAME TO CHECK FOR GAS LEAKS. IF A LEAK EXISTS, A FIRE OR EXPLOSION COULD OCCUR, RESULTING IN DAMAGE, INJURY OR DEATH.

#### D. Relocating electrical controls.

**NOTE:** Some components must always be on same side of furnace. These are:

- Junction box;
- Fan/limit control;
- Auxiliary limit control;
- Gas controls;
- Electronic ignition lockout module;
- Draft inducer;
- Pressure switch.

This assures that routing of electrical wiring meets all electrical codes.

- Remove blower door which contains operating instructions. Move pull knob from right to left side of door facing instructions. Knob will then be in proper position when you later move door to other side of furnace. Remove other door. Keep all screws.
- Remove 3/4"-strain relief bushing from front of furnace below junction box. Remove similarly located bushing on rear of furnace.
- Remove wire tie on blower motor wires in blower compartment. Find auxiliary limit control on upper portion of blower panel. Disconnect its blue wires. Route blue wire from burner limit switch over blower housing. Remove auxiliary limit control and hole plug on upper corners of blower panel and exchange locations. See Figure 19.

- Remove junction box and fan/limit control covers.

- Disconnect wires in junction box as follows.

- Line voltage wiring:** See Figure 32 to identify junction box components. Remove blower motor, red or blue wire from spliced fan/limit control brown wire. Remove blower motor black wire from blower relay, terminal "N.O.". Remove blower motor white wire from spliced transformer primary, white wire. Remove fan/limit control, black wire from blower relay, terminal "N.C.". Remove 3/4"-strain relief bushing from back of junction box.

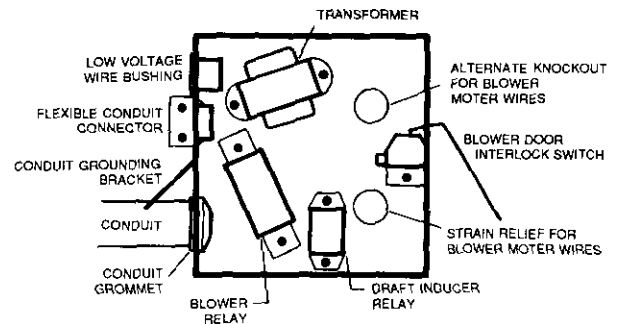


Figure 32 (4-065)

- Low-voltage wiring:** Pull auxiliary limit control blue wire into junction box. Remove red wire from terminal strip, terminal "W". Remove fan/limit controls yellow wire from blower relay coil terminal. Remove purple wire from inducer relay coil.
- Disconnect electronic ignition lockout module blue wire at terminal "24V". Pull it through 3/4" hole and into blower compartment. Route it under blower housing to other furnace side. Disconnect other electronic ignition lockout module blue wire and green ground wire. Save screws and wire for reinstallation.
  - Pull blower motor wires from junction box into blower compartment. Push them across top of blower housing to opposite side of blower compartment.
  - Remove mounting plate holding electronic ignition lockout module. Leave low voltage wires attached to module. Install on rear of furnace. Connect green ground wire to casing.
  - Unfasten and remove fan/limit control, conduit, and wires from junction box. Save screws for reinstallation.
  - Plug hole vacated by fan/limit control with 7/8"-hole plug from rear of furnace.
  - Remove fan/limit control, 3/4"-strain relief bushing. Remove conduit and then conduit grommet from original fan/limit control knockout. See Figure 33.

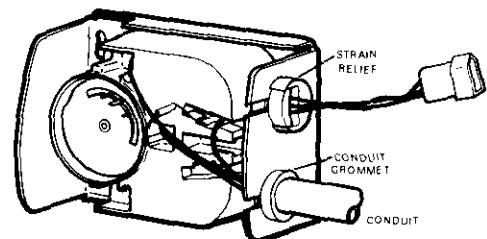


Figure 33 (4-048)

12. Reverse fan/limit control entry locations of three wires from pressure switch and wires from 3/4"-conduit.

**NOTE:** Reversing wire locations can be done without disconnecting any wires. Slide wires through slots in fan/limit control housing knockouts. Reverse wire locations. Install 3/4"-strain relief bushing. Install 3/4"-conduit grommet and conduit.

**WARNING:** DO NOT PUSH CONDUIT ALL THE WAY THROUGH CONDUIT GROMMET. DESIGN OF CONDUIT GROMMET HAS A STEP IN IT TO INSULATE AND PROTECT WIRES FROM END OF CONDUIT. END OF CONDUIT MUST NOT BE VISIBLE WITHIN FAN/LIMIT CONTROL. INCORRECT INSTALLATION OF CONDUIT COULD CAUSE AN ELECTRICAL SHORT, RESULTING IN DAMAGE, INJURY OR DEATH.

13. Remove junction box and 7/8"-insert bushing behind junction box. Save screws for reinstallation.
14. Plug hole vacated by junction box with 7/8"-hole plug removed from rear of furnace.
15. On side of junction box with terminal strip, move conduit grommet to low-voltage bushing location. Move low-voltage wire bushing to flexible conduit connector location and move flexible conduit connector to old conduit grommet location.
16. Rotate conduit grounding bracket 180-degrees so open part of "V" is pointing down towards relocated conduit bushing.
17. Remove junction box alternate knockout in back of junction box. See Figure 32 for location of alternate knockout.
18. At location "B" Figure 29, install 7/8"-insert bushing in furnace casing. Install junction box with blower door interlock switch facing blower end of furnace. See Figure 20 for interlock switch location.
19. Install fan/limit control (with conduit and wiring attached) at new location on rear of furnace.
20. Push fan/limit control wiring through conduit grommet on side of junction box. Install conduit in grommet. Install fan/limit control and replace cover.

**WARNING:** DO NOT PUSH CONDUIT ALL THE WAY THROUGH CONDUIT GROMMET. CONDUIT GROMMET DESIGN HAS A STEP IN IT TO INSULATE AND PROTECT WIRES FROM CONDUIT END. CONDUIT END MUST NOT BE VISIBLE WITHIN JUNCTION BOX. INCORRECT INSTALLATION OF CONDUIT COULD CAUSE AN ELECTRICAL SHORT, RESULTING IN DAMAGE, INJURY OR DEATH.

21. Make sure conduit grounding bracket is touching conduit. See Figure 20 for location of grounding bracket.

**WARNING:** FURNACE MUST HAVE PROPER ELECTRICAL GROUND. FAILURE TO PROVIDE A PROPER ELECTRICAL GROUND COULD CAUSE ELECTRICAL SHOCK OR FIRE, RESULTING IN DAMAGE, INJURY OR DEATH.

22. Within junction box, route fan/limit control blue wire through 7/8" opening at the back of junction box to the auxiliary limit control open terminal. Connect auxiliary limit control blue wire that was rerouted in Step 3) to the remaining auxiliary limit control open terminal.

23. Route blower motor wires and electronic ignition lockout module blue wire rerouted in step 6 from blower compartment through 7/8"-insert bushing into junction box. Install 3/4"-strain relief bushing on blower motor wires and electronic ignition lockout module blue wire. Then install bushing in rear of junction box.

24. Within junction box, connect line voltage and low-voltage wires. Do so in reverse order from Step 5, completing 5) b), then 5) a). Wiring must conform to wiring diagram on junction box cover.

**WARNING:** PROPERLY INSULATE UNUSED BLOWER MOTOR WIRES TO PREVENT RISK OF ELECTRICAL SHOCK, WHICH COULD RESULT IN DAMAGE, INJURY OR DEATH.

25. Connect electronic ignition lockout module wires to gas control terminals. Connect red wire to gas control at terminal "MV". Connect white wire to gas control at terminal "PV/MV". Connect black wire to gas control at terminal "PV". See wiring diagram on junction box cover. Connect orange high-voltage ignition wire to electronic ignition lockout module at high-voltage terminal.
26. Connect blue wire from junction box terminal strip at terminal "C" to electronic ignition lockout module at terminal "24V(GND)".
27. Connect other electronic ignition lockout module blue wire, rerouted in step 6, to electronic ignition lockout module at terminal "24V".
28. Install junction box cover.
29. Inspect blower compartment and bundle loose wires together so there is no chance of wires entering blower intake.
30. Reinstall 3/4"-strain relief bushings on front and rear of furnace.
31. Install blower doors, making sure operating instructions are next to controls. Move blower door, pull knob if not done already.

#### E. Relocating draft inducer and pressure switch.

You may move draft inducer and pressure switch from as-shipped position. It may be easier to do this before placing furnace in an attic or crawl space, but first determine if you have sufficient access space. If you have limited space, move them at the final furnace site.

**WARNING:** INSTALL DRAFT INDUCER WITHIN SAME ATMOSPHERIC PRESSURE ZONE AS BURNER COMBUSTION AIR INTLETS. FAILURE TO DO SO COULD CAUSE IMPROPER BURNER OPERATION, RESULTING IN DAMAGE, INJURY OR DEATH.

If you leave gas and electrical controls in as-shipped position, use the instructions in paragraph 1). If you moved gas and electrical controls, follow the instructions in paragraph 2).

1. Installing draft inducer when you leave gas and electrical controls in as-shipped position. As-shipped controls are in position "A" and draft inducer is in position "D", shown in Figure 34.

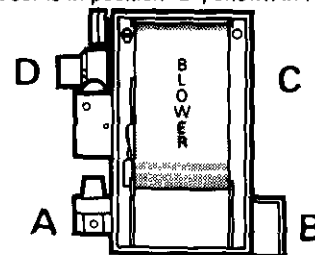


Figure 34 (4-042)

- a. Draft inducer and pressure switch are in a carton in blower compartment. Remove draft inducer and pressure switch from carton, being careful not to damage fiberglass sealing gasket.
  1. Place sealing gasket over four mounting studs on draft inducer collector box. Mounting stud pattern is not symmetrical. Sealing gasket will only fit properly one way. Align it to match stud pattern.
  2. Place draft inducer on four mounting studs with vent outlet on the right. See Figure 35. Attach draft inducer to draft inducer collector box. Use four #8-32 hex nuts from hardware package. Tighten to torque of 60 inch-pounds.

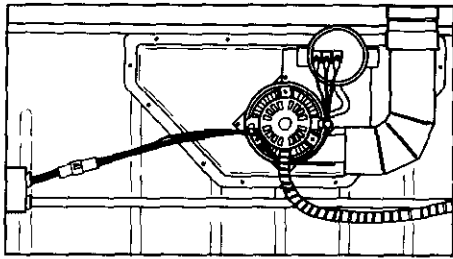


Figure 35 (4-049)

**NOTE:** Sealing gasket between draft inducer and draft inducer collector box must be in place. Tightly secure or furnace may shut down.

3. Remove junction box cover. Inspect end of flexible conduit from draft inducer to be sure that orange plastic anti-short bushing is still in conduit. See Figure 36. Locate flexible conduit connector, shown in Figure 32.

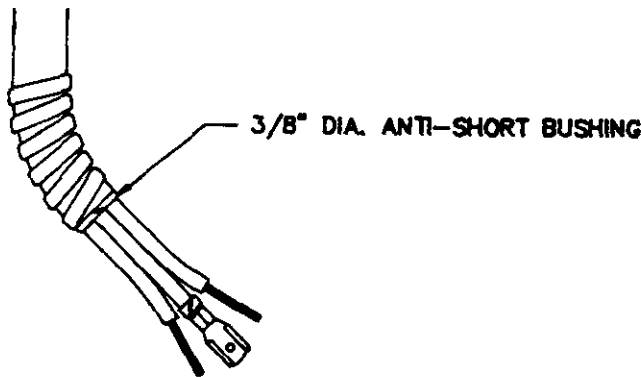


Figure 36 (4-062)

4. Thread three wires from draft inducer through flexible conduit connector on junction box. Push flexible conduit into connector and securely tighten set screw.
5. Locate draft inducer relay shown in Figure 32. Using Figure 38 and the wiring diagram enclosed separately, attach black wire from flexible conduit to terminal #5 on draft inducer relay. Attach white wire from flexible conduit to 115-volt common power supply. Attach green wire to green grounding pigtail junction box.

## INDUCED DRAFT RELAY WIRING DIAGRAM

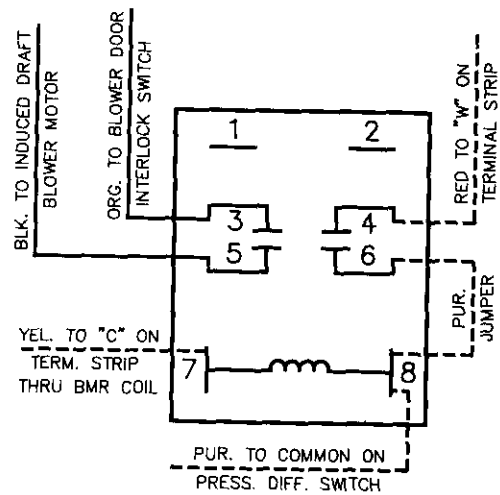


Figure 37 (4-044)

- b. Installing pressure switch.

1. Install pressure switch on mounting studs at top and right side of draft inducer. Use #8-32 hex nuts from hardware package. See Figure 35 for correct location.

**NOTE:** DO NOT remove hex nuts securing draft inducer to mount pressure switch.

2. Tighten hex nuts to torque of 60 inch-pounds.
3. Connect pressure tubing to draft inducer pressure fitting as shown in Figure 35. Be sure tubing is open and has no kinks or splits.
4. Attach wires that run beneath draft inducer motor to pressure switch terminals. All terminals are different. You can only connect them one way.

**WARNING:** DO NOT ALTER WIRE OR PRESSURE SWITCH TERMINALS TO ALLOW INCORRECT CONNECTION. MISWIRING COULD CAUSE UNSAFE OPERATION, RESULTING IN DAMAGE, INJURY OR DEATH.

5. Plug plastic connector on pressure switch wire into plastic connector on fan/limit control wire assembly.

**NOTE:** Wires from pressure switch must not touch any part of draft inducer blower housing.

6. Remove heat deflector from blower compartment. Using yellow-headed screw, install on furnace side opposite draft inducer. Yellow-headed screw is 3-1/4" from heat exchanger end and 2-3/8" down from top.

**WARNING:** FAILURE TO INSTALL HEAT DEFLECTOR COULD ALLOW HOT SURFACES TO TOUCH COMBUSTIBLE MATERIAL. THIS COULD CAUSE FIRE, RESULTING IN DAMAGE, INJURY OR DEATH.

2. Relocating controls and draft inducer from as-shipped position. You may move controls to position "B" and draft inducer and pressure switch to position "C" shown in Figure 38.



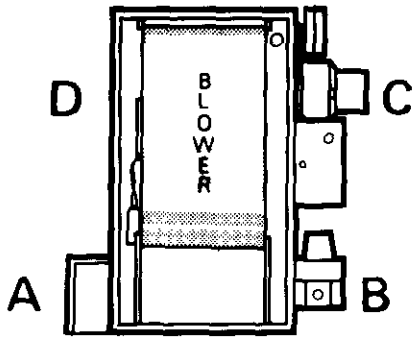


Figure 38 (4-043)

**NOTE:** Some components must always be on same side of furnace. These are:

- Junction box;
- Fan/limit control;
- Auxiliary limit control;
- Electronic ignition lockout module;
- Pressure switch;
- Gas controls;
- Draft inducer.

a. Relocating draft inducer collector box.

1. Remove draft inducer collector box and screws from outlet furnace front. See Figure 39. Save screws for reinstallation.

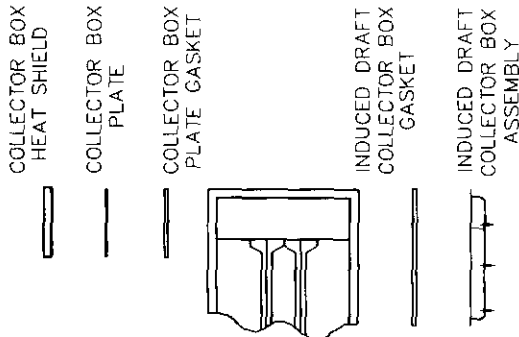


Figure 39 (4-045)

2. Remove heat exchanger collector box heat shield, cover plate and fiberglass gasket located on rear of furnace. Install them on front. See Figure 39. Take care to align gasket.
3. Install four screws below heat exchanger collector box outlet on new draft inducer side of furnace. See Figure 39.
4. Install draft inducer collector box on new draft inducer side of furnace using screws saved during removal. See Figure 39. Carefully align gasket.

**NOTE:** Some screw holes are not open. Use self-drilling screws provided or a 1/8" - drill. See Figure 40.

**WARNING: FAILURE TO REPLACE ALL SCREWS AROUND HEAT EXCHANGER OPENINGS MAY ALLOW AIR LEAKAGE INTO HEAT EXCHANGER. THIS COULD CAUSE A FIRE RESULTING IN DAMAGE, INJURY OR DEATH.**

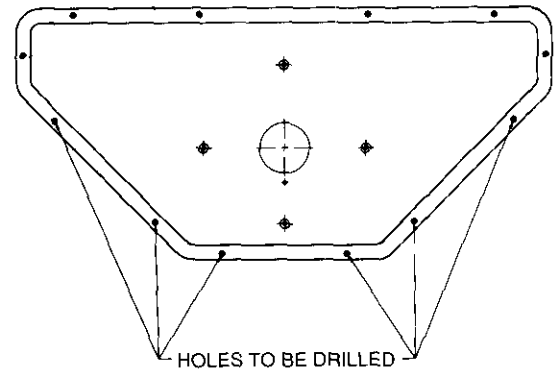


Figure 40 (4-046)

- b. Locate draft inducer and pressure switch in a carton in the blower compartment. Remove draft inducer and pressure switch, being careful not to damage fiberglass sealing gasket.

1. Place sealing gasket over four mounting studs on draft inducer collector box. Mounting stud pattern is not symmetrical. Sealing gasket will fit properly in one position. Align it to match stud pattern.
2. Place draft inducer on four mounting studs with vent outlet on the right. See Figure 41. Attach draft inducer to draft inducer collector box. Use four #8-32 hex nuts from hardware package. Tighten to torque of 60 inch-pounds.

**NOTE:** Sealing gasket between draft inducer and draft inducer collector box must be in place. Tightly secure or furnace could shut down.

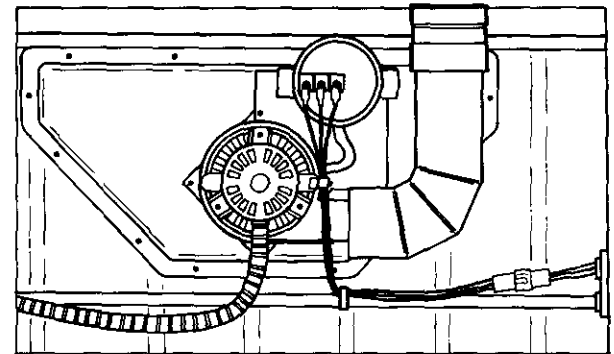


Figure 41 (4-050)

3. Remove junction box cover. Inspect flexible conduit end from draft inducer to be sure that orange plastic anti-short bushing is in conduit. See Figure 36. Locate flexible conduit connector shown in Figure 32.
4. Thread three wires from draft inducer through flexible conduit connector on junction box. Push flexible conduit into connector and securely tighten set screw.
5. See Figure 32 for draft inducer relay location. Follow Figure 37 and furnace wiring diagram enclosed separately. Attach black wire from flexible conduit to terminal #5 on draft inducer relay. Attach white wire from flexible conduit to 115-volt common power supply. Attach green wire to green junction box grounding pigtail.

c. Installing pressure switch.

1. Install pressure switch on mounting studs at top and right side of draft inducer. Use #8-32 hex nuts from hardware package. See Figure 41.

**NOTE:** DO NOT remove hex nuts securing draft inducer to mount pressure switch.

2. Tighten hex nuts to torque of 60 inch-pounds.
3. Connect pressure tubing to draft inducer pressure fitting as shown in Figure 41. Be sure tubing is open and has no kinks or splits.
4. Attach wires running beneath draft inducer motor to pressure switch terminals. All terminals are different. You can only connect them one way.

**WARNING:** DO NOT ALTER WIRE OR PRESSURE SWITCH TERMINALS. MISWIRING COULD CAUSE UNSAFE OPERATION, RESULTING IN DAMAGE, INJURY OR DEATH.

5. Remove wire clamp on left hand side of draft inducer motor mount. See Figure 41.
6. Remove and discard wire clamp.
7. Install draft inducer motor mounting screw removed in Step 5).
8. Gather pressure switch wires to fan/limit control conduit. Do so directly beneath wire clamp on right hand side of draft inducer motor mount.
9. Install wire tie provided in hardware package around pressure switch wires and fan/limit control conduit. Tighten securely. Place wire tie directly beneath wire clamp. See Figure 41.
10. Locate plastic connector on pressure switch wire assembly. Locate plastic connector on fan/limit control wire assembly. Plug the two together.

**NOTE:** The wires from pressure switch must not touch any part of draft inducer blower housing.

11. Compare completed installation with Figure 41.

### SECTION 14—INSTALLING ELECTRICAL WIRING

Equipment Needed: Save time by getting these tools before you start: Item numbers 2, 3, 17, 18 and 19 listed in Section 10.

Select a location for room thermostat that is away from supply and return air registers, on draft-free interior wall, and not near lights, television or other heat sources. Install thermostat following field drawing diagram in Section 15. Use electrical wiring that meets current National Electrical Code ANSI/NFPA 70 and local codes. Use Type T (63 degrees C rise) wire or equivalent. See Section 31 for code information.

**WARNING:** PROVIDE FURNACE WITH ITS OWN SEPARATE ELECTRICAL CIRCUIT, MEANS OF CIRCUIT PROTECTION AND ELECTRI-

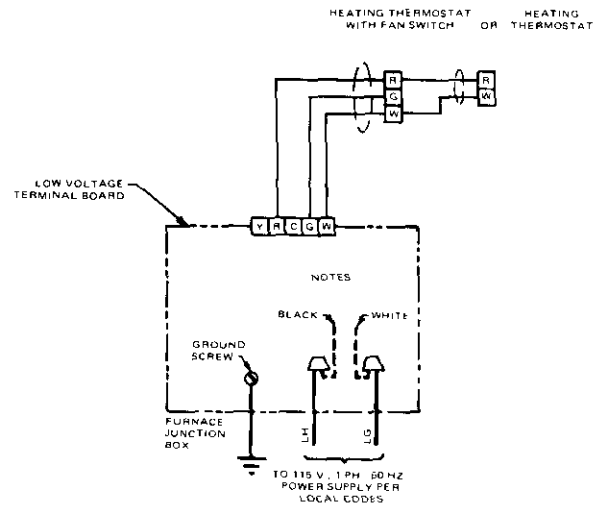
CAL DISCONNECT SWITCH. FOLLOW CURRENT NATIONAL ELECTRICAL CODE ANSI/NFPA 70 AND STATE AND LOCAL CODES. FAILURE TO PROVIDE THESE SHUT-OFF MEANS COULD CAUSE ELECTRICAL SHOCK OR FIRE, RESULTING IN DAMAGE, INJURY OR DEATH.

Install proper electrical grounding by attaching grounding source to green wire conductor in furnace junction box. Follow current National Electrical Code ANSI/NFPA 70 and local codes.

**WARNING:** FURNACE MUST HAVE PROPER ELECTRICAL GROUND. FAILURE TO PROVIDE A PROPER ELECTRICAL GROUND COULD CAUSE ELECTRICAL SHOCK OR FIRE, RESULTING IN DAMAGE, INJURY OR DEATH.

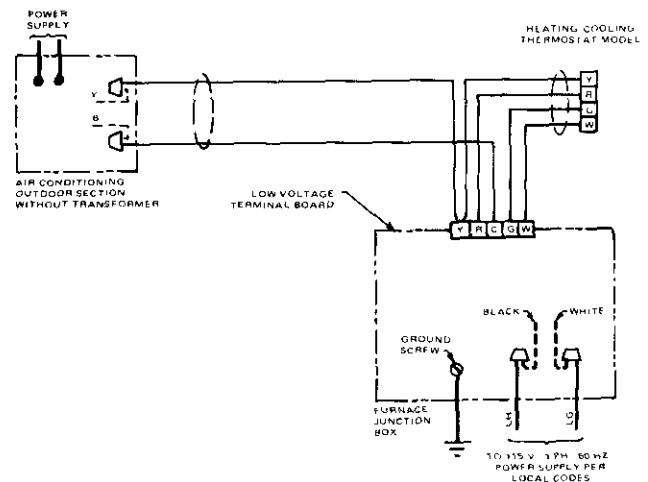
### SECTION 15—FOLLOWING FIELD WIRING DIAGRAMS

#### FIELD WIRING DIAGRAM HEATING ONLY



STANDING PILOT AND ELECTRONIC IGNITION MODELS  
Figure 42 (4-025)

#### FIELD WIRING DIAGRAM HEATING/COOLING OUTDOOR UNIT WITHOUT TRANSFORMER



INDUCED DRAFT MODELS  
Figure 43 (4-026)

## SECTION 16—ADJUSTING ROOM THERMOSTAT HEAT ANTICIPATOR

Equipment Needed: Save time by getting these tools before you start: Item numbers 8, 24 and 25 listed in Section 10.

### A. Approximate heat anticipator setting.

Wire system using field wiring diagram in Section 15. Find heat anticipator under room thermostat cover. Set heat anticipator at 0.6 for Standing Pilot models; at 0.8 for Electronic Ignition and Induced Draft models.

### B. Exact heat anticipator setting.

Exactly setting heat anticipator helps avoid potential callbacks. If you believe any of the following factors exist, set heat anticipator to match actual current draw in circuit:

- The system contains controls other than those specified on wiring diagram;
- The system contains nonstandard (18 AWG) size thermostat wire;
- The system has longer than the 30-foot average distance between thermostat and furnace.

Follow these steps to exactly set heat anticipator:

1. Use 2-foot piece of 24-gauge thermostat wire, stripped on both ends.
2. Use ammeter capable of reading exact amperage in 0-10 amp range. If it is adjustable, set on 0-10 scale.
3. Wind the 2-foot piece of 24-gauge thermostat wire ten times around one open arm of ammeter. Close ammeter arms. This will act as a ten times multiplier.
4. Make sure 115-volt power to furnace is on. Connect ends of wire on ammeter across terminals "R" and "W" of thermostat sub-base, following Figure 44.

Thermostat Sub-Base Terminals

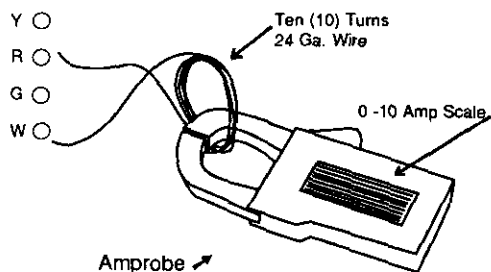


Figure 44 (4-010)

5. Read amp draw of furnace circuit on ammeter and divide by 10. This gives you an exact heat anticipator setting.

Example:

$$\begin{array}{rcl} \text{Meter reading} & = & 9 \text{ amps} \\ \text{Heat anticipator setting} & = & \frac{9 \text{ amps}}{10 \text{ turns}} = .9 \text{ amps} \end{array}$$

6. Set room thermostat's heat anticipator to this amp setting following instructions provided with thermostat.

## SECTION 17—INSTALLING DUCT WORK

**CAUTION:** Install all duct work to meet current standards:

- ASHRAE/NFPA 90, Standard for Installation of Warm Air Heating and Air Systems;
- State and local codes.

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

Properly size duct work based on heat loss and heat gain calculations. Doing so assures:

- Good heating and cooling installations;
- Potentially fewer callbacks;
- Delivery of required circulating air.

For all furnaces, design duct systems for minimum and maximum external static pressures detailed in Figure 45. See Section 27 on measuring duct work static pressure.

EXTERNAL STATIC PRESSURE  
(Inches of Water Column)

*INPUT (BTU/HR)	MINIMUM (HEATING)	MAXIMUM (COOLING)
40,000	0.10	0.50
50,000	0.12	0.50
60,000	0.12	0.50
75,000	0.12	0.50
80,000	0.12	0.50
100,000	0.15	0.50
120,000	0.20	0.50
140,000	0.20	0.50

\*Input is on furnace rating plate on blower door.

Figure 45

### A. Supply air duct work.

**NOTE:** Supply air duct (plenum) connection must be the same size as the furnace supply air opening. Attach to supply air duct flanges.

When you install furnace with an air conditioner, provide an 18" transition without turns from furnace to cooling coil. If you cannot obtain a full 18" transition, design one that allows free air flow through furnace and cooling coil. Make sure furnace temperature rise is within range noted on furnace rating plate. Also consult air conditioner's duct work installation instructions.

When you install furnace without an air conditioner, extend supply air duct 18" from furnace connection without any turns or round pipe connections. Make sure resulting air temperature rise is within range noted on furnace rating plate.

Seal supply air duct work to furnace casing, walls, ceilings or floors it passes through. End duct work outside furnace space.

**B. Return air duct work.**

**NOTE:** Return air plenum connection must be same size as furnace return air opening. Attach to return air plenum flanges. Connect all return air ducts to plenum. Do not connect them to top, bottom, sides or doors of furnace blower compartment.

Whether you install furnace with or without an air conditioner, return air plenum should extend 18" from furnace connection without turns or round pipe connections. To make sure return air enters blower compartment smoothly and balanced, consider:

- Size and shape of return air plenum;
- Number of return air ducts;
- Your own experience.

Be sure you balance airflow into blower assembly side opposite the motor with airflow into blower motor side.

**WARNING: COMBUSTION PRODUCTS COULD ENTER CIRCULATING AIR STREAM THROUGH AIR STREAM LEAKS, RESULTING IN INJURY OR DEATH.**

**C. Duct dampers.**

You may balance air flow with dampers installed in each branch run duct and adjust for even temperature throughout.

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 return air plenum is correct;
- Number of return air ducts is correct;
- You consider your own experience and seek assistance if needed.

Uneven air flow could cause blower motor to overheat. Avoid vent system reverse pressure by running return air duct work outside furnace space. Seal return air duct work to furnace casing, walls, ceilings or floors it passes through. End duct work outside furnace space.

**WARNING: COMBUSTION PRODUCTS COULD ENTER CIRCULATING AIR STREAM THROUGH AIR STREAM LEAKS, RESULTING IN INJURY OR DEATH.**

**D. Common duct work.**

If furnace will share common duct work with a separate cooling unit, install it parallel to or upstream from the cooling unit. This avoids condensation in heating element.

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, the furnace or cooling unit must not operate.

**SECTION 18—SELECTING AND INSTALLING AIR FILTERS**

**CAUTION:** You must install air filters to keep these components clean: blower motor, blower wheel and air conditioning coil, if there is one. Dirty equipment may reduce system efficiency or cause erratic control performance, resulting in damage to blower motor or heat exchanger and air conditioner (if installed).

Air filters are not supplied with furnace. Obtain and install correct size.

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 cleanable filters. Too small a filter could cause excess static pressure, adversely affecting furnace operation. Follow minimum sizing and quantity recommendations in Figure 46, as well as the air filter manufacturer's.

*GAS INPUT BTU/HR	MOTOR H.P.	FIELD-SUPPLIED DISPOSABLE AIR FILTERS	FIELD-SUPPLIED CLEANABLE AIR FILTERS
		(TWO REQUIRED) SIZE	(ONE REQUIRED) SIZE
40,000	1/4	16" x 20" x 1"	16" x 20" x 1"
50,000	1/4	16" x 20" x 1"	16" x 20" x 1"
60,000	1/6	20" x 20" x 1"	20" x 20" x 1"
60,000	1/4	20" x 20" x 1"	20" x 20" x 1"
60,000	1/3	20" x 20" x 1"	20" x 20" x 1"
75,000	1/6	20" x 20" x 1"	20" x 20" x 1"
75,000	1/6	20" x 20" x 1"	20" x 20" x 1"
75,000	1/3	20" x 20" x 1"	20" x 20" x 1"
80,000	1/5	20" x 20" x 1"	20" x 20" x 1"
80,000	1/3	20" x 20" x 1"	20" x 20" x 1"
80,000	1/2	20" x 25" x 1"	20" x 25" x 1"
100,000	1/5	20" x 20" x 1"	20" x 20" x 1"
100,000	1/3	20" x 20" x 1"	20" x 20" x 1"
100,000	1/2	20" x 25" x 1"	20" x 25" x 1"
120,000	1/2	20" x 25" x 1"	20" x 25" x 1"
140,000	1/2	20" x 25" x 1"	20" x 25" x 1"

\*Gas input and motor horsepower are on furnace rating plate.

**Figure 46**

Do not install air filters inside furnace casing. You may use an appropriately sized and installed return grille or in-duct air filter. Consult filter manufacturer for installation instructions. Use good engineering practices when selecting filter location.

To inspect, replace or clean air filters, follow Users' Information Manual instructions.

**SECTION 19—CHECKING BEFORE STARTING FURNACE**

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

1. Have you removed the cardboard blower wheel shipping support from inside the blower wheel on the side opposite the motor? See Section 1.
2. Is furnace properly equipped to operate with available fuel? See Section 2.
3. Have you cleared away all loose construction and insulation materials? See Section 6.

4. Is furnace level? See Section 7.
5. If furnace is in crawl space, is it sufficiently elevated above the ground? See Section 7.
6. Does furnace have sufficient ventilation air? See Section 8.
7. Does vent system meet current National Fuel Gas Code ANSI Z223.1/ NFPA 54 and local codes? See Section 9.
8. Is vent connection securely fastened to draft diverter or draft inducer? See Section 9.
9. Did you completely check gas pipe and controls for gas leaks? See Section 11.
10. If you moved controls, is gas control next to blower door? See Section 12 or 13.
11. If you moved controls, are hole plugs in all vacated holes? Are all wires properly insulated and connected? See Section 12 or 13.
12. If you moved controls, draft diverter or draft inducer, did you replace all screws? See Section 12 or 13.
13. Is draft diverter or draft inducer installed correctly? See Section 12 or 13.
14. Have you pushed VLS red reset button on Standing Pilot or Electronic Ignition models? See Section 12.
15. For all models, have you pushed burner limit switch reset buttons? See Section 12 or 13.
16. If a Standing Pilot or Electronic Ignition model, are both heat deflectors installed on supply air end of furnace? See Section 12.
17. If an Induced Draft model, is heat deflector installed on supply air end of furnace opposite the draft inducer? See Section 13.
18. Does electrical wiring follow current National Electrical Code ANSI/ NFPA 70 as well as local codes? See Section 14.
19. Is furnace electrically grounded? See Section 14.
20. Is room thermostat properly installed and heat anticipator set correctly? See Section 16.
21. Is duct work system correctly sized and sealed? See Section 17.
22. Are air filters in place and correctly sized? See Section 18.
23. On furnace installations above a 2000-foot elevation, is furnace derated properly? See Section 24.

## SECTION 20 —ADJUSTING PILOT

Equipment Needed: Save time by getting these tools before you start. Item numbers 6, 7, 14, 15, 21, 22, 26 and 30 listed in Section 10.

**WARNING:** YOU MUST HAVE CORRECT GAS SUPPLY LINE AND PILOT GAS PRESSURES. CORRECT PRESSURES GIVE PROPER IGNITION PILOT AND BURNER OPERATION. USE A "U" TUBE WATER MANOMETER TO MEASURE ACTUAL GAS PRESSURE. FAILURE TO ACCURATELY ADJUST PRESSURE COULD CAUSE A FIRE OR EXPLOSION, RESULTING IN DAMAGE, INJURY OR DEATH.

Dwg. No. 21X146100 PO2

### A. Gas supply line pressure.

1. Turn off gas at manual shut-off valve in gas supply line just ahead of furnace.
2. Remove inlet pressure plug from gas control.
3. Make sure valve is in off position, then install 1/8"-pipe manual shut-off valve in hole vacated by plug.
4. Attach "U" tube water manometer to 1/8"-pipe manual shut-off valve just installed.
5. Open manual shut-off valve in gas supply line near furnace.
6. Open 1/8"-pipe manual shut-off valve leading to "U" tube water manometer.
7. Read gas supply line pressure on manometer.
  - a. Gas supply line pressure must be between 7 inches and 11 inches W.C. for natural gas.
  - b. Gas supply line pressure must be between 11 inches and 14 inches W.C. for propane (LP) gas.
8. If gas supply line pressure is not within these limits, call gas supplier.

### B. Pilot flame adjustment.

Before adjusting pilot flame, confirm that gas supply line pressure is correct, as explained in paragraph A) above, then proceed:

1. For Standing Pilot models:
  - a. Open manual shut-off valve in gas supply line near furnace.
  - b. Light pilot following lighting instructions on furnace blower door or Users' Information Manual.
  - c. Pilot flame should cover 1/2" of tip of thermocouple as shown in Figure 47.

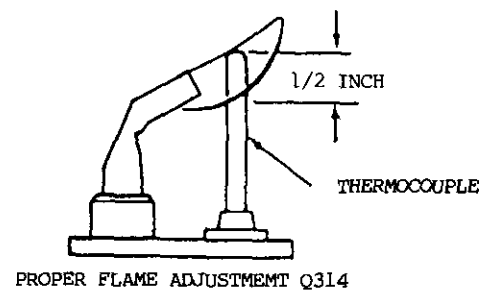


Figure 47 (4-031)

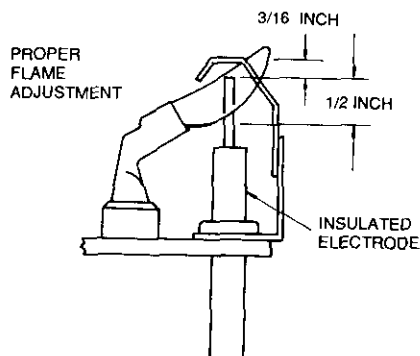
- d. If you need to adjust pilot flame, remove pilot adjustment cover screw on gas control. Save screw for reinstallation. Turn inner adjustment screw clockwise **N** to decrease flame; counter-clockwise **A** to increase pilot flame.
- e. After making adjustment, replace cover screw and tighten to torque of 10 inch-pounds. This will prevent gas leakage.

- f. If you will not check gas input now, turn off shut-off valve in gas control inlet pressure tap. Turn gas off using manual shut-off valve in gas supply line. Remove shut-off valve from gas control inlet pressure tap. Install inlet pressure plug. Turn on gas.
- g. Check pilot adjustment cover screw and gas control inlet pressure tap plug for gas leaks. Use a commercial soap solution made for leak detection.

**WARNING: NEVER USE AN OPEN FLAME TO CHECK FOR GAS LEAKS. A GAS LEAK COULD CAUSE A FIRE OR EXPLOSION, RESULTING IN DAMAGE, INJURY OR DEATH.**



2. For Electronic Ignition and Induced Draft models:

- a. Open manual shut-off valve located in gas supply line near furnace.
- b. If necessary, adjust spark gap to 3/16" as shown in Figure 48. Pilot flame should cover 1/2" of tip of electrode.



PROPER PILOT FLAME ADJUSTMENT FOR Q345

Figure 48 (4-032)

- c. Disconnect red wire from electronic ignition lockout module at terminal "MV".
- d. Start furnace following operating instructions on blower door. Pilot will light; after delay, blower will come on, but main burners will not light.
- e. Pilot flame should cover 1/2" of tip of flame sensor as shown in Figure 48.
- f. If you need to adjust pilot flame, remove pilot adjustment cover screw on gas control. Save screw for reinstallation. Turn inner adjustment screw clockwise  to decrease flame; counterclockwise  to increase pilot flame. Install cover screw and tighten to torque of 10 inch-pounds to prevent gas leakage.
- g. Shut off furnace. Connect red wire from gas control at terminal "MV" to electronic ignition lockout module at terminal "MV".
- h. If you will not be checking gas input now, turn off gas. Use manual shut-off valve in gas supply line. Remove shut-off valve from gas control inlet pressure tap. Install inlet pressure tap plug. Turn on gas.
- i. Check pilot adjustment cover screw and gas control inlet pressure tap plug for gas leaks. Use a commercial soap solution made for leak detection.

**WARNING: NEVER USE AN OPEN FLAME TO CHECK FOR GAS LEAKS. A GAS LEAK COULD CAUSE A FIRE OR EXPLOSION, RESULTING IN DAMAGE, INJURY OR DEATH.**

## SECTION 21—ADJUSTING MANIFOLD PRESSURE



Equipment Needed: Save time by getting these tools before you start: Item numbers 6, 14, 15, 16, 22, 26 and 30 from Section 10.

**WARNING: CORRECT MANIFOLD PRESSURE IS NECESSARY FOR PROPER IGNITION AND BURNER OPERATION. USE A "U" TUBE WATER MANOMETER TO MEASURE ACTUAL GAS PRESSURES. FAILURE TO ACCURATELY ADJUST PRESSURE COULD CAUSE HEAT EXCHANGER FAILURE, ASPHYXIATION, FIRE OR EXPLOSION, RESULTING IN DAMAGE, INJURY OR DEATH.**

### A. Normal manifold pressures (gas control outlet pressures).

GAS SUPPLY	NORMAL	
Natural gas	3.5 inches	W.C.
Propane (LP) gas	10.0 inches	W.C.

### B. Connect a "U" tube water manometer to measure manifold pressure:

1. Turn gas off at manual shut-off valve located in gas supply line just ahead of furnace.
2. Remove outlet pressure tap plug from gas control.
3. Make sure shut-off valve is in off position, then install 1/8"-pipe manual shut-off valve in hole vacated by plug.
4. Attach "U" tube water manometer to 1/8"-pipe manual shut-off valve just installed.
5. Turn on all gas appliances attached to gas supply line.
6. Open manual shut-off valve in gas supply line just ahead of furnace. Start furnace following operating or lighting instructions on blower door.
7. Open 1/8"-pipe manual shut-off valve leading to manometer.
8. Read manifold pressure on manometer.
9. Make small changes in manifold pressure within allowable range by turning gas control regulator adjusting screw clockwise  to increase pressure; counterclockwise  to decrease pressure. Make major changes in flow rate by changing main burner orifice size. Refer to Section 24 C.
10. Check gas input following instructions in Section 20. After making final manifold pressure adjustment, replace regulator adjustment cover screw. Tighten to torque of 5 inch-pounds to prevent gas leakage.
11. Turn off shut-off valve in gas control outlet pressure tap. Remove shut-off valve from gas control outlet pressure tap. Install outlet pressure plug. Turn on gas.

12. Check regulator adjustment cover screw and gas control outlet pressure tap plug for gas leaks. Use a commercial soap solution made for leak detection.

**WARNING: NEVER USE AN OPEN FLAME TO CHECK FOR GAS LEAKS. A GAS LEAK COULD CAUSE A FIRE OR EXPLOSION RESULTING IN DAMAGE, INJURY OR DEATH.**

## SECTION 22—CHECKING GAS INPUT



Equipment Needed: Save time by getting these tools before you start: Item numbers 6, 16, 21, 22, 26 and 29 listed in Section 10.

Make sure furnace has correct gas input. Underfiring could cause inadequate heat or ignition problems. Overfiring could cause sooting, flame impingement or overheating of heat exchanger.

### A. Natural gas.

**NOTE:** For operations above 2,000 feet elevation, follow instructions in Section 24.

Before starting natural gas input check, obtain gas heat value from local supplier.

1. Be sure orifices and burner spoiler screws are correct. Make sure gas piping is large enough to allow for all appliances connected to it to operate at once without lowering main line pressure. Failure to do so could cause lighting or burning problems on any of the appliances.
2. Make sure gas control inlet pressure is between 7 inches and 11 inches W.C. Use method in Section 20 to check gas supply line pressure.
3. Make sure all other gas appliances are off. You may leave pilots on. Start furnace following operating or lighting instructions on blower door or in Users' Information Manual.
4. As furnace warms up, watch gas supply line (gas control inlet) pressure using "U" tube water manometer installed in gas control inlet pressure tap. See Section 20. Natural gas supply line pressure must still be between 7 inches and 11 inches W. C.
5. After 6 minutes, close shut-off valve in gas control inlet pressure tap. Move manometer connection to gas control outlet pressure tap. See Section 21. Open shut-off valve in outlet pressure tap.
6. Manifold pressure should be 3.5 inches W.C. Adjust by removing regulator cover screw on gas control. Save screw for reinstallation. Turn inner adjustment screw counterclockwise  to decrease manifold pressure; clockwise  to increase manifold pressure. Set correct manifold pressure. Install cover screw. Tighten to torque of 5 inch-pounds.
7. 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.
8. With stopwatch, measure time it takes to consume TWO cubic feet of gas.

- a. If dial is one-half-cubic foot per revolution, measure time for four revolutions.
- b. If dial is one-cubic foot per revolution, measure for two revolutions.
- c. If dial is two-cubic feet per revolution, measure for one revolution.
- d. Divide time it takes for two cubic feet to flow by to get seconds for one-cubic foot flow.

Example:

If it took 58 seconds for two-cubic feet to flow, it would take 29 seconds for one-cubic foot to flow.

9. a. Use this formula to calculate gas input:

$$\text{Gas Input} = \frac{\text{Gas BTU/CU. FT.} \times 3,600 \text{ seconds per hour}}{\text{Seconds for one cubic foot of gas}} = \text{BTUH}$$

Example:

Assume it took 29 seconds for one cubic foot of gas to flow and heating value of 1,000 BTU/CU.FT.

$$\text{Gas Input} = \frac{1,000 \times 3,600}{29} = 124,000 \text{ BTUH}$$

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

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

Example:

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

Water heater pilot	1,000 BTUH
Dryer pilot	500 BTUH
4 range burner pilots	2,000 BTUH
1 range oven pilot	500 BTUH
	<hr/>
	4,000 BTUH

Subtracting 4,000 BTUH from 124,000 BTUH measured above equals 120,000 BTUH. 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. If you cannot get rated input with manifold pressure within the allowable range, you will need to change orifices. See Section 24) C).

- Turn off gas before removing the 1/8"-pipe manual shut-off valves you used. Install 1/8"-pipe plugs in gas control inlet and outlet pressure taps. Tighten to torque of 50 inch-pounds. Turn on gas. Check both pipe plugs for gas leaks. Use a commercial soap solution made for leak detection.

**WARNING: NEVER USE AN OPEN FLAME TO CHECK FOR GAS LEAKS. A GAS LEAK COULD CAUSE A FIRE OR EXPLOSION, RESULTING IN DAMAGE, INJURY OR DEATH.**

#### B. Propane (LP) gas.

**NOTE:** For operation at elevations above 2,000 feet, follow instructions in Section 24.

- Make sure you have correct pilot orifice, main burner orifices and burner spoiler screws. Be sure that gas piping is large enough to allow all appliances connected to it to operate at once without lowering main line pressure. Failure to do so could cause lighting or burning problems on any of the appliances.
- Gas control inlet pressure must be between 11 inches and 14 inches for propane (LP) gas. See Section 20 to check gas supply line pressure.
- Turn off all other gas appliances. Pilots may be left on. Start furnace following operating or lighting instructions on blower door or in Users' Information Manual.
- As furnace warms up, watch gas supply line (gas control inlet pressure) using "U" tube water manometer in gas control inlet pressure tap. See Section 20. Supply line pressure must still be between 11 inches and 14 inches W.C. for propane (LP) gas.
- After 6 minutes, close shut-off valve in gas control inlet pressure tap. Move manometer to gas control outlet pressure tap. See Section 21. Open shut-off valve in gas control inlet pressure tap.
- Manifold pressure should be 10.0 inches W.C.  $\pm$  0.3 inches W.C. Adjust by removing regulator cover screw on gas control. Save screw for reinstallation. Turn inner adjustment screw counterclockwise  to decrease manifold pressure; clockwise  to increase manifold pressure. Set correct manifold pressure. Install cover screw. Tighten to torque of 5 inch-pounds.

**WARNING: PROPANE (LP) GAS INSTALLATIONS DO NOT HAVE GAS METERS TO DOUBLE CHECK INPUT RATE. YOU MUST MEASURE MANIFOLD PRESSURE ADJUSTMENT WITH AN ACCURATE "U" TUBE WATER MANOMETER. FAILURE TO ACCURATELY ADJUST PRESSURE COULD CAUSE HEAT EXCHANGER FAILURE, ASPHYXIATION, FIRE OR EXPLOSION, RESULTING IN DAMAGE, INJURY OR DEATH.**

- Turn off gas before removing the 1/8"-pipe manual shut-off valves. Install 1/8"-pipe plugs in gas control inlet and outlet pressure taps. Tighten to torque of 50 inch-pounds. Turn on gas. Check both pipe plugs for gas leaks. Use a commercial soap solution made for leak detection.

**WARNING: NEVER USE AN OPEN FLAME TO CHECK FOR GAS LEAKS. A GAS LEAK COULD CAUSE A FIRE OR EXPLOSION RESULTING IN DAMAGE, INJURY OR DEATH.**

## SECTION 23—ORIFICE SIZE

See Figure 49 for natural gas orifice sizes as shipped from factory for Standing Pilot and Electronic Ignition models. For Induced Draft models, see Figure 50.

Standing Pilot and Electronic Ignition Models Initial Orifice Size		
Input* BTU/HR	Natural Gas Orifice Size*	Propane Orifice Size*
40,000	2.15mm	1.30mm
50,000	2.40mm	1.45mm
60,000	2.15mm	1.30mm
75,000	2.40mm	1.45mm
80,000	2.15mm	1.30mm
100,000	2.40mm	1.45mm
120,000	2.35mm	1.40mm
140,000	2.30mm	1.40mm
*Input (BTU/HR) and orifice size are on furnace rating plate.		

Figure 49

Induced Draft Models Initial Orifice Size		
Input* BTU/HR	Natural Gas Orifice Size*	Propane Orifice Size*
40,000	2.15mm	1.30mm
60,000	2.15mm	1.30mm
80,000	2.15mm	1.30mm
100,000	2.15mm	1.30mm
120,000	2.15mm	1.30mm
*Input (BTU/HR) and orifice size are on furnace rating plate.		

Figure 50

Check with your local gas supplier to determine heat value (BTU/CU.FT.) of gas in your area. Depending on your local heat value and elevation, you may need to adjust manifold pressure or change orifices to get proper gas input rate. See Section 24.

## SECTION 24—DERATING FOR HIGH ALTITUDES

Equipment Needed: Save time by getting these tools before you start: Item numbers 4, 10, 11 and 30 listed in Section 10.

### A. Installer responsibility.

Make sure actual furnace gas input does not exceed furnace rating plate value. You may need to change orifices to get correct gas input. Whether you do or not depends on furnace input, your gas heat value at standard conditions and elevation. Consult your local gas supplier for gas heat value at standard conditions and any special derating requirements.



## B. New orifice size

See appropriate chart to determine new orifice size.

A natural gas orifice kit containing the natural gas orifices indicated in the charts below is available through your supplier. A similar propane (LP) gas orifice kit is available. Individual orifices are also available in a convenient lot size. Use only these orifices to assure proper performance.

## C. Changing Orifices.

**WARNING: BEFORE CHANGING ORIFICES, TURN OFF ELECTRICAL POWER AND GAS. FAILURE TO DO SO COULD RESULT IN ELECTRICAL SHOCK OR GAS LEAK, RESULTING IN DAMAGE, INJURY OR DEATH.**

- From side of burner rack opposite gas control, remove one sheet metal screw as shown in "A" in Figure 51. Save screw for reinstallation.

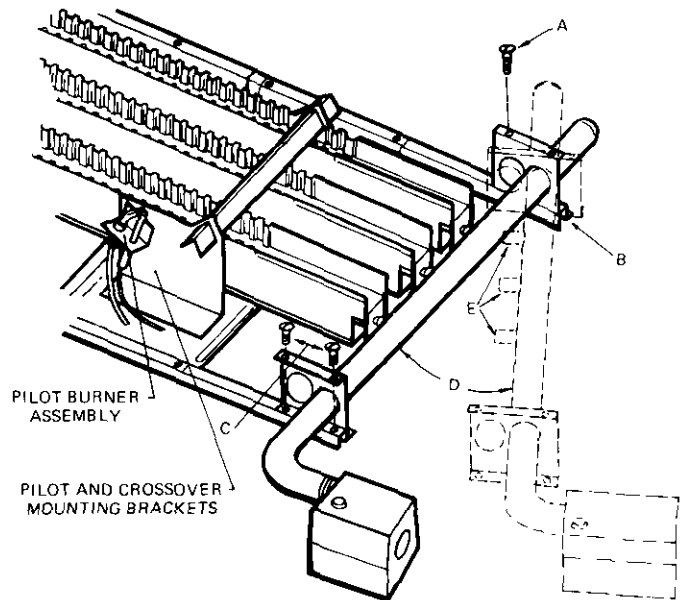


Figure 51 (4-029)

- Set room thermostat to its lowest or off setting.
- Turn off electricity to furnace.
- Remove low-voltage wires from gas control. On Electronic Ignition and Induced Draft models, remove orange high-voltage ignition wire from electronic ignition lockout module.
- Turn off manual shut-off valve in furnace gas supply line.
- Disconnect gas supply line upstream from furnace's gas control.
- Take burner cover off by removing three screws. Save screws for reinstallation.
- Remove and discard shipping supports if still in place. Replace lower screws.
- Take burner side shield off by removing two screws. Save them for reinstallation.
- Lift burner rack up and pull out of furnace.
- Disconnect pilot gas tubing at gas control. On Standing Pilot models, disconnect thermocouple at gas control.

- Loosen burner rack screw one turn, as shown in "B" in Figure 51.
- From gas control side of burner rack, remove two screws from manifold bracket as shown in "C" in Figure 51. Save screws for reinstallation.
- Pivot manifold away from burners as shown in "D" in Figure 51.
- Remove original gas orifices, illustrated as "E" in Figure 51.
- Install new orifices finger-tight into manifold. Do not cross-thread. Tighten to torque of 50 inch-pounds.

**NATURAL GAS —ORIFICE SIZE CHART**  
Standing Pilot and Electronic Ignition Models—Furnace Input: 40,000; 60,000; 80,000 BTU/HR

Gas Heat* Value BTU/CU.FT.	Elevation								
	Up to 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
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
1050-1100	2.10mm	2.05mm	2.00mm	2.00mm	1.95mm	1.90mm	1.90mm	1.85mm	1.85mm

\* At standard conditions: Sea-level pressure and 60 F temperature.  
NOTE: All orifices above are included in natural gas orifice kit.

**NATURAL GAS—ORIFICE SIZE CHART**  
**Standing Pilot and Electronic Ignition Models—Furnace Input: 50,000; 75,000; 100,000 BTU/HR**

Gas Heat* Value BTU/CU.FT.	Elevation								
	Up to 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
800-849	<u>2.65mm</u>	<u>2.60mm</u>	<u>2.55mm</u>	<u>2.50mm</u>	<u>2.50mm</u>	2.45mm	2.40mm	2.35mm	2.30mm
850-899	<u>2.60mm</u>	<u>2.55mm</u>	<u>2.50mm</u>	<u>2.45mm</u>	2.40mm	2.35mm	2.35mm	2.30mm	2.25mm
900-949	<u>2.50mm</u>	<u>2.45mm</u>	2.40mm	2.40mm	2.35mm	2.30mm	2.25mm	2.25mm	2.20mm
950-999	<u>2.45mm</u>	2.40mm	2.35mm	2.30mm	2.30mm	2.25mm	2.20mm	2.15mm	2.10mm
1000-1049	2.40mm	2.35mm	2.30mm	2.25mm	2.25mm	2.20mm	2.15mm	2.10mm	2.05mm
1050-1100	2.35mm	2.30mm	2.25mm	2.20mm	2.20mm	2.15mm	2.10mm	2.05mm	2.05mm

\* At standard conditions: Sea-level pressure and 60 F temperature.  
 NOTE: Orifices underlined are not included in natural gas orifice kit. Order separately.

**NATURAL GAS—ORIFICE SIZE CHART**  
**Standing Pilot and Electronic Ignition Models—Furnace Input: 120,000 BTU/HR**

Gas Heat* Value BTU/CU.FT.	Elevation								
	Up to 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
800-849	<u>2.60mm</u>	<u>2.55mm</u>	<u>2.50mm</u>	<u>2.45mm</u>	<u>2.45mm</u>	2.40mm	2.35mm	2.30mm	2.25mm
850-899	<u>2.55mm</u>	<u>2.50mm</u>	<u>2.45mm</u>	2.40mm	2.35mm	2.30mm	2.30mm	2.25mm	2.20mm
900-949	<u>2.45mm</u>	2.40mm	2.35mm	2.35mm	2.30mm	2.25mm	2.20mm	2.20mm	2.15mm
950-999	2.40mm	2.35mm	2.30mm	2.25mm	2.25mm	2.20mm	2.15mm	2.15mm	2.10mm
1000-1049	2.35mm	2.30mm	2.25mm	2.20mm	2.20mm	2.15mm	2.10mm	2.05mm	2.05mm
1050-1100	2.30mm	2.25mm	2.20mm	2.15mm	2.15mm	2.10mm	2.05mm	2.05mm	2.00mm

\* At standard conditions: Sea-level pressure and 60 F temperature.  
 NOTE: Orifices underlined are not included in natural gas orifice kit. Order separately.

**NATURAL GAS—ORIFICE SIZE CHART**  
**Standing Pilot and Electronic Ignition Models—Furnace Input: 140,000 BTU/HR**

Gas Heat* Value BTU/CU.FT.	Elevation								
	Up to 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
800-849	<u>2.55mm</u>	<u>2.50mm</u>	<u>2.45mm</u>	<u>2.45mm</u>	2.40mm	2.35mm	2.30mm	2.30mm	2.25mm
850-899	<u>2.50mm</u>	<u>2.45mm</u>	2.40mm	2.35mm	2.35mm	2.30mm	2.25mm	2.20mm	2.15mm
900-949	2.40mm	2.35mm	2.35mm	2.30mm	2.25mm	2.25mm	2.20mm	2.15mm	2.10mm
950-999	2.35mm	2.30mm	2.25mm	2.25mm	2.20mm	2.15mm	2.15mm	2.10mm	2.05mm
1000-1049	2.30mm	2.25mm	2.20mm	2.20mm	2.15mm	2.10mm	2.10mm	2.05mm	2.00mm
1050-1100	2.25mm	2.20mm	2.15mm	2.15mm	2.10mm	2.05mm	2.05mm	2.00mm	1.95mm

\* At standard conditions: Sea-level pressure and 60 F temperature.  
 NOTE: Orifices underlined are not included in natural gas orifice kit. Order separately.

**NATURAL GAS—ORIFICE SIZE CHART**  
 Induced Draft Models—Furnace Input: 40,000; 60,000; 80,000; 100,000; 120,000 BTU/HR

Gas Heat* Value BTU/CU.FT.	Elevation								
	Up to 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
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
1050-1100	2.10mm	2.05mm	2.00mm	2.00mm	1.95mm	1.90mm	1.90mm	1.85mm	1.85mm

\* At standard conditions: Sea-level pressure and 60 F temperature.  
 NOTE: All orifices above are included in natural gas orifice kit.

**PROPANE (LP) GAS—ORIFICE SIZE CHART**  
 Standing Pilot and Electronic Ignition Models

Input BTU/HR	Elevation								
	Up to 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	1.30mm	1.25mm	1.25mm	1.20mm	1.20mm	1.20mm	1.15mm	1.15mm	1.10mm
60,000	1.30mm	1.25mm	1.25mm	1.20mm	1.20mm	1.20mm	1.15mm	1.15mm	1.10mm
80,000	1.30mm	1.25mm	1.25mm	1.20mm	1.20mm	1.20mm	1.15mm	1.15mm	1.10mm
50,000	1.45mm	1.40mm	1.40mm	1.35mm	1.35mm	1.35mm	1.30mm	1.30mm	1.25mm
75,000	1.45mm	1.40mm	1.40mm	1.35mm	1.35mm	1.35mm	1.30mm	1.30mm	1.25mm
100,000	1.45mm	1.40mm	1.40mm	1.35mm	1.35mm	1.35mm	1.30mm	1.30mm	1.25mm
120,000	1.40mm	1.40mm	1.35mm	1.35mm	1.30mm	1.30mm	1.30mm	1.25mm	1.25mm
140,000	1.40mm	1.35mm	1.35mm	1.30mm	1.30mm	1.30mm	1.25mm	1.25mm	1.20mm

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

**PROPANE (LP) GAS—ORIFICE SIZE CHART**  
 Induced Draft Models

Input BTU/HR	Elevation								
	Up to 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	1.30mm	1.25mm	1.25mm	1.20mm	1.20mm	1.20mm	1.15mm	1.15mm	1.10mm
60,000	1.30mm	1.25mm	1.25mm	1.20mm	1.20mm	1.20mm	1.15mm	1.15mm	1.10mm
80,000	1.30mm	1.25mm	1.25mm	1.20mm	1.20mm	1.20mm	1.15mm	1.15mm	1.10mm
100,000	1.30mm	1.25mm	1.25mm	1.20mm	1.20mm	1.20mm	1.15mm	1.15mm	1.10mm
120,000	1.30mm	1.25mm	1.25mm	1.20mm	1.20mm	1.20mm	1.15mm	1.15mm	1.10mm

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

17. Slowly return manifold to its place by sliding each burner over its orifice. Replace two screws as shown in "C", Figure 51, and one screw as shown in "A", Figure 51.
18. Tighten four screws in manifold bracket to torque of 60 inch-pounds.
19. Tighten gas control pilot tube fitting to torque of 60 inch-pounds. On Standing Pilot models, attach thermocouple finger-tight and tighten 1/4 turn with wrench.
20. Slide burner rack assembly into place. When properly installed, it nests snugly in bottom of furnace and does not move in any direction.
21. Install front burner side shield. Use screws saved earlier. Properly place side shield support leg. See Figure 52.

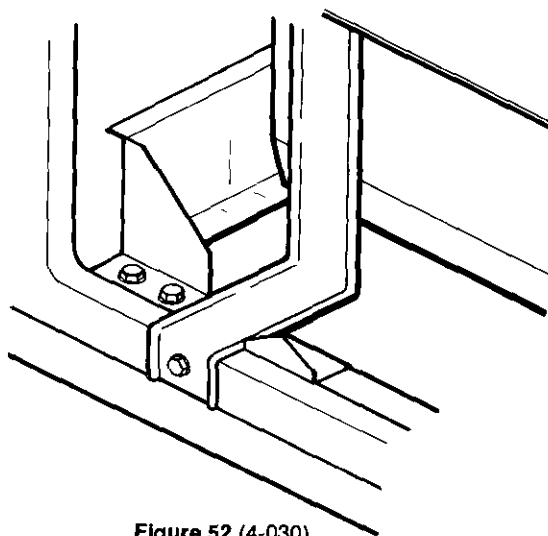


Figure 52 (4-030)

22. Install front burner cover using screws saved earlier.
23. Connect low-voltage wires to gas control.
  - a. For Standing Pilot models:
    1. Connect wire from vent limit switch (VLS) to gas control at terminal "TH".
    2. Connect blue wire from terminal strip at terminal "C" to gas control at terminal "TR".
  - b. For Electronic Ignition and Induced Draft models:
    1. Connect red wire from electronic ignition lockout module at terminal "MV" to gas control at terminal "MV".
    2. Connect white wire from electronic ignition lockout module at terminal "MV/PV" to gas control at terminal "PV/MV".
    3. Connect black wire from electronic ignition lockout module at terminal "PV" to gas control at terminal "PV".
    4. Connect orange high-voltage ignition wire from pilot/ignitor to electronic ignition lockout module at high-voltage terminal.
24. Follow procedures below to complete installation.

## SECTION 25 —NORMAL BURNER FLAME HEIGHT

- A. Furnace operates more efficiently with a taller burner flame at blower end of furnace. This design extracts more heat from heat exchanger. Figure 53 illustrates approximate burner flame height of first primary mantle at middle of burner.

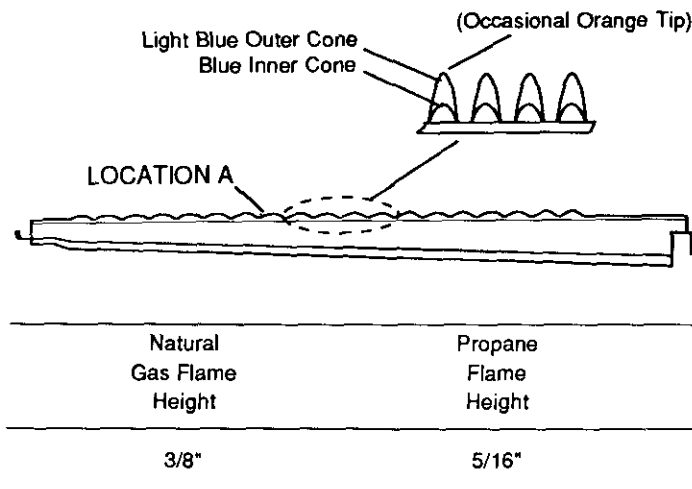


Figure 53 (4-033)

- B. Operate furnace 5 minutes. If burner flame height appears abnormal, check:
  - Orifice size; see Section 23,
  - Spoiler screw size and alignment; make sure they are driven fully in and positioned parallel with the vertical, front to back and left to right;
  - Manifold pressure and gas input; see Sections 21 and 22;
  - Gas supply line pressure; see Section 20.

## SECTION 26 —ADJUSTING BLOWER SPEED

Equipment Needed: Save time by getting these tools before you start: Item numbers 17, 18 and 19 listed in Section 10.

**CAUTION: Inadequate air circulation could cause excessive air temperature rise through furnace. This could cause high-temperature limit switch to cycle burners on and off which could reduce furnace efficiency and shorten life of heat exchanger and blower motor.**

Determine initial cooling and heating speeds in system design stage. See product data sheet for airflow data. Depending on test results performed in Sections 27 and 28, you may want to change blower motor speed.

- A. Heat-only models use single-speed motors. You may not adjust motor speed.
- B. Air conditioning models use three-speed motors. Blower motor cooling speed is high-speed (black motor wire) as-shipped. Blower motor

heating speed is medium-speed (blue motor wire) as-shipped. Note that cooling speed in the field is usually higher than heating speed.

Motor speed wire color designations are:

- High-Speed ..... Black
- Medium-Speed ..... Blue
- Low-Speed ..... Red

**WARNING: BEFORE CHANGING BLOWER MOTOR SPEED, ALWAYS TURN OFF ELECTRICAL POWER TO FURNACE TO PREVENT RISK OF ELECTRICAL SHOCK WHICH COULD RESULT IN DAMAGE, INJURY OR DEATH.**

1. If the desired cooling and heating speeds are different, within junction box:
  - a. Connect desired blower motor wire to blower relay at terminal "N.O." for cooling speed.
  - b. Connect desired blower motor wire to fan/limit control conduit brown wire for heating speed.
  - c. Insulate remaining blower motor wire.
2. If your desired cooling and heating speeds are the same:
  - a. Cut blower motor black wire. Leave black pigtail attached to blower relay at terminal "N.O."
  - b. Connect pigtail, fan/limit control brown wire and desired cooling/heating speed blower wire.
  - c. Insulate remaining blower motor wires.

**WARNING: PROPERLY INSULATE UNUSED BLOWER MOTOR WIRES IN JUNCTION BOX TO MEET REQUIREMENTS OF CURRENT NATIONAL ELECTRICAL CODE ANSI/NFPA 70. FAILURE TO INSULATE COULD CAUSE FURNACE OVERHEATING, ELECTRICAL SHOCK OR FIRE, RESULTING IN DAMAGE, INJURY OR DEATH.**

## SECTION 27—MEASURING DUCT WORK STATIC PRESSURE

Equipment Needed: Save time by getting item number 27 listed in Section 10 before you start.

### A. Preparing to measure duct work static pressure.

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. Make sure air filters are clean and in place. Set balancing dampers. See Section 18 for filter information.
2. Check duct work for obstructions or leaks.

### B. Measuring duct work static pressure.

1. Place slope gauge near furnace where level and adjust scale to read 0.00 inches W.C.

2. Insert one static pressure tap into transition duct between furnace and cooling coil. Insert tap into warm air supply plenum on heating-only applications. Insert a static pressure tap in return air plenum. See Figure 54.

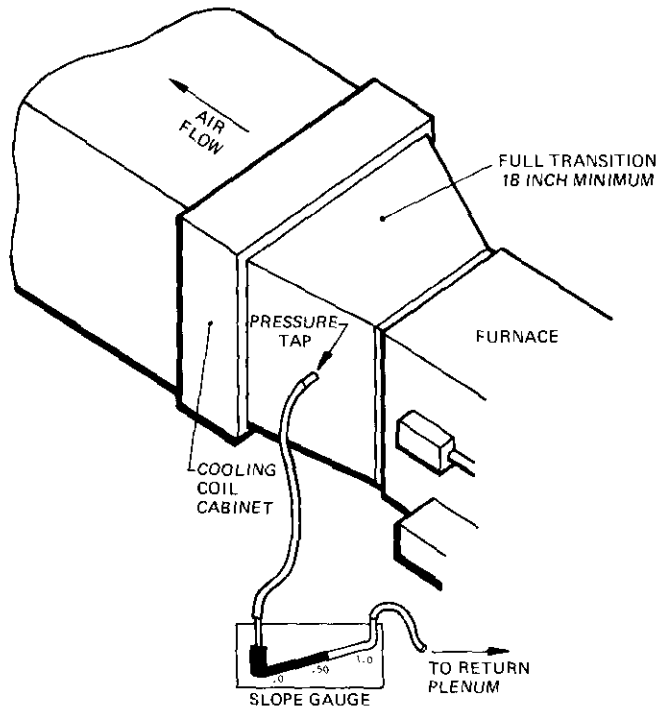


Figure 54 (4-027)

3. Connect pressure tap attached to transition duct (warm air supply plenum) to positive pressure side of slope gauge (bottom of scale). See Figure 54. Use flexible tubing.
4. Connect pressure tap attached to return air plenum to negative pressure side of slope gauge (top of scale). See Figure 54. Use flexible tubing.
5. Disconnect room thermostat wires at junction box terminal strip. For furnaces with multi-speed motors, start blower on cooling speed by jumping terminals "R" and "G" on terminal strip. Start blower on heating speed by jumping terminals "R" and "W" on terminal strip. Wait about one minute for blower to start on heating speed.
6. When blower is running, read duct work static pressure. It should fall between values listed in Figure 55.

### EXTERNAL STATIC PRESSURE (INCHES W.C.)

*BTU/HR INPUT	HEATING MINIMUM	COOLING MAXIMUM
40,000	0.10	0.50
50,000	0.12	0.50
60,000	0.12	0.50
75,000	0.12	0.50
80,000	0.12	0.50
100,000	0.15	0.50
120,000	0.20	0.50
140,000	0.20	0.50

\*See BTU/HR INPUT on furnace rating plate.

Figure 55

7. Adjust duct work static pressure. Use blower motor speed change or duct configuration change. See Section 26.
8. Remove jumper wire installed above. Reconnect room thermostat wires to junction box terminal strip. Remove pressure taps and seal holes in duct work. Failure to seal holes in duct work could result in reduced system performance.

## SECTION 28—MEASURING AIR TEMPERATURE RISE

Equipment Needed: Save time by getting item number 28 listed in Section 10 before you start.

### A. Preparing to measure air temperature rise.

1. Open supply air registers and return air grilles. Make sure registers and grilles are free from obstruction by rugs, carpets, drapes or furniture. Make sure air filters are clean and in place. Set balancing dampers. See Section 18 for filter information.
2. Check duct work for obstructions or leaks.

### B. Measuring air temperature rise.

Air temperature rise (warm air supply temperature minus cold air return temperature) must be within allowable air temperature rise range. See furnace rating plate on blower door for range.

1. Place thermometer through hole located 2 feet from furnace in warm air supply plenum. Center thermometer tip in duct work, front to back and top to bottom.
2. Place thermometer through a hole located 2 feet from furnace in cold air return. Center thermometer tip in duct work, front to back and top to bottom.
3. Set room thermostat to highest temperature setting. Operate furnace for 6 minutes. Record supply and return air temperatures.
4. Subtract cold air return temperature from warm air supply temperature. The result is the air temperature rise in Fahrenheit degrees. Compare this rise to allowable range on furnace rating plate.
5. Reset room thermostat to normal temperature setting.
  - a. If air temperature rise is higher than allowed, you need more airflow.
    1. Change blower motor to a higher speed (see Section 26). Air temperature rise will be lower but duct work static pressure will be higher. Do not exceed maximum duct work static pressure allowed in Section 27. Re-check air temperature rise.
    2. If air temperature rise is still outside the range allowed, check duct work design with a qualified heating engineer. You may need to resize duct work.
  - b. If air temperature rise is below rise allowed, you need less air flow.
    1. Change blower motor to a lower speed (see Section 26). Air temperature rise will be higher, but duct work static pressure will be lower. Do not go below minimum duct work static pressure allowed in Section 27. Re-check air temperature rise.

2. If air temperature rise is still outside allowable range, check duct work design with a qualified heating engineer. You may need to resize duct work.

6. Remove thermometers and seal duct work holes once air temperature rise is correct. Failure to seal holes could result in reduced system performance.




## SECTION 29 —CHECKING CONTROLS


Equipment needed: Save time by getting these tools before you start: Item numbers 4 and 26 listed in Section 10.

**WARNING: HIGH TEMPERATURE LIMIT OF FAN/LIMIT CONTROL IS FACTORY PRESET. DO NOT ADJUST IT. INCORRECT HIGH TEMPERATURE LIMIT SETTING COULD CAUSE FURNACE OVERHEATING AND FIRE, RESULTING IN DAMAGE, INJURY OR DEATH.**


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

### A. Checking out controls on Standing Pilot models.


1. Remove front burner cover; replace screws.
2. Light furnace pilot following lighting instructions on blower door or in User's Information Manual.
3. With brown gas control knob in pilot position, set room thermostat to highest temperature setting. Burners should not ignite.
4. Turn brown gas control knob counterclockwise  to on position. Burners should now ignite. Wait for blower motor to start.
5. Cycle electrical disconnect switch next to furnace on and off. Watch at least five ignition cycles.
6. Burner flames should look the same height with circulating blower on or off. If not, or if they are floating around top of burner ports, remove rear burner cover, replace screws. Turn off gas by turning brown gas control knob clockwise  to off. Turn on blower. Check burner box openings on furnace front and rear. Check for air leaks between heat exchanger sealing flanges and casing front and rear panels. Detect air leaks by passing a match flame along burner box sealing flanges. Tighten screws until air leaks stop. Install burner covers.
7. With main burners and blower operating, block off all return air grilles to restrict return air. Wait for fan/limit control to cycle burners off.
8. Remove all restrictions from return air grilles. Wait for main burners to automatically reignite. This test shows how fan/limit control protects furnace against overheating.
9. Turn room thermostat to lowest or off setting. Wait until main burners go off and blower stops running.
10. With pilot operating and main burners and blower motor not operating, rotate brown gas control knob clockwise  to off position.
11. Without pilot flame, thermocouple will cool in about 1-1/2 minutes. This allows safety shut-off valve inside gas control to close. Touch gas control lightly. Feel and listen for closing of internal safety shut-off valve.

12. Immediately after safety shut-off valve closes, turn brown gas control knob counterclockwise  to pilot position, but do not push down on red reset button.
13. Using a match, try to re-light pilot. If pilot will re-light without pushing red reset button, replace gas control. If you replace gas control, repeat Steps 2) through 6) and 9) through 13).



**WARNING:** USE REPLACEMENT PARTS LISTED IN PARTS LIST. FAILURE TO DO SO COULD CAUSE IMPROPER FURNACE OPERATION, RESULTING IN DAMAGE, INJURY OR DEATH.

14. Rotate brown gas control knob counterclockwise  to on position. Set room thermostat to desired setting.

**B. Checking controls on Electronic Ignition and Induced Draft models.**

1. Remove front burner cover; replace screws.
2. Turn off electricity at electrical disconnect switch next to furnace.
3. Turn brown gas control knob clockwise  to off position.
4. If it's not already installed, install "U" tube water manometer in gas control outlet (manifold) pressure tap.
5. Set room thermostat to its highest temperature.
6. Turn on electricity at electrical disconnect switch located next to furnace. Electronic ignition lockout module should start to spark pilot ignitor, but pilot burner should not light. Manifold pressure should remain at zero.
7. Electronic ignition lockout module should spark pilot ignitor for given lockout time of module and go into lockout mode. Lockout time for Honeywell S8600H is 75 to 90 seconds.

**NOTE:** Honeywell electronic ignition lockout module will stop sparking when module locks out.

8. Turn off electricity at electrical disconnect switch located next to furnace. Turn brown gas control knob counterclockwise  to on position. Wait 60 seconds for electronic ignition lockout module to reset.
9. Turn on electricity at electrical disconnect switch located next to furnace. Pilot should light from spark and ignite burners. Wait for blower motor to start.
10. Cycle electrical disconnect switch next to furnace on and off. Watch at least five ignition cycles. Pilot should light from spark and light main burners without delay.
11. Burner flames should look the same height with circulating blower on and off. If not or if they are floating around at top of burner ports, remove rear burner cover, replace screws.
12. Turn off gas by turning brown gas control knob clockwise  to off. Turn on blower. Check burner box openings on furnace front and rear. Check for air leaks between heat exchanger sealing flanges and casing front and rear panels. Detect air leaks by passing a match flame along burner box sealing flanges. Tighten screws until air leaks stops. Install burner covers.

13. With main burners and blower operating, block off all return air grilles to restrict return air. Wait for fan/limit control to cycle burners off.
14. Remove all restrictions from return air grilles. In a few minutes, main burners should automatically reignite. This test shows how fan/limit control protects furnace against overheating.
15. Set room thermostat to desired setting.

**SECTION 30—MAINTAINING FURNACE IN GOOD WORKING ORDER**

**WARNING:** FOLLOW THESE PROCEDURES BEFORE INSPECTING FURNACE.

- TURN ROOM THERMOSTAT TO ITS LOWEST OR OFF SETTING.
- TURN OFF MANUAL GAS SHUT-OFF VALVE.
- WAIT AT LEAST FIVE MINUTES FOR FURNACE TO COOL IF IT WAS RECENTLY OPERATING.
- TURN OFF FURNACE ELECTRICAL POWER; FAILURE TO DO SO COULD RESULT IN INJURY OR DEATH.

**WARNING:** USE REPLACEMENT PARTS LISTED IN PARTS LIST. FAILURE TO DO SO COULD CAUSE IMPROPER FURNACE OPERATION, RESULTING IN DAMAGE, INJURY OR DEATH.

- A. Perform periodic preventive maintenance once before heating season begins and once during heating season. Inspect, clean, oil and repair as needed following items:

1. All combustion and ventilation air openings into furnace space.
2. All burner combustion air openings.
3. All flue product passages, as well as burners, pilot, heat exchanger, collector box, draft diverter or draft inducer assembly and complete vent system.
4. All gas pipes leading to furnace.
5. All electrical wiring and connections, including electrical ground.
6. All supply air and return air ducts for obstructions, air leaks and loose insulation.
7. Blower housing, motor and wheel, air filters, air conditioning and draft inducer motor (when so equipped). **Blower motor does not require oiling.** A local qualified service technician or gas supplier must oil draft inducer motor on Induced Draft models only. Use 4 drops of special high temperature oil, Anderol L465 or Chemlube 645 in each oiler hole every six months. Only a qualified service technician or gas supplier should oil this motor.
8. Assure the furnace is operating properly and safely.

- B. During cooling season, conditions may occur which cause heat exchanger to rust. Reduce potential for heat exchanger failure due to rust by cleaning it and burners at the beginning of heating season.

**WARNING:** HEAT EXCHANGER FAILURE COULD CAUSE FIRE OR COMBUSTION PRODUCTS TO COLLECT IN STRUCTURE. THIS COULD RESULT IN DAMAGE, INJURY OR LOSS OF LIFE.

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

2. Turn off gas supply at manual shut-off valve near furnace. Disconnect gas supply line at ground joint union.
3. Remove low-voltage wires from gas control. On electronic ignition models, remove orange high-voltage ignition wire from electronic ignition lockout module.
4. Remove front burner cover and burner side shield. Save screws for reinstallation.
5. Lift burner rack up and pull out of furnace. Inspect and remove any foreign materials. Clean as needed. Do not disturb position of pilot components next to burner.
6. Use stiff brush with a handle to remove loose scale from heat exchanger. Insert brush through burner box opening of heat exchanger and up into heat exchanger tubes. On larger furnaces, it can be difficult to reach all of heat exchanger tubes. You may need to remove the burner cover and side shield from the other side of furnace. Use vacuum to remove loosened debris.
7. Inspect inside of each heat exchanger tube with mirror and light. Remove all foreign material. Inspect collector box area for any foreign material by removing section of vent pipe. Once inspection and cleaning are complete, reinstall vent pipe.
8. If foreign material is soot, determine its cause. Soot does not form during normal furnace operation. Resolve problem or consult qualified heating engineer. Solve soot problems before operating furnace again.
9. If you removed rust, scale or soot from furnace, also inspect draft diverter or draft inducer and vent system. Clean as needed.
10. If you removed collector box heat shield and collector box sealing plate for cleaning, replace collector box sealing gasket. Obtain and use 1/4" thick, 3-pound density fiberglass. This provides a positive seal after replacing collector box and all screws. Be sure to install collector box heat shield.
11. Reassemble furnace by following Steps 1) through 5) in reverse order. Be sure of correct orifice size, correct burner spoiler screws, correct gas input and temperature rise. Cycle furnace to assure safe and proper operation.

**WARNING: AVOID OFF-CENTER BURNERS. PROPERLY INSTALL BURNER SIDE SHIELDS, BURNER COVERS AND SCREWS AROUND BURNER OPENINGS. FAILURE TO DO SO COULD CAUSE HEAT EXCHANGER FAILURE, RESULTING IN DAMAGE, INJURY OR DEATH.**

## SECTION 31—GETTING OTHER INFORMATION AND PUBLICATIONS

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

National Fuel Gas Code —ANSI Z223.1/NFPA 54

National Electrical Code —ANSI/NFPA 70

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  
1430 Broadway  
New York, NY 10018  
(212) 354-3300

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

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

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