



installation, start-up, and operation instructions

DOWNFLOW/HORIZONTAL 2-SPEED, 2-STAGE INDUCED COMBUSTION GAS FURNACES

331AAV Series A

Cancels: New

II 331A-63-1

7-1-93

NOTE: Read the entire instruction manual before starting the installation.

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SAFETY CONSIDERATIONS

Installing and servicing heating equipment can be hazardous due to gas and electrical components. Only trained and qualified personnel should install, repair, or service heating equipment.

Untrained personnel can perform basic maintenance functions such as cleaning and replacing air filters. All other operations must be performed by trained service personnel. When working on heating equipment, observe precautions in the literature, tags, and labels attached to or shipped with the unit and other safety precautions that may apply.

Follow all safety codes. In the United States, follow all safety codes including the National Fuel Gas Code NFPA No. 54-1992/ANSI Z223.1-1992. In Canada, refer to the current edition of



the National Standard of Canada CAN/CGA-B149.1- and 2-M91 Natural Gas and Propane Gas Installation Codes. Wear safety glasses and work gloves. Have fire extinguisher available during start-up and adjustment procedures and service calls.

Recognize safety information. This is the safety-alert symbol . When you see this symbol on the unit and in instructions or manuals, be alert to the potential for personal injury.

Understand the signal word DANGER, WARNING, or CAUTION. These words are used with the safety-alert symbol. DANGER identifies the most serious hazards which will result in severe personal injury or death. WARNING signifies hazards that could result in personal injury or death. CAUTION is used to identify unsafe practices which would result in minor personal injury or product and property damage.

These instructions cover minimum requirements and conform to existing national standards and safety codes. In some instances, these instructions exceed certain local codes and ordinances, especially those that may not have kept up with changing residential construction practices. We require these instructions as a minimum for a safe installation.

INTRODUCTION

The model 331AAV Series A Furnaces are available in sizes 65,000- through 130,000-Btu/h input capacities.

The design of the downflow/horizontal gas-fired furnace is A.G.A./C.G.A. certified for natural and propane gases and for installation on noncombustible flooring. The furnace may be installed on combustible flooring when installed with the accessory downflow subbase. This furnace is for installation in alcoves, attics, crawl spaces, basements, closets, or utility rooms. The design of this furnace line is NOT A.G.A./C.G.A. certified for installation in mobile homes, recreation vehicles, or outdoors.

Before installing the furnace, refer to the current edition of the National Fuel Gas Code NFPA No. 54-1988/ANSI Z223.1-1992. Canadian installations must be installed in accordance with CAN/CGA-B149 Installation Code and all authorities having jurisdiction. For further information, the National Fuel Gas Codes is available from National Fire Protection Association Inc., Batterymarch Park, Quincy, MA 02269, American Gas Association, 1515 Wilson Boulevard, Arlington, VA 22209, or from Literature Distribution.

TABLE 1— CLEARANCES FROM COMBUSTIBLE MATERIALS (IN.)

UNIT SIZES		065 AND 085	105 AND 130
DOWNFLOW (IN ALCOVE OR CLOSET)			
Sides	Single-wall Vent	1*	0
	Type B-1 Double-Wall Vent	0	0
	Special Gas Vent**	3	4
	Diameter		
Back	Clearance	0	3
		0	0
		1	1
Front†	Single-Wall Vent	6	6
	Type B-1 Double-Wall Vent	3	3
	Special Gas Vent**	3	4
	Diameter		
Vent	Clearance	5	9
		6	6
		1	1
		3	4
	Diameter		
	Clearance	5	9
HORIZONTAL POSITION (IN ALCOVE, ATTIC, AND CRAWLSPACE)			
Sides††	Single-Wall Vent	1	1
	Type B-2 Double-Wall Vent	1	1
	Special Gas Vent**	3	4
	Diameter		
Top	Clearance	1	3
		6	6
		3	3
		3	4
Front†	Diameter		
	Clearance	5	9
		6	6
		1	1
Vent	Single-Wall Vent		
	Type B-2 Double-Wall Vent		
	Special Gas Vent**		
	Diameter		
	Clearance	5	9
HORIZONTAL POSITION (IN CLOSET)			
Sides†††	Single-Wall Vent	1	1
	Type B-2 Double-Wall Vent	1	1
	Special Gas Vent**	3	4
	Diameter		
Top	Clearance	2	2
		2	2
		3	4
Front	Single-Wall Vent	6	6
	Type B-1 Double-Wall Vent	3	3
	Special Gas Vent**	3	4
	Diameter		
Vent	Clearance	5	9
		6	6
		1	1
		3	4
	Diameter		
	Clearance	5	9

such as when used with a night setback thermostat. Return-air temperature must not exceed 85°F db.

To aid in installation, troubleshooting, and service, a status code label is located on the blower component door. This label explains how to use the LED status indicated on the furnace control which is viewed through the sight glass on the door.

WARNING: Improper installation, adjustment, alteration, service, maintenance, or use can cause carbon monoxide poisoning, explosion, fire, electrical shock, or other conditions which may cause personal injury, loss of life, or property damage. Consult a qualified installer, service agency, local gas supplier, or your distributor or branch for information or assistance. The qualified installer or agency must use only factory-authorized and listed kits or accessories when modifying this product. A failure to follow this warning could result in electrical shock, fire, personal injury, or death.

For high altitude installation, the high altitude conversion kit must be installed for conventional Category I (negative pressure) vertical vents at or above 5500 ft above sea level. For Category III vertical or horizontal high temperature plastic Special Gas Vents, the kit must be installed at or above altitudes of 4000 ft above sea level.

For accessory installation details, refer to the applicable installation literature.

NOTE: Remove all shipping brackets and materials before operating the furnace.

I. LOCATION

A. General

CAUTION: DO NOT install furnace in a corrosive or contaminated atmosphere. Make sure all combustion and circulating air requirements are followed, in addition to all local codes and ordinances.

DO NOT use this furnace during construction when adhesives, sealers, and/or new carpets are being installed.

If the furnace is required during construction, use clean outside air for combustion and ventilation. Compounds of chlorine and fluorine when burned in combustion air form acids which will cause corrosion of the heat exchangers and metal vent systems. Some of these compounds are released from paneling and dry wall adhesives, paints, thinners, masonry cleaning materials, and many other solvents commonly used in the construction process.

This furnace must be installed so the electrical components are protected from water.

Locate the furnace as near to the center of the air distribution system as possible. The furnace should be installed as level as possible.

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

When venting vertically with Category I vent materials, locate furnace close to the chimney or vent.

Provide ample space for servicing and cleaning. Always comply with the minimum fire protection clearances shown on the unit clearance label. This furnace shall not be installed directly on carpeting, tile, or any combustible material other than wood flooring. The furnace may be installed on combustible flooring when installed with the accessory downflow subbase, which is available from your distributor or branch when required.

*For casing widths larger than 14-1/4 in., 0 clearance may be used.

†18 in. front clearance required for alcove.

‡Clearance shown is for the outlet end. The inlet end must maintain 6 in. clearance from flue to combustible materials when using single-wall vent.

**Listed for Category III appliances per UL1738 (high temperature plastic pipe).

††Indicates supply or return sides when furnace is in the horizontal position.

NOTES:

1. Provide 30-in. front clearance for servicing. An open door in front of the furnace can meet this requirement.

2. A minimum clearance of 3 in. must be provided in front of the furnace for combustion air and proper operation.

CAUTION: Application of this furnace should be indoors with special attention given to vent sizing and material, gas input rate, air temperature rise, and unit sizing. Improper installation or misapplication of the furnace can require excessive servicing or cause premature component failure.

Installation must conform to the regulations of the serving gas supplier and the local building, heating, and plumbing codes in effect in the area in which the installation is made, or in the absence of local codes, with the requirements of the National Fuel Gas Code.

This furnace is designed for a minimum continuous return-air temperature of 60°F db or intermittent operation down to 55°F

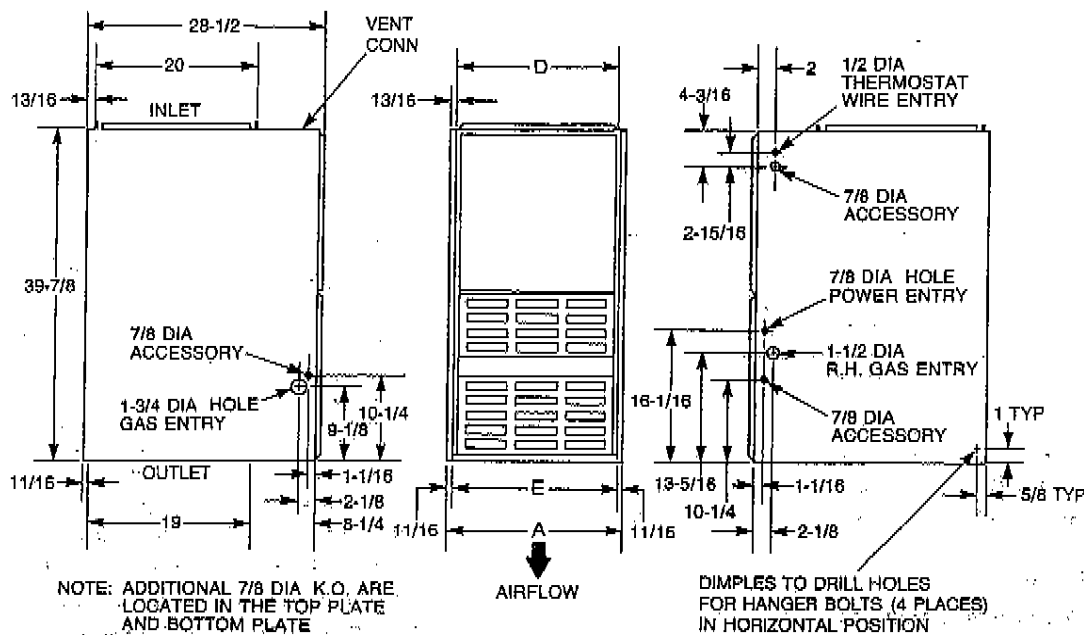


Fig. 1—Dimensional Drawing

TABLE 2—DIMENSIONS (IN.)

UNIT SIZE	A	D	E	VENT CONN	SHIP. WT
024065	14-3/16	12-9/16	12-11/16	4	141
036065	14-3/16	12-9/16	12-11/16	4	145
036085	17-1/2	15-7/8	16	4	154
048085	17-1/2	15-7/8	16	4	154
048105	17-1/2	15-7/8	16	4	171
060105	21	19-3/8	19-1/2	4	181
060130	24-1/2	22-7/8	23	5	192

B. Location With Respect to Cooling Equipment

The cooling coil must be installed parallel with or on the downstream side of the furnace to avoid condensation in the heat exchangers. When installed parallel with a furnace, dampers or other means used to control the flow of air must prevent chilled air from entering the furnace. If the dampers are manually operated, they must be equipped with means to prevent operation of either unit unless the damper is in the full-heat or full-cooling position.

C. Hazardous Locations

When the furnace is installed in a residential garage, it must be installed so that the burners and ignition source are at least 18 in. above the floor. Also, the furnace should be protected from physical damage by vehicles.

When a furnace is installed in public garages, airplane hangars, or other buildings having hazardous atmospheres, the unit must be installed in accordance with the recommended good practice requirements of the National Fire Protection Association, Inc.

II. AIR FOR COMBUSTION AND VENTILATION

Provisions for adequate combustion and-ventilation air must be provided in accordance with Section 5.3, Air for Combustion and Ventilation, of the National Fuel Gas Code, ANSI Z223.1-1992, or applicable provisions of the local building codes.

Canadian installations must be installed in accordance with CAN/CGA-B149 Installation Codes, and all authorities having jurisdiction.

CAUTION: Air for combustion must not be contaminated by halogen compounds, which include fluoride, chloride, bromide, and iodide. These elements are found in aerosol sprays, detergents, bleaches, cleaning solvents, salts, air fresheners, and other household products.

CAUTION: The operation of exhaust fans, kitchen ventilation fans, clothes dryers, or fireplaces could create a negative air pressure condition at the furnace. Make-up air must be provided for the ventilation devices, in addition to that required by the furnace.

All fuel-burning equipment must be supplied with air for combustion of the fuel. Sufficient air **MUST** be provided to ensure there will not be a negative pressure in the equipment room or space. In addition, a positive seal **MUST** be made between the furnace cabinet and the return-air duct to avoid pulling air from the burner area and draft safeguard opening.

The requirements for combustion and ventilation air depend upon whether the furnace is located in a **CONFINED** or **UNCONFINED** space. A confined space is defined as a space whose volume is less than 50 cubic ft per 1000 Btuh of the total input ratings of all appliances installed in that space.

A. Unconfined Space

An unconfined space must have at least 50 cubic ft for each 1000 Btuh of input for all the appliances (i.e. furnaces, clothes dryer, water heaters, etc.) in the space.

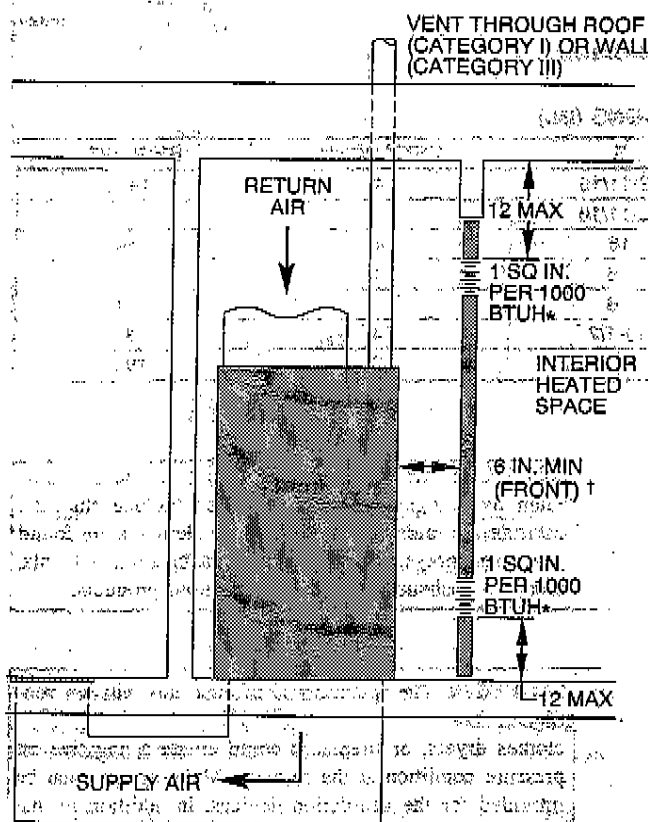
For Example:

331AAV FURNACE INPUT BTUH HIGH FIRE	MINIMUM SQ FT WITH 7-1/2 FT CEILING
63,000	420
84,000	560
105,000	700
126,000	840

If the unconfined space is constructed unusually tight, air for combustion and ventilation MUST come from either the outdoors or spaces freely communicating with the outdoors. Combustion and ventilation openings must be sized the same as for a confined space as defined below. Return air must not be taken from the room, unless an equal or greater amount of air is supplied to the room.

B. Confined Space

A confined space MUST have 2 permanent openings, 1 within 12 in. of the ceiling, and the other within 12 in. of the floor. (See Fig. 2.)



* Minimum opening size is 100 square in. with minimum dimensions of 3 in.

† Minimum of 3 in. when type-B vent is used.

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Fig. 2—Air for Combustion and Ventilation. (Inside Air)

NOTE: In determining the free area of an opening, the blocking effect of the louvers, grilles, and screens must be considered. If the free area of a louver or grille design is unknown, assume that wood louvers have a 20 percent free area and metal louvers or grilles have a 60 percent free area. Screens, when used, must not be smaller than 1/4-in. mesh. Louvers and grilles must be constructed so they cannot be closed.

The size of the openings depends upon whether the air comes from inside or outside of the structure.

1. All air from inside the structure:

- Each opening MUST have at least 1 square in. of free area per 1000 Btuh of the total input for all equipment within the confined space, but not less than 100 square in. per opening. (See Fig. 2.) The minimum dimension of air openings shall not be less than 3 in.

For Example:

331AAV FURNACE INPUT BTUH HIGH FIRE	FREE AREA PER OPENING (SQUARE IN.)
63,000	100
84,000	100
105,000	105
126,000	126

- If the building is constructed unusually tight, a permanent opening directly communicating with the outdoors should be provided. This opening should have a minimum free area of 1 square in. per 5000 Btuh of total input rating for all equipment in the enclosure.
- If the furnace is installed on a raised platform to provide a return-air plenum, and return air is taken directly from the hallway or space adjacent to the furnace, all air for combustion must come from outdoors. (See Fig. 3.)

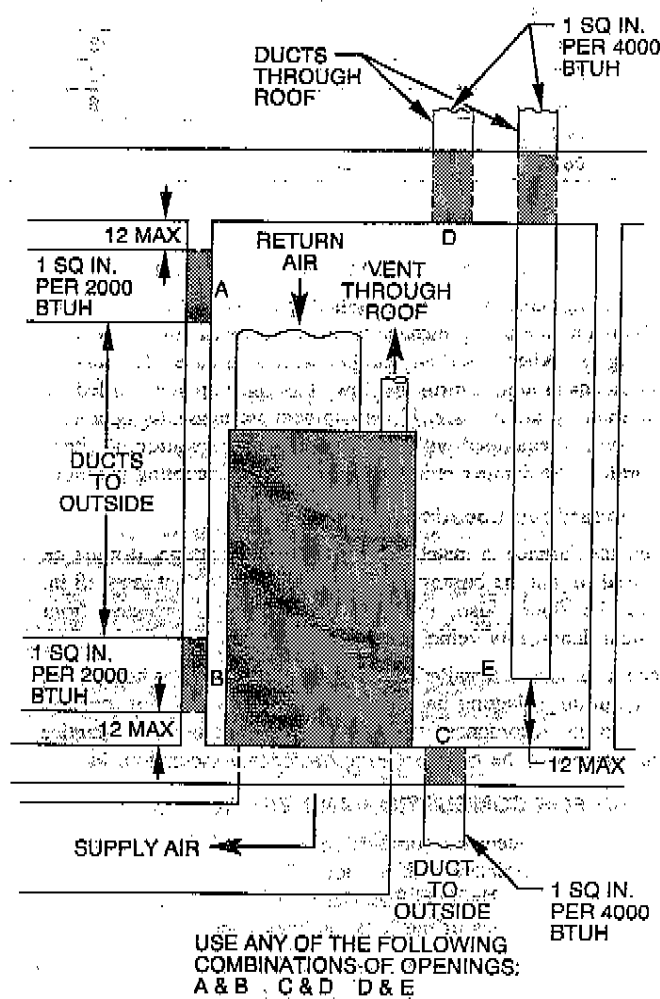


Fig. 3—Air for Combustion and Ventilation (Outside Air)

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2. All air from outdoors:

- If combustion air is taken from outdoors through vertical ducts, the openings and ducts **MUST** have at least 1 square inch of free area per 4000 Btuh of the total input for all equipment within the confined space.

For Example:

331AAV FURNACE INPUT BTUH HIGH FIRE	FREE AREA PER OPENING (SQUARE IN.)	ROUND PIPE (IN. DIA)
63,000	15.8	5
84,000	21.0	6
105,000	26.3	6
126,000	31.5	7

- If combustion air is taken from the outdoors through horizontal ducts, the openings and ducts **MUST** have at least 1 square in. of free area per 2000 Btuh of the total input for all equipment within the confined space. (See Fig. 3.)

For Example:

331AAV FURNACE INPUT BTUH HIGH FIRE	FREE AREA PER OPENING (SQUARE IN.)	ROUND PIPE (IN. DIA)
63,000	31.5	7
84,000	42.0	8
105,000	52.5	9
126,000	63.0	9

When ducts are used, they must be of the same cross-sectional area as the free area of the openings to which they connect. The minimum dimension of rectangular ducts must not be less than 3 in. (See Fig. 3.)

III. SUPPLY-AIR PLENUM INSTALLATION (DOWN-FLOW)

A. Installation On a Concrete Slab

- Construct hole in floor per dimensions in Fig. 4 and Table 3.
- Place plenum and furnace as shown in Fig. 5.

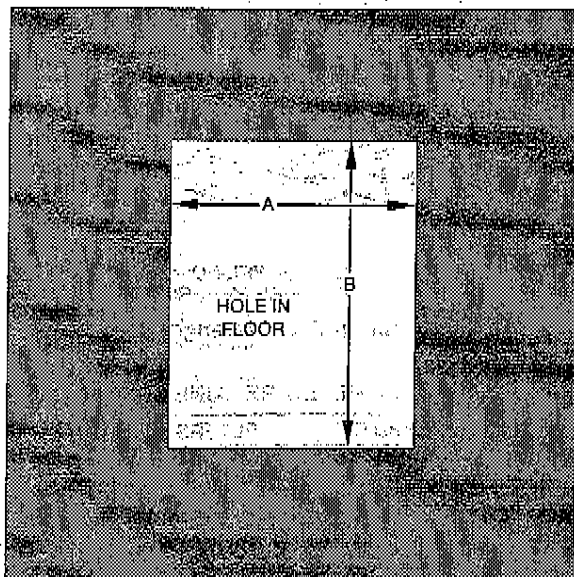


Fig. 4—Floor Opening for Concrete Slab

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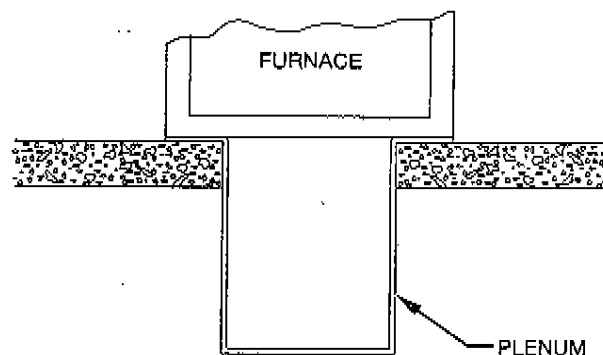


Fig. 5—Furnace on a Concrete Slab (Non-Garage Installation)

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TABLE 3—OPENING DIMENSIONS (IN.)

FURNACE CASING WIDTH	A	B	
		Heat-Only	Heat/Cool*
14-3/16	13-1/8	19-5/8	19-7/16
17-1/2	16-7/16	19-5/8	19-7/16
21	19-7/8	19-5/8	19-7/16
24-1/2	23-7/16	19-5/8	19-7/16

* These dimensions apply when a model GB or CD Evaporator Coil casing is to be installed.

B. Installation On a Combustible Floor

- Cut and frame hole in floor per dimensions in Installation Instructions packaged with downflow subbase.
- When completed, downflow subbase, plenum, and furnace (or coil casing when used) should be installed as shown in Fig. 6.

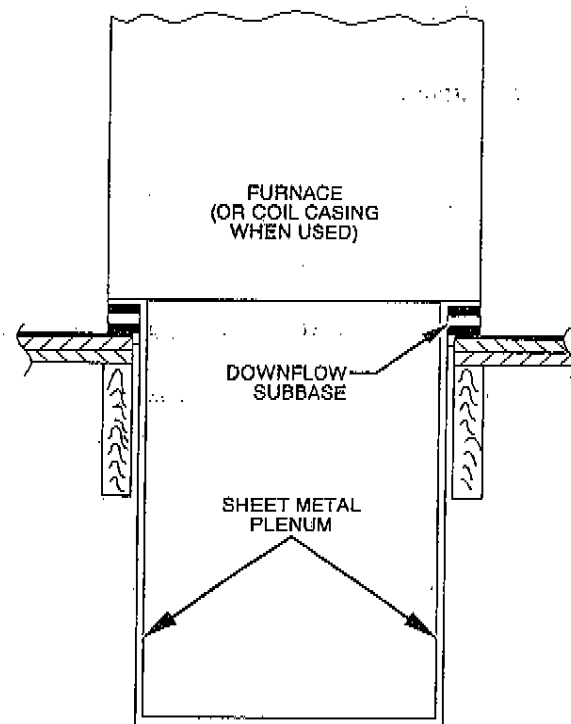


Fig. 6—Furnace, Plenum, and Subbase Installed on a Combustible Floor

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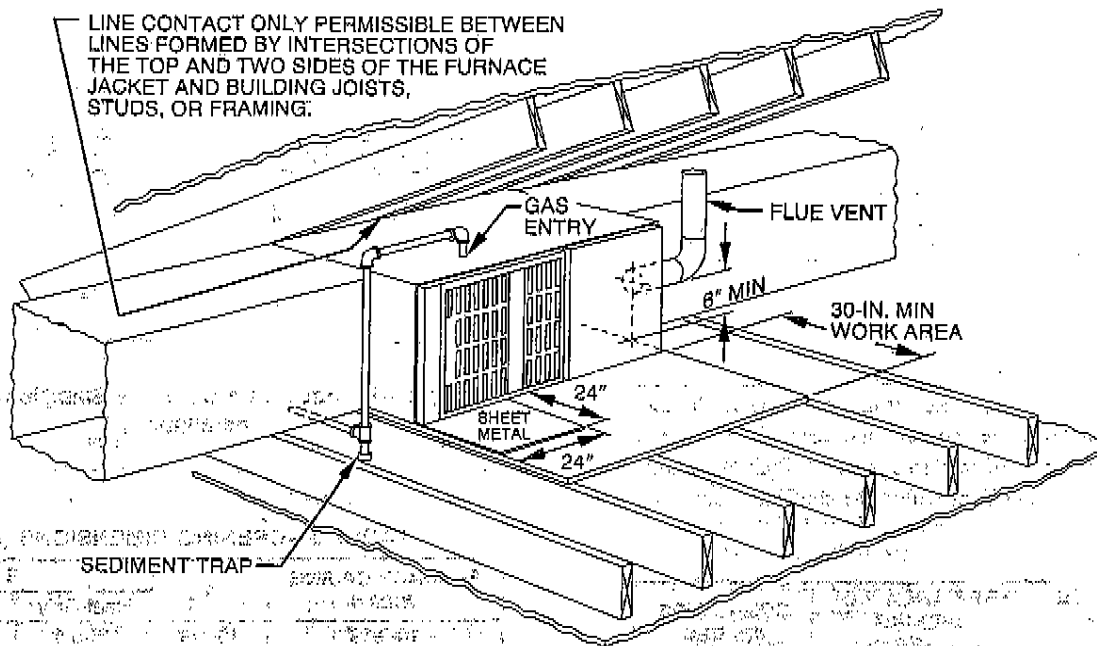


Fig. 7—Typical Attic Installation

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IV. HORIZONTAL ATTIC INSTALLATION

WARNING: Do not install the furnace on its back; safety control operation will be adversely affected. Never connect return-air ducts to the sides or back of the furnace. A failure to follow this warning could result in fire, personal injury, or death.

The furnace can be installed horizontally on either the left-hand (LH) or right-hand (RH) side. A typical attic installation is shown in Fig. 7.

A. Construct a Working Platform

Construct working platform on location where all required furnace clearances are obtainable. (See Table 1 and Fig. 7.)

B. Install Furnace

1. Position furnace in desired location.
2. Connect gas supply pipe. See Fig. 7 for typical piping entry.
3. Connect supply- and return-air ducts.
4. Install field-supplied filter retainers as indicated in Fig. 8 and Table 4 before connecting return-air duct to furnace.
5. Install 24" X 24-in. sheet metal shield on platform in front of louvered control panel as shown in Fig. 7.

V. HORIZONTAL CRAWL SPACE INSTALLATION

The furnace can be installed horizontally with either the LH or RH side up. In a crawl space, the furnace can either be hung from the floor joist or installed on suitable blocks or pad. The furnace can be suspended from each corner by hanger bolts (4 each 3/8-in. all-thread rod) cut to desired length, 1" X 3/8-in. flat washer, 3/8-in. lockwasher, and 3/8-in. nut. Dimples are provided for hole locations. (See Fig. 1.)

The horizontal crawl space installation is very similar to the attic; therefore, refer to Section IV. The installation of a sheet metal shield in front of the louvered control panel is covered in Section IV. For a crawl space installation, this same sheet metal shield must be installed above the louvered control panel. Extend the sheet metal shield over the furnace top far enough to cover the gas pipe entry hole.

VI. FILTER ARRANGEMENT

WARNING: Never operate unit without a filter or with filter access door removed. A failure to follow this warning could result in fire, personal injury, or death.

The 2 factory-supplied filters are shipped in the blower compartment. After the return-air duct has been connected to the furnace, install the filters in a V-formation inside the return-air plenum. See Fig. 8 and Table 4 for horizontal applications. Horizontal filter retainers must be field-supplied. See Fig. 9 for downflow applications.

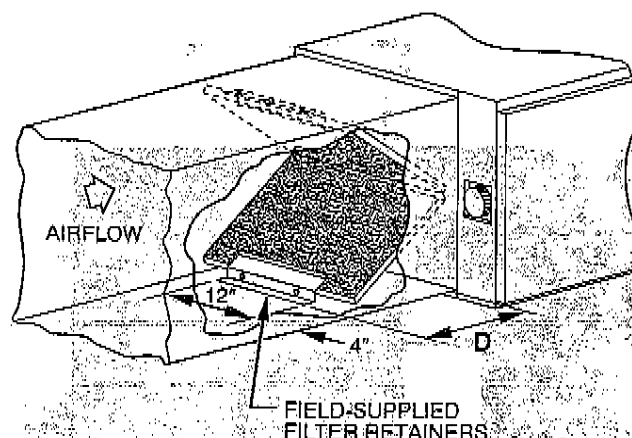


Fig. 8—Horizontal Filter Arrangement

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TABLE 4—FILTER RETAINER

FURNACE CASING WIDTH	FILTERS	D
14-3/16	(2) 14 X 20 X 1	14-3/8
17-1/2	(2) 14 X 20 X 1	13-3/8
21	(2) 16 X 20 X 1	11-5/8
24-1/2	(2) 16 X 20 X 1	10-1/4

VII. GAS PIPING

Gas piping must be installed in accordance with national and local codes. Refer to the current edition of the National Fuel Gas Code.

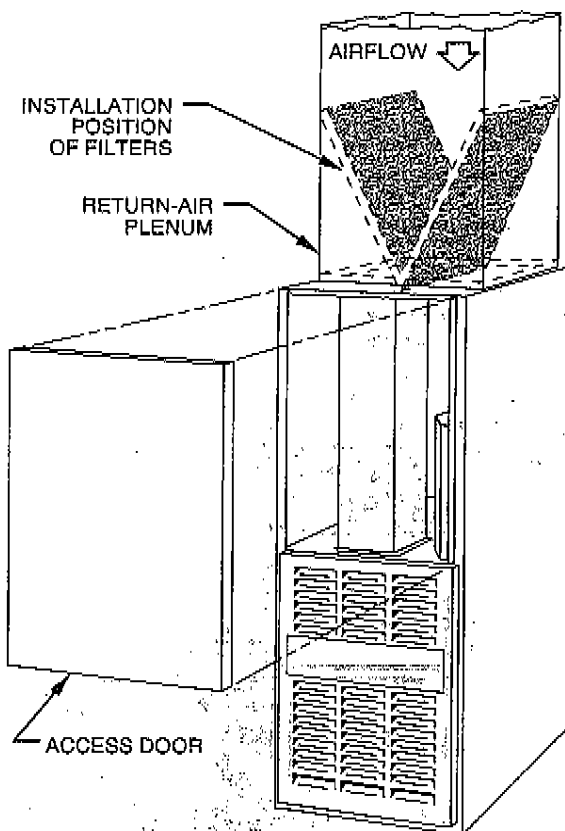


Fig. 9—Downflow Filter Arrangement

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Canadian installations must be installed in accordance with CAN/CGA.B149 Installation Code, and all authorities having jurisdiction.

The gas supply line should be a separate line directly from the meter to the furnace, if possible. Refer to Table 5 for recommended gas pipe sizing. Risers should be used to connect to the furnace and to the meter.

TABLE 5—MAXIMUM CAPACITY OF PIPE*

NOMINAL IRON PIPE SIZE (IN.)	INTERNAL DIAMETER (IN.)	LENGTH OF PIPE (FT)				
		10	20	30	40	50
1/2	0.622	175	120	97	82	73
3/4	0.824	360	250	200	170	151
1	1.049	680	465	375	320	285
1-1/4	1.380	1400	950	770	660	580
1-1/2	1.610	2100	1460	1180	990	900

Ref: Table 10-2, NFPA 54-1992.

*Cubic feet of gas per hr. for gas pressures of 0.5 psig (14-in. wc) or less, and a pressure drop of 0.5-in. wc (based on a 0.60 specific gravity gas)

CAUTION: If a flexible connector is required or allowed by the authority having jurisdiction, black iron pipe shall be installed at the gas valve and extend a minimum of 2 in. outside the furnace casing.

WARNING: Use the proper length of pipes to avoid stress on the gas control manifold. A failure to follow this warning could result in a gas leak causing fire, explosion, personal injury, or death.

CAUTION: Use a backup wrench at the furnace gas control when connecting the gas pipe to the furnace to avoid damaging gas controls or manifold.

WARNING: Never purge a line into a combustion chamber. Never use matches, candles, flame, or other sources of ignition to check for gas leakage. Use a soap-and-water solution to check for gas leaks. A failure to follow this warning could result in fire, explosion, personal injury, or death.

Joint compounds (pipe dope) should be applied sparingly and only to the male threads of the joints. This pipe dope must be resistant to the action of propane gas.

Install an accessible manual shutoff valve upstream of the furnace gas controls and within 72 in. of the furnace. A 1/8-in. NPT plugged tapping, accessible for test gage connection, must be installed immediately upstream of the gas supply connection to the furnace and downstream of the manual shutoff valve. Place a ground joint union between the gas control manifold and the manual shutoff.

Install a sediment trap in the riser leading to the furnace. The trap can be installed by connecting a tee to the riser leading from the furnace. Connect a capped nipple into the lower end of the tee. The capped nipple should extend below the level of the gas controls. (See Fig. 10.)

Piping should be pressure-tested in accordance with local and national plumbing and gas codes before the furnace has been attached. If the test pressure exceeds 0.5 psig (14-in. wc), the gas supply pipe must be disconnected from the furnace and capped before the pressure test. If the test pressure is equal to or less than 0.5 psig (14-in. wc), close the manual shutoff valve located on the gas valve before the test. It is recommended that the ground joint union be loosened before pressure testing.

After all connections have been made, purge the lines and check for gas leakage with regulated gas supply pressure.

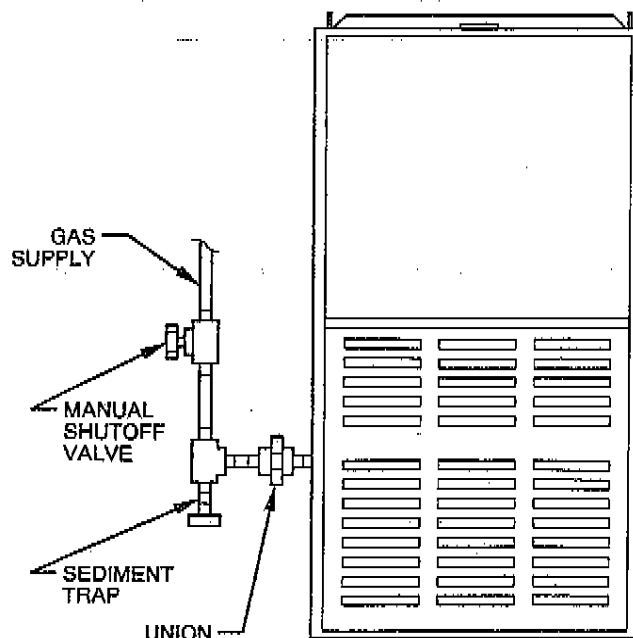


Fig. 10—Typical Gas Pipe Arrangement

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VIII. ELECTRICAL CONNECTIONS

A. 115-V Wiring

Refer to the unit rating plate or Table 6 for equipment electrical requirements. The control system requires an earth ground for proper operation.

CAUTION: Do not connect aluminum wire between disconnect switch and furnace. Use only copper wire.

Make all electrical connections in accordance with the current edition of the National Electrical Code ANSI/NFPA 70-1993, and any local codes or ordinances that might apply. For Canadian installations, all electrical connections must be made in accordance with CSA C22.1 Canadian Electrical Code, or authorities having jurisdiction.

NOTE: Proper polarity must be maintained for 115-v wiring. If polarity is incorrect, the furnace control will flash code 02 on the status LED and prevent heating operation.

WARNING: The cabinet must have an uninterrupted or unbroken ground according to National Electrical Code, ANSI/NFPA 70-1993 and Canadian Electrical Code, CSA C22.1 or local codes to minimize personal injury if an electrical fault should occur. This may consist of electrical wire or conduit approved for electrical ground when installed in accordance with existing electrical codes. Do not use gas piping as an electrical ground.

B. 24-V Wiring

Make field 24-v connections at the 24-v terminal strip. (See Fig. 11.) Connect terminal Y as shown in Fig. 12 or 13 for proper operation in cooling mode. Use AWG No. 18 color-coded, COPPER, thermostat wire only.

When the furnace is installed in the horizontal position with RH discharge air, 24-v wire connections can be made easier by removing the 2" control box mounting screws and letting the control box turn so that the 24-v screw terminals are visible. Be sure to reinstall the control box after the connections are made.

The 24-v circuit contains an automotive-type, 3-amp fuse located on the main control. Any 24v electrical shorts during installation, service, or maintenance could cause this fuse to blow. If fuse replacement is required, use **ONLY** a 3-amp fuse. The control will flash code 24 when the fuse needs replacement.

C. Accessories

1. Electronic air cleaner (EAC)

A terminal block (EAC-1 and EAC-2) is provided for electronic air cleaner connection. (See Fig. 11.) The terminals are energized with 115v, 1-amp maximum during blower motor operation.

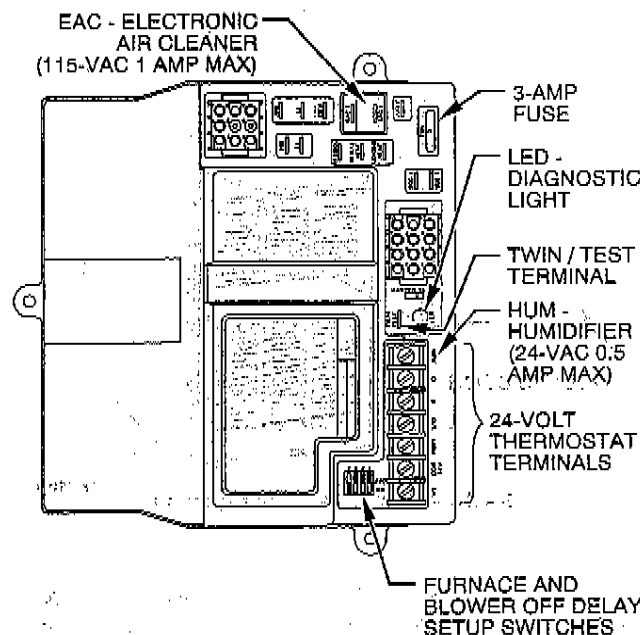


Fig. 11—Control Center

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2. Humidifier (HUM)

Screw terminals (HUM-1 and COM) are provided for 24-v humidifier connection. The terminals are energized with 24v, 0.5-amp maximum when the gas valve is energized.

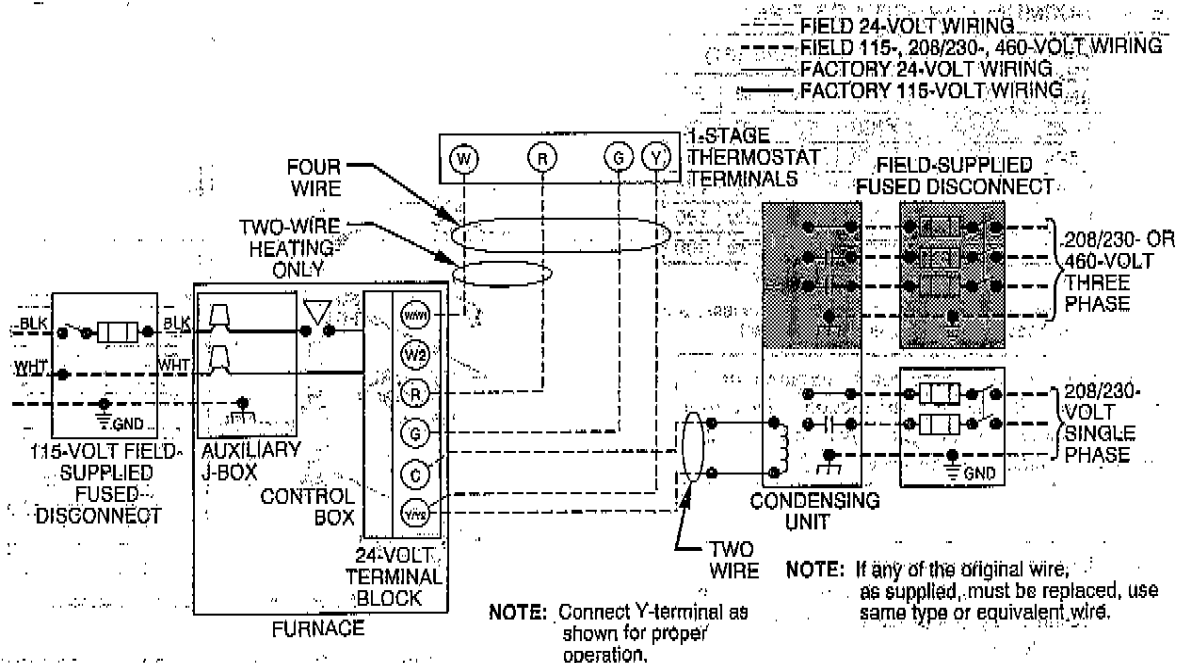
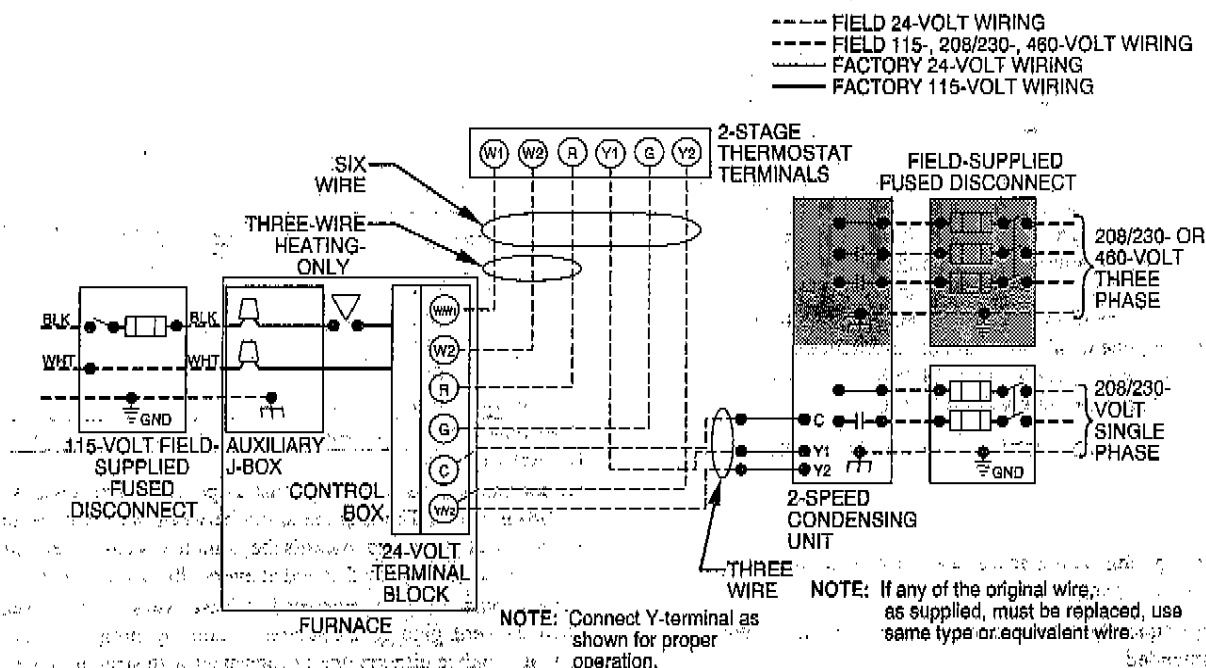


Fig. 12—Heating and Cooling Application Wiring Diagram With 1-Stage Thermostat and Condensing Unit

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Fig. 13—Heating and Cooling Application Diagram With 2-Stage Thermostat and Condensing Unit

TABLE 6—ELECTRICAL DATA

UNIT SIZE	VOLTS-HERTZ PHASE	OPERATING VOLTAGE RANGE		MAX UNIT AMPS	MIN WIRE GAGE	MAX WIRE LENGTH FT†	MAX FUSE† OR HACR-TYPE CKT BKR AMPS
		Max*	Min*				
024065	115-60-1	127	104	6.9	14	41	15
036065	115-60-1	127	104	8.6	14	33	15
036085	115-60-1	127	104	9.4	14	30	15
048085	115-60-1	127	104	10.4	14	27	15
048105	115-60-1	127	104	10.3	14	27	15
060105	115-60-1	127	104	13.5	12	33	20
060130	115-60-1	127	104	14.5	12	31	20

*Permissible limits of the voltage range at which the unit will operate satisfactorily.

†Time-delay fuse is recommended.

‡Length shown is as measured 1 way along wire path between unit and service panel for maximum 2 percent voltage drop.

IX. VENTING

For conventional Category I vertical venting, refer to the enclosed installation instructions, GAMA venting table for category I furnaces, and EZ Vent™ table for category I fan-assisted furnaces. The horizontal portion of the venting system shall maintain a minimum of 1/8-in. upward slope per linear ft and it shall be rigidly supported every 5 ft or less with hangers or straps to ensure that there will be no movement after installation.

This furnace may also be installed with a Category III vertical or horizontal (sidewall) vent system using the accessory kit listed on the vent label on the top plate of the furnace. This kit MUST be used for Category III venting. Refer to the kit instructions for detailed information about Category III venting.



WARNING: DO NOT install a Category III vent system without the accessory conversion kit. Category III vents without the accessory kit will have nuisance shutdowns on draft safeguard switch, and may cause vent and furnace component failure resulting in property damage, personal injury, or death.



WARNING: When this furnace is converted to Category III it must have its own dedicated vent. DO NOT common vent with any other appliance. Common venting with other appliances will result in spillage of flue gas and failure of vent system which may cause property damage, personal injury, or death.

A gastight heat dissipator, condensate drain tube and clamps, condensate trap and mounting bracket, and draft safeguard modification plate are provided in the kit. No substitution for any of the components may be made when installing furnace with a Category III vent system.



WARNING: Table 7 lists the required vent size for furnace sizes based on high fire input. Refer to the furnace rating plate and Table 7 to determine size of Special Gas Vent pipe. An incorrectly sized vent may cause inadequate wind resistance, poor operation, or vent failure. Vent failure may result in property damage, or flue gas spillage, resulting in personal injury or death.

Only Special Gas Vent pipe listed per UL 1738 for Category III appliances may be used. See accessory kit instructions for allowable vent pipe and fittings part numbers.

TABLE 7—VENT PIPE SIZE*

HIGH FIRE INPUT (BTU/HR) NORMAL POSITION	PIPE DIAMETER
40,000—84,000	3-in.
85,000—140,000	4-in.

*Only Category III conversion kit specified on furnace and pipe size listed for furnace input shall be used.

All joints in the vent system, between vent system and heat dissipator, and between heat dissipator and furnace must be sealed airtight with only the high temperature RTV specified by the special gas vent pipe manufacturer. The accessory kit contains provisions for vent condensate drainage. Drain and trap MUST be installed per kit instructions. Incorrect drain installations may cause furnace component failure. Furnace installations in unconditioned spaces where temperature may fall below 32°F REQUIRE freeze protection heat tape on condensate trap.

A. High Temperature Plastic, Special Gas Vent Installation

CUTTING

1. Hand cut piping with a sharp saw. Saw blade must have at least 24 teeth per in.
2. Cut pipe squarely. Use of a miter box when cutting pipe is recommended.

NOTE: DO NOT cut with power saw. Doing this may cause immediate or eventual cracking or shattering of pipe. DO NOT cut or alter fittings.

ADHESIVE JOINING

Pipe and fittings are joined together using high temperature RTV adhesive/sealants. Use ONLY adhesives listed by vent manufacturer. Do not use any other adhesives or sealants. Do not use solvent cements.

Do not drill holes in pipe or fittings. Do not use sheet metal or other types of screws to join plastic piping or fittings. Do not use rivets to join piping or fittings.

Before applying sealant, pipe ends must be smooth and clean.

1. Apply minimum 1/4-in. bead of adhesive/sealant entirely around pipe end no more than 1/8-in. from end.
2. Push pipe and fitting together while twisting pipe into fitting.
3. Inspect joint for complete seal. Full curing of joints takes 24 hr.

WARNING: Failure to ensure complete seal of all joints between furnace, heat dissipator, vent pipes, and fittings will allow spillage of flue gas, which may result in personal injury or death.

Inspect each joint after the adhesive/sealant has cured to ensure that all joints are sealed. Reapply adhesive/sealant to any joints that are suspected of fuel gas leakage.

VENT INSTALLATION

Minimum vent length is 5 ft of straight pipe, one 90° long-radius (sweep) elbow or equivalent, condensate drain assembly, and termination (coupling and bird screen).

Maximum vent length is 40 ft of straight pipe, four 90° long-radius (sweep) elbows, condensate drain assembly, and termination (coupling and bird screen).

Length and number of elbows may be adjusted according to equivalent ft of pipe for fittings shown in Table 8.

Example: In a 3-in. diameter vent system, to add an additional 90° long-radius (sweep) elbow, maximum vent length must be reduced to 35 ft.

A coupling and a bird screen are the recommended vent termination for both horizontal and vertical vents. For vertical vents, if a tee and 2 bird screens are required, the allowable vent length must be adjusted according to Table 8. No elbows shall be used as terminations.

TABLE 8—EQUIVALENT PRESSURE DROP IN LENGTH OF STRAIGHT PIPE FOR FITTINGS

FITTING	EQUIVALENT FT OF PIPE	
	3-in. Diameter	4-in. Diameter
90° Elbow	10	N/A
90° Sweep Elbow (Long-Radius)	5	6
45° Elbow	5	5-1/2
Tee Used as an Elbow	10	10
Tee Used as a Termination	5	5

N/A—Not applicable

All horizontal runs of piping must slope backward towards drain tee 1/4-in. per ft. The horizontal run between the drain tee and the furnace must also slope towards the drain tee. Vent system must be supported at least every 5 ft and at every elbow on horizontal runs. Vertical runs must be supported at least every 10 ft by supports listed by vent pipe manufacturer. Frame opening in floor using lumber which is dimensionally consistent with structural members. Framing must be level and must provide required air space clearance to pipe.

VENT TERMINATION (VERTICAL)

Where vent passes through roof, a listed flashing and storm collar must be used to maintain required clearances and to keep weather out. Framed opening must be large enough to maintain required air clearance taking into account slope of roof. Install flashing and storm collar as directed by vent manufacturer. Vertical termination must be at least 2 ft horizontally from roof surface, at least 8 ft away from any vertical wall, and must extend above roof as required in kit instructions. Vents extending 2-1/2 ft or more above roof must be securely guyed or braced according to vent manufacturer's installation instructions. Terminate with a coupling and a bird screen.

VENT TERMINATION (HORIZONTAL)

TABLE 9—HORIZONTAL VENT TERMINATION CLEARANCES

LOCATION	CLEARANCE (FT)	
	U.S.A.	Canada
Above anticipated snow depth	1	1½
From mechanical Fresh Air Intake	1	6
For furnaces with an input capacity less than 100,000 Btuh from any nonmechanical air supply (such as door or window) or combustion-air opening	4 below 4 horizontally	1
For furnaces with an input capacity greater than 100,000 Btuh from any nonmechanical air supply (such as door or window) or combustion-air opening	1 above	3
From service regulator vent, electric and gas meters and relief equipment	4*	6†
Above grade when adjacent to public walkway	7	7

*Horizontal distance
†36 in. to electric meter
‡18 in. above roof surface in Canada

NOTE: Do not locate the vent termination close to shrubbery. Flue gas may stunt growth or kill shrubs. Combustion products may affect unprotected building material surfaces. Sealing or shielding of exposed surfaces with a corrosion resistant material may be required in these cases.

NOTE: In U.S.A., vent must terminate 3 ft above any mechanical fresh air intake within 10 ft.

After vent system is installed, inspect all joints and supports. If all joints are secure, fully sealed, and well supported by straps, furnace may be started, adjusted per furnace installation instructions, and placed into operation. See vent pipe manufacturer's installation instructions as cure time may be required before operating furnace.

X. START-UP, ADJUSTMENT, AND SAFETY CHECK

A. General

The furnace must have a 115-v power supply properly connected and grounded. Correct polarity must be maintained to enable operation.

The gas service pressure must not exceed 0.5 PSIG (14-in. wc), but be no less than 0.16 PSIG (4.5-in. wc).

Thermostat wire connections at R and W/W1 are the minimum required for gas heating operation. W2 must be connected for 2-stage heating thermostats. COM, Y/Y2, and G are required for cooling, heat pumps, and some clock thermostats. These must be made at the 24-v terminal block on the control. (See Fig. 11.)

This furnace can be installed with either a single-stage heating or a 2-stage heating thermostat. For single-stage thermostats, connect thermostat W to W/W1 at the furnace control terminal block. (See Fig. 12.) For single-stage thermostats the control will determine, based on length of previous heating cycles, when to operate in low and high heat for optimum comfort. Setup Switch-2 (SW-2) must be in the factory-shipped OFF position. See Fig. 14 and Tables 10 and 11 for setup switch information.

If a 2-stage heating thermostat is to be used, move SW2 to the ON position at the end of the furnace installation. This will override the built-in control process for selecting high and low fire and allow the 2-stage thermostat to select heating modes. The W2 from the thermostat must be connected to W2 on the control terminal block. (See Fig. 13.)

Before operating the furnace, check each manual reset switch for continuity. If necessary, press and release the button to reset the switch.

TABLE 10—BLOWER OFF DELAY SETUP SWITCH POSITION

DESIRED HEATING MODE BLOWER OFF DELAY (SEC)	SETUP SWITCH	
	SW-3	SW-4
90	OFF	OFF
135	ON	OFF
180	OFF	ON
225	ON	ON

CAUTION: This furnace is equipped with 2 manual reset limit switches in the gas control area. The switches will open and shut off power to the gas valve if a flame rollout or an overheating condition occurs in the gas control area. DO NOT bypass the switches. Correct inadequate combustion, air supply, component failure, restricted flue gas passageway, and reset the switches.

B. Sequence of Operation

Using the schematic diagram, Fig. 14, follow the sequence of operation through the different modes. Read and follow the wiring diagram very carefully.

NOTE: If a power interruption occurs during a call for heat (W/W1 or W/W1-and-W2), the control will start a 90-sec blower-only ON period 2 sec after power is restored, if the thermostat is still calling for gas heating. The LED red light will flash code 12 during the 90-sec period, after which the LED will be ON continuous, as long as no faults are detected. After the 90-sec period, the furnace will respond to the thermostat normally.

TABLE 11—SETUP SWITCH (SW) DESCRIPTION

SETUP SWITCH NO.	NORMAL POSITION	DESCRIPTION OF USE
SW-1 High Gas Heat	OFF	Turn switch ON to obtain high gas heat operation on any call for heat regardless of whether R-W/W1, or R-W/W1, -W2 is closed. SW-1 overrides SW-2.
SW-2 Low Gas Heat	OFF	Turn switch OFF for installations with single-stage thermostats; control selects low gas heat or high gas heat operation based on previous cycles. Turn switch ON for installations with 2-stage thermostats to permit only low gas heat operation in response to closing R-W/W1. High gas heat is supplied only when R to W/W1 and W2 is closed.
SW-3, and SW4	ON, OFF	Switches control gas heating mode blower off delay. See Table 10.

The blower door must be installed for power to be conducted through the blower door interlock switch ILK to the furnace control CPU, transformer TRAN, inducer motor IDM, blower motor BLWM, hot surface ignitor HSI, and gas valve GV.

1. Single-Stage Thermostat and 2-Stage Heating (Adaptive mode) (See Fig. 12 for thermostat connections).

NOTE: With the high heat only switch SW1 (see Fig. 14) OFF, the low heat only switch SW2 selects either the low heat only operation mode when ON, (see 2. below) or the adaptive heating mode when OFF in response to a "call for heat." When the high heat only switch SW1 is ON, it will always cause high gas heat operation when the R to W circuit is closed, regardless of the setting of the low heat only switch SW2.

This furnace can operate as a 2-stage furnace with a single-stage thermostat because the furnace control CPU includes a programmed adaptive sequence of controlled operation, which selects low gas heat or high gas heat operation. This selection is based upon the stored history of the length of previous gas heating periods of the single-stage thermostat.

The furnace will start up in either low or high gas heat. If the furnace starts up in low gas heat, the control CPU determines the low gas heat on-time (from 0 to 16 minutes) which is permitted before switching to high gas heat.

If the power is interrupted, the stored history is erased and the control CPU will select low gas heat for up to 16 minutes and then switch to high gas heat, as long as the thermostat continues to "call for heat." Subsequent selection is based on stored history of the thermostat cycle times.

The wall thermostat "calls for heat," closing the R to W1 circuit. The furnace control performs a self-check, verifies the low heat and high heat pressure switches contacts LPS and HPS are open, and starts the inducer motor IDM in low speed or high speed as appropriate.

- Inducer prepurge period—As the inducer motor IDM comes up to low speed or high speed, the low heat pressure switch contacts LPS close to begin a 15-sec prepurge period.
- Ignitor warm-up—At the end of the prepurge period, the Hot Surface Ignitor HSI is energized for a 17-sec ignitor warm-up period.
- Trial-For-Ignition sequence—When the ignitor warm-up period is completed the main gas valve relay contacts MGVR-1 and -2 close to energize the low heat gas valve

solenoid GV, the gas valve opens, and 24-v power is supplied for a field-installed humidifier at terminals HUM and COM. The low heat gas valve solenoid GV permits gas flow to the burners where it is ignited. After 5 sec, the ignitor HSI is de-energized and a 2-sec Flame-Proving period begins.

If the furnace control CPU selects high gas heat operation, the high heat gas valve solenoid-GV is also energized after the normally-closed high heat pressure switch relay HPSR closes and after the inducer motor IDM goes to high speed and provides sufficient pressure to close the high heat pressure switch HPS. (HPSR is open while the furnace is powered in standby mode.) If the high heat pressure switch HPS fails to close and the low heat pressure switch LPS closes, the furnace will operate at low heat gas flow rate until the high heat pressure switch closes.

d. Flame-proving—When the burner flame is proved at the flame-proving sensor electrode FSE, the control CPU begins the Blower on delay period and continues to hold the gas valve GV open. If the burner flame is not proved within 2 sec, the control CPU will close the gas valve GV, and the control CPU will repeat the ignition sequence for up to 3 more Trials-For-Ignition before going to Ignition-Lockout. Lockout will be reset automatically after 3 hours, or by momentarily interrupting 115-v power to the furnace, or by interrupting 24-v power at SEC1 or SEC2 to the control CPU (not at W/W1, G, R, etc.). Opening the thermostat R to W circuit will not reset an Ignition-Lockout.

If flame is proved when flame should not be present, the control CPU will lock out of Gas heating mode and operate the inducer motor IDM on high speed until flame is no longer proved.

e. Blower on delay—If the burner flame is proven, 45 sec after the gas valve GV is opened, the blower motor BLWM is energized on the appropriate heating speed, low gas heat or high gas heat speed. Simultaneously, the electronic air cleaner terminals EAC-1 and EAC-2 are energized and remain energized as long as the blower motor BLWM is energized.

f. Switching from low to high gas heat—If the furnace control CPU switches from low gas heat to high gas heat, the control CPU will switch the inducer motor IDM speed from low to high. The high heat pressure switch relay HPSR will close. When the inducer motor IDM provides sufficient pressure to close the high heat pressure switch HPS, the high heat gas valve solenoid GV is energized. The blower motor BLWM will switch speed for high gas heat 5 sec after the control CPU switches from low gas heat to high gas heat.

Switching from high to low gas heat—The control CPU will not switch from high gas heat to low gas heat while the thermostat R to W circuit is closed; when a single-stage thermostat is used.

g. Blower off delay—When the thermostat is satisfied, the R to W circuit is opened, de-energizing the gas valve GV, stopping gas flow to the burners, and de-energizing the humidifier terminals HUM and COM. The inducer motor IDM will remain energized for a 5 sec post-purge period. The blower motor BLWM and air cleaner terminals EAC-1 and EAC-2 will remain energized for 90, 135, 180, or 225 sec (depending on selection at Blower off delay switches SW3 and SW4). The furnace control CPU is factory-set for a 135-sec Blower off delay.

2. Two-Stage Thermostat and 2-Stage Heating mode (See Fig. 13 for thermostat connections).

NOTE: The low heat only switch SW2 ON selects the low heat only operation mode in response to closing the thermostat R to W1 circuit. When the high heat only switch SW1 is OFF, closing the thermostat R to W1-and-W2 circuits is required for high gas heat operation. When the high heat only switch SW1 is ON it will always cause high gas heat operation when the R to W1 circuit is closed, regardless of the setting of the low heat only switch SW2 and regardless of whether the R to W2 circuit is closed or open.

The start up and shut down functions and delays described in 1. above apply to the 2-stage heating mode as well, except for switching from low to high gas heat and vice versa.

a. The wall thermostat "calls for heat," closing the R to W1 circuit for low gas heat or closing the R to W1-and-W2 circuits for high gas heat. The furnace control performs a self-check, verifies the low heat and high heat pressure switches' contacts LPS and HPS are open, and starts the inducer motor IDM in low speed or high speed as appropriate.

b. Switching from low to high gas heat—If the thermostat R to W1 circuit for low gas heat is closed and the R to W2 circuit for high gas heat closes, the control CPU will switch the inducer motor IDM speed from low to high. The high heat pressure switch relay HPSR will close. When the inducer motor IDM provides sufficient pressure to close the high heat pressure switch HPS, the high heat gas valve solenoid GV is energized. The blower motor BLWM will switch speed for high gas heat 5 sec after the R to W2 circuit closes.

c. Switching from high to low gas heat—If the thermostat R to W2 circuit for high gas heat opens, and the R to W1 circuit for low gas heat remains closed, the control CPU will switch the inducer motor IDM speed from high to low. The high heat pressure switch relay HPSR will open to de-energize the high heat gas valve solenoid GV. When the inducer motor IDM reduces pressure sufficiently, the high heat pressure switch HPS will open. The low heat gas valve solenoid GV will remain energized as long as the low heat pressure switch remains closed. The blower motor BLWM will switch speed for low gas heat 5 sec after the R to W2 circuit opens.

3. Cooling mode—The thermostat "calls for cooling."

a. Single-Speed cooling outdoor unit. See Fig. 12 for thermostat connections.

(1.) The thermostat closes the R to G-and-Y circuits. The R to Y circuit starts the outdoor unit, and the R to G-and-Y circuits start the furnace blower motor BLWM on high cooling speed.

(2.) The electronic air cleaner terminals EAC-1 and EAC-2 are energized with 115v when the blower motor BLWM is operating.

(3.) When the thermostat is satisfied, the R to G-and-Y circuits are opened. The outdoor unit will stop, and the furnace blower motor BLWM will continue operating on the high cooling speed for an additional 90 sec.

b. Two-Speed cooling outdoor unit. (See Fig. 13 for thermostat connections.)

- (1.) The thermostat closes the R to G-and-Y1 circuits for low cooling or closes the R to G-and-Y1-and-Y2 circuits for high cooling. The R to Y1 circuit starts the outdoor unit on low cooling speed, and the R to G circuit starts the furnace blower motor BLWM on low cooling speed (same speed as for low gas heat). The R to Y1-and-Y2 circuits start the outdoor unit on high cooling speed, and the R to G-and-Y2 circuits start the furnace blower motor BLWM on high cooling speed.

NOTE: Y1 is not located on the furnace control, but is found in the outdoor unit. The furnace control CPU controls blower motor BLWM speed by sensing only G (for low cooling speed) and Y2 (for high cooling speed).

- (2.) The electronic air cleaner terminals EAC-1 and EAC-2 are energized with 115-v when the blower motor BLWM is operating on either cooling speed.
- (3.) When the thermostat is satisfied, the R to G-and-Y1 or R to G-and-Y1-and-Y2 circuits are opened. The outdoor unit stops, and the furnace blower will continue operating on the cooling speed for an additional 90 sec.

4. Continuous-blower mode

- a. When the R to G circuit is closed by the thermostat, the blower motor BLWM will operate on low gas heat speed (identical to low cooling speed). Terminals EAC-1 and EAC-2 are energized as long as the blower motor BLWM is energized.

- b. During a call for heat, the blower BLWM will stop during ignitor warm-up (17 sec), ignition (7 sec), and blower on delay (45 sec), allowing the furnace heat exchangers to quickly heat up.

- (1.) The blower motor BLWM will revert to continuous-blower speed after the heating cycle is completed. In high gas heat, the furnace control CPU will hold the blower motor BLWM at high gas heat speed during the selected Blower off delay period before reverting to continuous-blower speed.

- (2.) When the thermostat "calls for low cooling," the blower motor BLWM will continue to operate on low gas heat speed. When the thermostat is satisfied, the blower motor BLWM will continue on continuous-blower speed.

- (3.) When the thermostat "calls for high cooling," the blower motor BLWM will operate on high cooling speed. When the thermostat is satisfied, the blower motor BLWM will operate an additional 2 sec on high cooling speed before reverting back to continuous-blower speed.

- (4.) When the R to G circuit is opened, the blower motor BLWM will continue operating for an additional 90 sec; if no other function requires blower motor BLWM operation.

5. Heat pump

NOTE: An accessory interface kit is required with single-speed heat pumps. See interface kit installation instructions for single-speed heat pump thermostat and interface connections. No interface kit is needed for 2-speed heat pumps. See 2-speed heat pump installation instructions for thermostat connections.

a. Cooling mode—Single-Speed Heat Pump Cooling

- (1.) The thermostat and interface kit close the R to G-and-Y circuit to start the furnace blower motor

BLWM on high cooling speed. (NOTE: The Y input to the furnace control is necessary to provide adequate cooling airflow.)

- (2.) The electronic air cleaner terminals EAC-1 and EAC-2 are energized with 115v when the blower motor BLWM is operating.
- (3.) When the thermostat is satisfied, furnace blower motor BLWM will continue operating on the high cooling speed for an additional 90 sec.

b. Two-Speed Heat Pump Cooling

- (1.) The thermostat closes the R to G circuits for low cooling or closes the R to G-and-Y2 circuits for high cooling. The thermostat R to G circuit starts the furnace blower motor BLWM on low cooling speed. The thermostat R to G-and-Y2 circuits start the furnace blower motor BLWM on high cooling speed.

- (2.) The furnace control CPU controls blower motor BLWM speed by sensing only G (for low cooling speed) and Y2 (for high cooling speed).

- (3.) The electronic air cleaner terminals EAC-1 and EAC-2 are energized with 115v when the blower motor BLWM is operating on either cooling speed.

- (4.) When the thermostat is satisfied, the furnace blower motor BLWM will continue operating on the cooling speed for an additional 90 sec.

c. Heating mode—Single-Speed Heat Pump Heating

- (1.) The thermostat and accessory interface kit R to G-and-Y circuits start the furnace blower motor BLWM on Heat Pump high heat speed (identical to high cooling speed).

- (2.) The electronic air cleaner terminals EAC-1 and EAC-2 are energized with 115v when the blower motor BLWM is operating.

- (3.) When the thermostat is satisfied the furnace blower motor BLWM will continue operating on the Heat Pump high heat speed for an additional 90 sec.

d. Two-Speed Heat Pump Heating

- (1.) The thermostat closes the R to G circuit for low heating and starts the furnace blower motor BLWM on Heat Pump low heat speed (identical to low cooling speed). Closing the R-to-Y2 circuit to the furnace will provide blower motor BLWM Heat Pump high heat speed.

- (2.) The furnace control CPU controls blower motor BLWM speed by sensing only G (for Heat Pump low heat speed) and Y2 (for Heat Pump high heat speed).

- (3.) The electronic air cleaner terminals EAC-1 and EAC-2 are energized with 115v when the blower motor BLWM is operating on either heating speed.

- (4.) When the thermostat is satisfied, the R to G or R to G-and-Y2 circuits are opened. After opening the R to G-and-Y2 circuit, the furnace blower motor BLWM will continue operating on the heating speed for an additional 90 sec.

- (5.) Opening the R to Y2 circuit will reduce the blower motor BLWM speed to Heat Pump low heat speed.

6. Defrost

- a. When the furnace control R to W/W1-and-Y/Y2 circuits are closed the furnace control CPU will continue blower motor BLWM operation at the heat pump heating speed until the end of the purge period, then shut off until the end of the HSI Ignitor-On period (22 sec).
- (1.) When installed with a heat pump, the furnace control CPU automatically holds the blower off time to 22 sec during the HSI Ignitor-On period. After 17 sec of the HSI Ignitor on period, a Trial-For-Ignition sequence occurs as described above for gas heating. After flame is proved, and without a Blower on delay, the blower motor BLWM will then operate on high gas heat speed during defrost. For both single-speed and 2-speed heat pumps, defrost mode is in high gas heat only.
- (2.) When furnace control R to W/W1 circuit is opened, the furnace control CPU will begin the normal inducer Post-Purge period and the blower motor BLWM will remain on for the Blower off delay period. If the R to G circuit remains closed, the blower motor BLWM will revert to continuous operation.

C. Start-Up Procedures

1. Component-test—The furnace features a component-test system to help diagnose a system problem in the case of a component failure. To initiate the component-test procedure, ensure that there are no thermostat inputs to the control and that all time delays have expired. Short the Twin/Test terminal to ground or COM for 1 to 4 sec. See Fig. 11 for terminal locations.

NOTE: The component-test feature will not operate if the control is receiving any thermostat signals and until all time delays have expired.

The component-test sequence is as follows:

- a. The furnace control will check itself then operate the inducer motor on low speed for 7 sec, and on high speed for 7 sec, then off.
- b. The hot surface ignitor is then energized for 15 sec, then de-energized.
- c. The blower motor will operate on low gas heat/heat pump low heat/low cool/continuous fan speed for 7 sec.
- d. The blower motor will operate on high gas heat speed for 7 sec, then stop.
- e. The blower will operate on heat pump high heat/high cool speed for 7 sec then off.
2. Purge gas lines—After all connections have been made, purge the lines and check for leaks.

WARNING: Never purge a line into a combustion chamber. Never use matches, candles, flame or other sources of ignition to check for gas leakage. Use a soap-and-water solution to check for gas leaks. A failure to follow this warning could result in fire, explosion, personal injury, or death.

3. To operate furnace, follow procedures on operating instruction label attached to furnace.
4. With furnace operating, set thermostat below room temperature and observe that furnace goes off. Set thermostat above room temperature and observe that furnace restarts.

D. Adjustments

1. Set gas input rate.

The gas input rate must be set for both high and low fire. Each adjustment is independently made at the gas control regulators.

There are 2 methods of adjusting the gas input rate. The preferred method is by using Table 12 and item a. The second method is by clocking the gas meter as outlined in item b.

The procedure in item b must be used for altitudes above 2000 ft. The gas control regulators have been nominally set for 1.5-in. wc for low fire and 3.5-in. wc for high fire for natural gas.

a. Check gas input rate using Table 12.

- (1.) Obtain average yearly heat value for local gas supply.
- (2.) Obtain average yearly specific gravity for local gas supply.
- (3.) Verify furnace model. Table 12 can only be used for model 331AAV Furnaces.
- (4.) Check and verify orifice size in furnace. NEVER ASSUME THE ORIFICE SIZE. ALWAYS CHECK AND VERIFY.
- (5.) Find natural gas heat value and specific gravity in Table 12.
- (6.) Follow heat value and specific gravity lines to point of intersection. Find orifice size and manifold pressure settings for proper operation at given natural gas conditions on low and high fire.

EXAMPLE:

Heat value 1070 Btu/cu ft

Specific gravity 0.58

Therefore: Orifice No. 45 *

Manifold pressure 3.7-in. wc on high fire and 1.5-in. wc on low fire.

* The furnace is shipped with No. 44 orifices. Therefore, in this example all main burner orifices must be changed and the manifold pressure must be adjusted.

- (7.) Proceed to item c. to adjust manifold pressure.

b. Check gas input rate by clocking gas meter for low and high fire.

- (1.) Obtain average yearly heat value for local gas supply.

NOTE: Be certain heating value used for calculating is correct for your altitude. Consult local gas utility for altitude adjustments of gas heating value.

- (2.) Check and verify orifice size in furnace. NEVER ASSUME THE ORIFICE SIZE. ALWAYS CHECK AND VERIFY.
- (3.) Turn off all other gas appliances and pilots.
- (4.) Turn SW2 to ON. Close R-to-W/W1 and jumper R to W2 to start furnace in high fire and let run for 3 minutes.
- (5.) Measure time (in sec) for gas meter to complete 1 revolution.
- (6.) Refer to Table 13 for cubic ft of gas per hr.

TABLE 12—ORIFICE SIZE AND MANIFOLD PRESSURE (IN. WC)

GAS HEAT VALUE BTU/CU FT	SPECIFIC GRAVITY OF NATURAL GAS															
	0.58		0.60		0.62		0.64		0.66		0.68		0.70		0.72	
	Orf No.	Heat High/Low	Orf No.	Heat High/Low	Orf No.	Heat High/Low	Orf No.	Heat High/Low	Orf No.	Heat High/Low	Orf No.	Heat High/Low	Orf No.	Heat High/Low	Orf No.	Heat High/Low
860			42	3.5/1.4	42	3.2/1.3 3.6/1.5	41 42	3.3/1.4 3.7/1.5	40 41 42	3.2/1.3 3.4/1.4 3.6/1.5	40 41	3.3/1.3 3.5/1.5	40 41	3.3/1.4 3.6/1.5	39 40 41	3.2/1.3 3.4/1.4 3.7/1.5
875	42	3.2/1.3	42	3.3/1.4	42	3.4/1.4	41 42	3.2/1.3 3.6/1.5	41 42	33.3/1.4 3.7/1.5	41 42	3.4/1.4 3.8/1.6	40 41	3.2/1.3 3.5/1.4	40 41	3.3/1.4 3.6/1.5
890	43	3.8/1.6	42	3.2/1.3	43	3.3/1.4	42	3.4/1.5	41 42	3.2/1.3 3.5/1.5	41 42	3.3/1.4 3.7/1.5	41 42	3.4/1.4 3.8/1.6	40 41	3.2/1.3 3.5/1.4
905	43	3.7/1.5	43	3.8/1.6	43	3.2/1.3	42	3.3/1.4	42	3.4/1.4	41 42	3.2/1.3 3.5/1.4	41 42	3.3/1.4 3.6/1.5	41 42	3.4/1.4 3.7/1.5
920	43	3.6/1.5	43	3.7/1.5	43	3.8/1.6	42	3.2/1.3	42	3.3/1.4	42	3.4/1.4	41 42	3.2/1.3 3.5/1.5	41 42	3.3/1.3 3.6/1.5
935	43	3.4/1.4	43	3.6/1.5	43	3.7/1.5	43	3.8/1.6	42	3.2/1.3	42	3.3/1.3	42	3.4/1.4	42	3.2/1.3 3.5/1.4
950	43 44	3.3/1.4 3.8/1.6	43	3.5/1.4	43 44	3.6/1.5	43	3.7/1.5	43	3.8/1.6	42	3.2/1.3	42	3.3/1.4	42	3.4/1.4
965	43 44	3.2/1.3 3.7/1.5	43 44	3.3/1.4 3.8/1.6	43 44	3.5/1.4	43	3.6/1.5	43	3.7/1.5	43	3.8/1.5	42	3.2/1.3	42	3.3/1.4
980	44	3.8/1.3	43 44	3.2/1.3 3.7/1.5	43 44	3.4/1.4 3.8/1.6	43	3.5/1.4	43	3.6/1.5	43	3.7/1.5	43	3.8/1.6	42	3.2/1.3
995	44	3.5/1.4	44	3.6/1.5	44	3.3/1.3 3.7/1.5	43 44	3.4/1.4 3.8/1.6	43	3.5/1.4	43	3.6/1.4	43	3.7/1.5	43	3.8/1.6
1010	44	3.4/1.4	44	3.5/1.4	44	3.2/1.3 3.6/1.5	43 44	3.3/1.3 3.7/1.5	43 44	3.4/1.4 3.8/1.6	43	3.5/1.4	43	3.6/1.5	43	3.7/1.5
1025	44	3.3/1.4	44	3.4/1.4	44	3.5/1.4	43 44	3.2/1.3 3.6/1.5	43 44	3.3/1.3 3.7/1.5	43 44	3.4/1.4 3.8/1.5	43	3.5/1.4	43	3.6/1.5
1040	44	3.1/1.3	44	3.3/1.4	44	3.4/1.4	44	3.5/1.4	43 44	3.2/1.3 3.6/1.5	43 44	3.3/1.3 3.7/1.5	43 44	3.4/1.4 3.8/1.6	43	3.5/1.4
1055	45	3.8/1.6	44	3.2/1.3	44	3.3/1.4	44	3.4/1.4	44	3.5/1.5	43 44	3.2/1.3 3.6/1.5	43 44	3.3/1.4 3.4/1.5	43 44	3.4/1.4 3.6/1.6
1070	45 46	3.7/1.5 3.8/1.6	45	3.8/1.6	44	3.2/1.3	44	3.3/1.4	44	3.4/1.4	44	3.5/1.5	43 44	3.2/1.3 3.6/1.5	43 44	3.3/1.4 3.7/1.5
1085	45 46	3.6/1.5 3.7/1.5	45	3.7/1.5	45	3.8/1.6	44	3.2/1.3	44	3.3/1.4	44	3.4/1.4	44	3.5/1.5	43 44	3.2/1.3 3.6/1.5
1100	45 46	3.5/1.4 3.6/1.5	45 46	3.6/1.5 3.8/1.6	45	3.7/1.5	45	3.8/1.6	44	3.2/1.3	44	3.3/1.4	44	3.4/1.4	44	3.5/1.5

(7.) Multiply gas rate (cubic ft/hr) x heating value (Btu/cubic ft).

EXAMPLE:

Btu heating input = Btu/cu ft x cu ft/hr

Heating value of gas = 1070 Btu/cu ft

Time for 1 revolution of 2-cu ft dial = 72 sec

Gas rate = $100 \times 1070 = 107,000$ Btu/h

(8.) Remove jumper R-to-W2, and repeat items 5 through 7 for high fire.

CAUTION: DO NOT redrill burner orifices. Improper drilling (burrs, out of round, etc.) can cause excessive burner operating noise and misdirection of burner flames. This could result in flame impingement on burners and heat exchanger surfaces, leading to potential failures.

(9.) Measured gas inputs should equal low and high fire gas inputs on unit rating plate, ± 2 percent.

(10.) Proceed to item 2 to adjust manifold pressure.

2. Adjust gas input.

a. Move SW2 to the ON position R-to-W/W1-W2. (See Fig. 13.) Jumper to call for low gas heat.

b. Remove gas control regulator adjustment seal caps. (See Fig. 15.)

c. Turn low fire adjusting screw (5/64-in. hex Allen wrench) counterclockwise (out) to decrease input rate or clockwise (in) to increase rate. When adjusting input rate, DO NOT set manifold pressure less than 3.2-in. wc or more than 3.8-in. wc for natural gas. If manifold pressure is outside this range, change main burner orifices.

d. Remove R-to-W2 jumper on control to place furnace in low gas heat operation for low fire adjustment.

e. Turn low fire adjusting screw (5/64-in. hex Allen wrench) counterclockwise (out) to decrease input rate or clockwise (in) to increase rate. When adjusting input rate, DO NOT set manifold pressure less than 1.3-in. wc or more than 1.7-in. wc for natural gas. If manifold pressure is outside this range, change main burner orifices.

NOTE: If orifices are changed, both high fire and low fire input rates must be readjusted, with manifold pressures within ranges specified in items c and e.

NOTE: If orifice hole appears damaged or it is suspected to have been redrilled, check the orifice size with a numbered drill bit of the correct size. Never use a redrilled orifice. A burr-free and squarely aligned orifice hole is essential for proper flame characteristics.

f. Remove jumper on R-W/W1 after low fire adjustments.

g. Replace gas control regulator adjustment caps.

TABLE 13—GAS RATE CU FT/HR

SECONDS FOR 1 REVOLUTION	SIZE OF TEST DIAL			SECONDS FOR 1 REVOLUTION	SIZE OF TEST DIAL		
	1 cu ft	2 cu ft	5 cu ft		1 cu ft	2 cu ft	5 cu ft
10	360	720	1800	50	72	144	360
11	327	655	1636	51	71	141	355
12	300	600	1500	52	69	138	346
13	277	555	1385	53	68	136	340
14	257	514	1286	54	67	133	333
15	240	480	1200	55	65	131	327
16	225	450	1125	56	64	129	321
17	212	424	1059	57	63	126	316
18	200	400	1000	58	62	124	310
19	189	379	947	59	61	122	305
20	180	360	900	60	60	120	300
21	171	343	857	62	58	116	290
22	164	327	818	64	56	112	281
23	157	313	783	66	54	109	273
24	150	300	750	68	53	106	265
25	144	288	720	70	51	103	257
26	138	277	692	72	50	100	250
27	133	267	667	74	48	97	243
28	129	257	643	76	47	95	237
29	124	248	621	78	46	92	231
30	120	240	600	80	45	90	225
31	116	232	581	82	44	88	220
32	113	225	563	84	43	86	214
33	109	218	545	86	42	84	209
34	105	212	529	88	41	82	205
35	103	206	514	90	40	80	200
36	100	200	500	92	39	78	196
37	97	195	486	94	38	76	192
38	95	189	474	96	38	75	188
39	92	185	462	98	37	74	184
40	90	180	450	100	36	72	180
41	88	176	439	102	35	71	178
42	86	172	429	104	35	69	173
43	84	167	419	106	34	68	170
44	82	164	409	108	33	67	167
45	80	160	400		33	65	164
46	78	157	391	110	32	64	161
47	76	153	383	112	31	62	155
48	75	150	375	118	31	62	155
49	73	147	367	120	30	60	150

3. Set temperature rise.

Place SW2 in the ON position; jumper R to W/W1 and W2 to check temperature rise. To check low-gas-heat-temperature rise, remove jumper to W2. Determine air temperature rise for both high and low fire using the following steps. DO NOT exceed the temperature rise ranges specified on the unit rating plate for high and low fire.

- Place duct thermometers in return and supply ducts as near furnace as possible. Be sure thermometers do not see heat exchangers so that radiant heat will not affect thermometer readings. This is particularly important with straight-run ducts.
- When thermometer readings stabilize, subtract return-air temperature from supply-air temperature to determine temperature rise.

NOTE: If the temperature rise is outside this range, first check:

- (1.) Gas input for low and high-fire operation.
 - (2.) Derate for altitude if applicable.
 - (3.) Return and supply ducts for excessive restrictions causing static pressures greater than 0.50-in. wc.
- c. Adjust air temperature rise by adjusting blower speed. Increase blower speed to reduce temperature rise. Decrease blower speed to increase temperature rise. For high-fire, speed tap selection can be 2 or 3 (factory setting). For low fire, speed tap selection can be 4 (factory setting) or 3 if high-fire speed selections is 2.

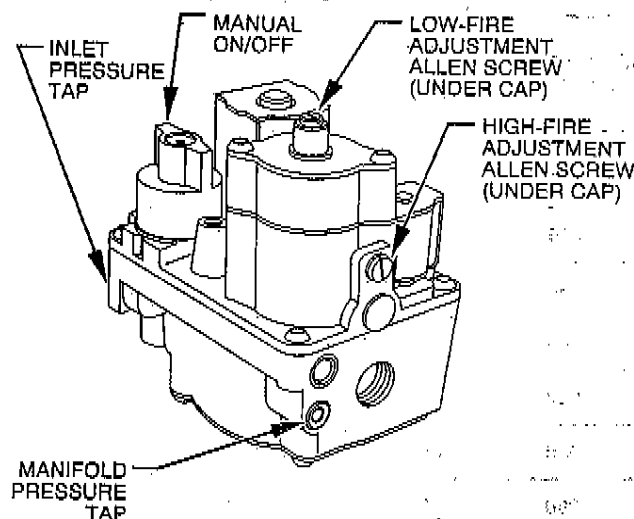


Fig. 15—Redundant Automatic Gas Control Valve

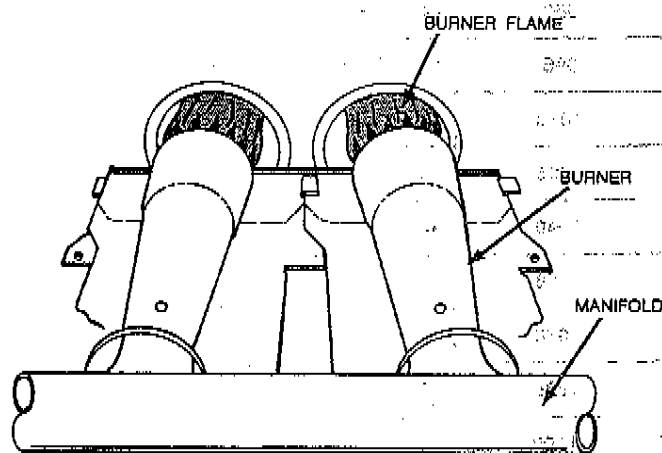


Fig. 16—Burner Flame

WARNING: Disconnect the electrical power before changing the speed tap. A failure to follow this warning can cause personal injury or death.

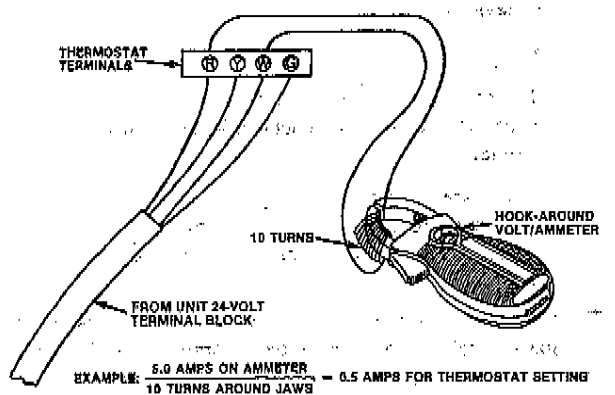
- To change motor speed taps, remove the motor tap lead and relocate it on the desired terminal on the plug-in terminal block/speed selector located on the blower housing. (See Table 14.)

TABLE 14—SPEED SELECTOR

SPEED	TAP NO.*
Common	C
High	1
Med-High	2
Med-Low	3
Low	4

*White wire from control to common; black wire from control to high cooling speed selection; blue wire from control to high gas heating speed selection; and red wire from control to low gas heat/low cooling/continuous fan speed selection.

CAUTION: Recheck the temperature rise. It must be within the limits specified on the unit rating plate. Recommended operation is at mid-point of rise or above.



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Fig. 17—Amp Draw Check With Ammeter

4. Set thermostat heat anticipator.

The thermostat heat anticipation must be set to match the amp draw of the electrical components in the R-W/W1 circuit. Accurate amp draw readings can be obtained at thermostat subbase terminals R and W. Fig. 17 illustrates an easy method of obtaining the actual amp draw. The amp reading should be taken after the blower motor has started and the furnace is operating in low fire. To operate the furnace in low fire, first move SW2 to the ON position, THEN close R-to-W/W1. Return SW2 to final desired location after completing reading. See the thermostat manufacturer's instructions for adjusting the heat anticipator and for varying the heating cycle length.

NOTE: When using an electronic thermostat, set cycle rate for 3 cycles per hr.

E. Check Safety Controls

The flame sensor, gas valve, and pressure switches were all checked in the Start-up section as part of normal operation.

1. Check primary limit control.

This control shuts off the combustion control system and energizes the circulating-air blower motor if the furnace overheats.

The preferred method of checking the limit control is to gradually block off the return air after the furnace has been operating for a period of at least 5 minutes. As soon as the limit has shut off the burners, the return-air opening should be unblocked. By using this method to check the limit control, it can be established that the limit is functioning properly and will operate if there is a motor failure.

2. Check draft safeguard switch. (Category I Vent Installations ONLY.)

The purpose of this control is to permit the safe shutdown of the furnace during certain blocked vent conditions.

- Disconnect power to furnace and remove vent connector from furnace outlet collar. Be sure to allow time for vent pipe to cool down before removing.
- Restore power to furnace and set room thermostat above room temperature.
- After normal start-up, allow furnace to operate for 2 minutes, then block flue outlet (100 percent). Furnace should cycle off within 2 minutes.

d. Remove blockage and reconnect vent pipe to furnace outlet collar.

e. Wait 5 minutes and then reset draft safeguard switch.

3. Check pressure switch.

This control proves operation of draft inducer blower.

- Turn OFF 115-v power to furnace.
- Remove control door and disconnect inducer motor lead wires from wire harness.
- Turn ON 115-v power to furnace.
- Close thermostat switch as if making normal furnace start. If the hot surface ignitor does not glow within several minutes and control flashes code 32, then the pressure switch is functioning properly.

c. Turn OFF 115-v power to furnace.

f. Reconnect inducer motor wires, replace control door, and turn ON 115-v power to furnace.

4. Check auxiliary limits.

- Turn OFF 115-v power to furnace.
- Remove blower access door.
- Disconnect red motor lead at blower speed selector. Mark terminal for proper reconnection.
- Replace blower access door.
- Turn ON 115-v power to furnace. Be sure room thermostat is calling for low heat.
- Allow furnace to operate until auxiliary limit activates, but DO NOT operate furnace longer than 4 minutes.
- If furnace operates for 4 minutes, check/replace limit switch(es).
- Turn OFF 115-v power to furnace.
- Remove blower access door.
- Reconnect red motor lead, reset switch, and replace door.
- Turn ON 115-v power to furnace.

F. Check List

- Put away tools, instruments, and clean up debris.
- Check SW1 through SW4 after completing installation to ensure desired settings for thermostat type (SW1 and SW2) and blower off delay (SW3 and SW4). Refer to Tables 10 and 11.
- Verify manual reset switches have continuity.
- Ensure blower and control access doors are properly installed.
- Cycle test furnace with room thermostat.
- Check operation of accessories per manufacturer's instructions.
- Review User's Manual with owner.
- Leave literature packet near furnace.