



installation, start-up, and operating instructions

UPFLOW/HORIZONTAL TWO-STAGE, VARIABLE-SPEED GAS FURNACE

**333BAV
333JAV
Series B or C**

Cancels: II 333B-60-3

II 333B-60-4
7-99

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

This symbol → indicates a change since the last issue.

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REGISTERED
QUALITY SYSTEM

SAFETY CONSIDERATIONS

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

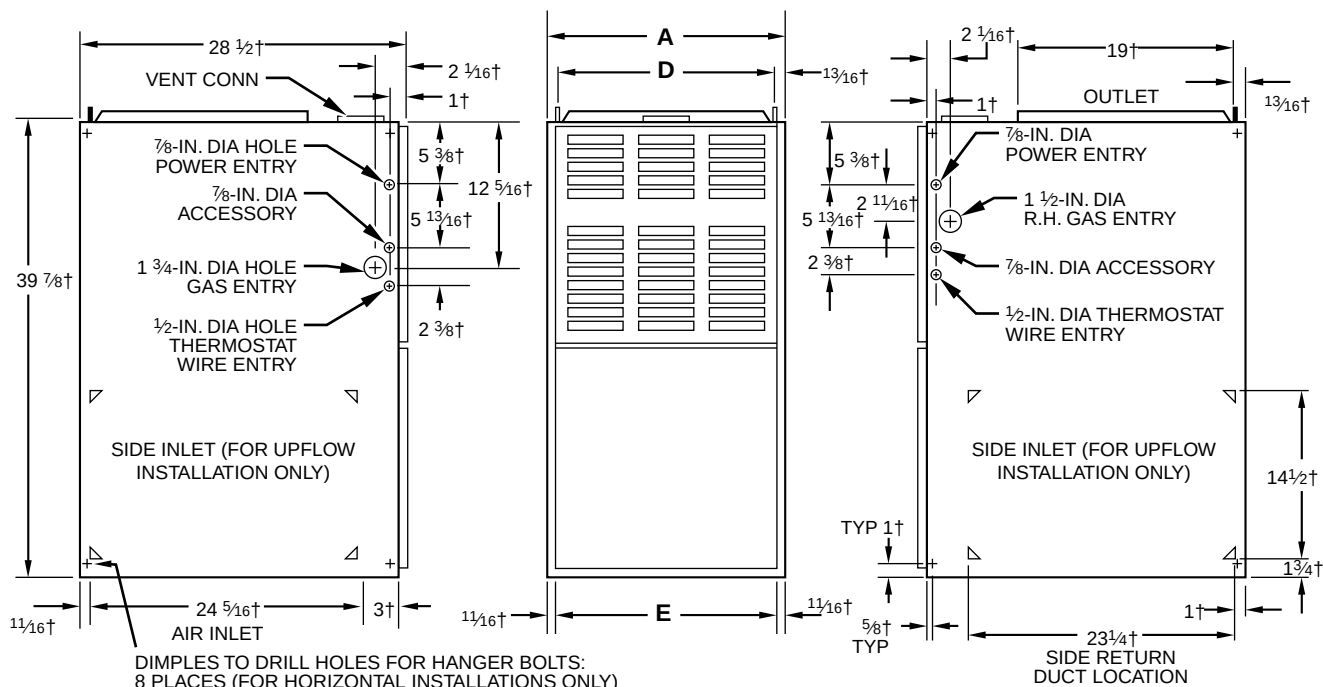
Untrained personnel can perform basic maintenance functions such as cleaning and replacing air filters. All other operations must be performed by trained service personnel. When working on heating equipment, observe precautions in the literature, on tags, and on labels attached to or shipped with the 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) NFPA 54-1996/ANSI Z223.1-1996 and the Installation Standards, Warm Air Heating and Air Conditioning Systems (NFPA 90B) ANSI/NFPA 90B. In Canada, refer to the CAN/CGA-B149.1- and .2-M95 National Standard of Canada, Natural Gas and Propane Installation Codes (NSCNGPIC). 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 furnace and in instructions or manuals, be alert to the potential for personal injury.

→ Understand the signal words DANGER, WARNING, CAUTION and NOTE. 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 a hazard which **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. NOTE is used to highlight suggestions which **will** result in enhanced installation, reliability, or operation.

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.



- NOTES:**
- Two additional 7/8-in. dia holes are located in the top plate.
 - Minimum return-air openings at furnace, based on metal duct. If flex duct is used, see flex duct manufacturer's recommendations for equivalent diameters.
 - For 800 CFM—16-in. round or 14 1/2 x 12-in. rectangle.
 - For 1200 CFM—20-in. round or 14 1/2 x 19 1/2-in. rectangle.
 - For 1600 CFM—22-in. round or 14 1/2 x 23 1/4-in. rectangle.
 - For airflow requirements above 1800 CFM, see Air Delivery table in Product Data literature for specific use of single side inlets. The use of both side inlets, a combination of 1 side and the bottom, or the bottom only will ensure adequate return air openings for airflow requirements above 1800 CFM.

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Fig. 1—Dimensional Drawing
TABLE 1—DIMENSIONS (IN.)

UNIT SIZE	A	D	E	FLUE COLLAR	SHIP. WT
036060	14-3/16	12-9/16	12-11/16	4	133
048080	21	19-3/8	19-1/2	4	157
060100	24-1/2	22-7/8	23	4	185
060120	24-1/2	22-7/8	23	5	183

ELECTROSTATIC DISCHARGE (ESD) PRECAUTIONS PROCEDURE

CAUTION: Electrostatic discharge can affect electronic components. Take precautions during furnace installation and servicing to protect the furnace electronic control. Precautions will prevent electrostatic discharges from personnel and hand tools which are held during the procedure. These precautions will help to avoid exposing the control to electrostatic discharge by putting the furnace, the control, and the person at the same electrostatic potential.

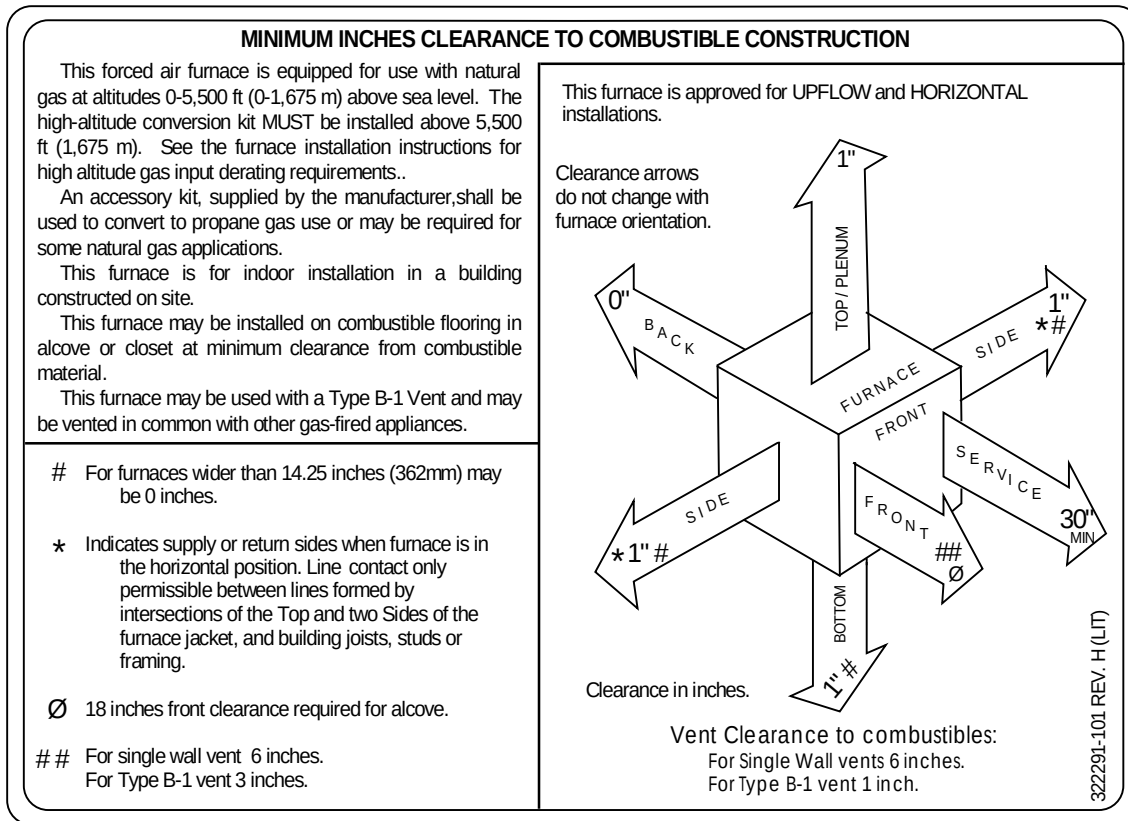
- Disconnect all power to the furnace. **DO NOT TOUCH THE CONTROL OR ANY WIRE CONNECTED TO THE CONTROL PRIOR TO DISCHARGING YOUR BODY'S ELECTROSTATIC CHARGE TO GROUND.**
- Firmly touch a clean, unpainted, metal surface of the furnace chassis which is close to the control. Tools held in a person's hand during grounding will be satisfactorily discharged.
- After touching the chassis you may proceed to service the control or connecting wires as long as you do nothing that recharges your body with static electricity (For example: **DO NOT** move or shuffle your feet, **DO NOT** touch ungrounded objects, etc.).

- If you touch ungrounded objects (recharge your body with static electricity), firmly touch furnace again before touching control or wires.
- Use this procedure for installed and uninstalled (ungrounded) furnaces.
- Before removing a new control from its container, discharge your body's electrostatic charge to ground to protect the control from damage. If the control is to be installed in a furnace, follow items 1 through 5 before bringing the control or yourself into contact with the furnace. Put all used **AND** new controls into containers before touching ungrounded objects.
- An ESD service kit (available from commercial sources) may also be used to prevent ESD damage.

INTRODUCTION

→ The models 333BAV and 333JAV Series B or C Furnaces are available in sizes 60,000 through 117,000 Btuh input capacities. These furnaces use variable-speed motors manufactured by General Electric (GE) and known as ICM2+ motors. They are integrated control motors, which include a pre-programmed micro-processor-based control to precisely control the selected airflow rates. The motor will be referred to as ICM2+ in the rest of this document.

The design of the upflow/horizontal gas-fired furnace is A.G.A. and C.G.A. design-certified for use with natural and propane gases and for installation on combustible wood flooring, in alcoves,



→ **Fig. 2—Clearances to Combustibles**

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attics, basements, closets, crawlspaces, or utility rooms. The design of this furnace line is **not** A.G.A. and C.G.A. design-certified for installation in mobile homes, recreation vehicles, or outdoors.

→ Before installing the furnace in the United States, refer to the current edition of the NFGC and the NFPA 90B. For copies of the NFGC and NFPA 90B, contact National Fire Protection Association Inc., Batterymarch Park, Quincy, MA 02269; or (for NFGC only) American Gas Association, 400 N. Capitol St., N.W., Washington, D.C. 20001.

→ Before installing the furnace in Canada, refer to the current edition of the NSCNPIC. Contact Standard Sales, CSA International, 178 Rexdale Boulevard, Etobicoke (Toronto), Ontario, M9W 1R3 Canada.

Installation must comply with regulations of serving gas supplier and local building, heating, plumbing or other codes in effect in the area in which installation is made. In absence of local codes, installation must conform with NFGC in the United States and the NSCNPIC and all authorities having jurisdiction in Canada.

These instructions cover minimum requirements for a safe installation 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 pace with changing residential construction practices. We require these instructions as a minimum for a safe installation.

⚠

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.

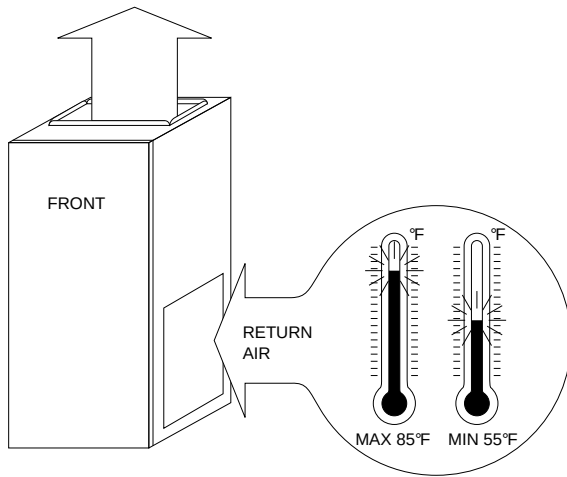
To aid in installation, troubleshooting, and service, a status code label is located on the blower compartment door. This label explains how to use the LED status indicator on the furnace control which is viewed through the sight glass on the door.

⚠

→ **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 can cause electrical shock, fire, personal injury, or death.

For high-altitude installations, the high-altitude conversion kit **MUST** be installed at or above 5500 ft above sea level.

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



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→ **NOTE:** These furnaces are designed for a minimum continuous return-air temperature of 60°F or intermittent operation down to 55°F such as when used with a night setback thermostat. Return-air temperature must not exceed a maximum of 85°F. Failure to follow these return-air temperature limits may affect reliability of heat exchangers, motors, and controls.

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 met in addition to all local codes and ordinances.

CAUTION: Do not use this furnace during construction when adhesives, sealers, and/or new carpets are being installed and curing. 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 system. 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. Excessive exposure to contaminated combustion air will result in safety and performance related problems.

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

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

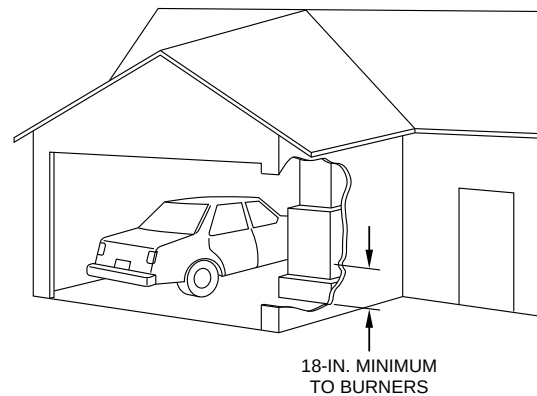
Locate furnace as near the center of the air distribution system and chimney or vent as possible. The furnace should be installed as level as possible. When a furnace is installed so that supply ducts carry air to areas outside the space containing the furnace, return air must also be handled by a duct(s) sealed to the furnace casing and terminating outside the space containing the furnace.

Provide ample space for servicing and cleaning. Always comply with the minimum fire protection clearances shown on furnace clearance-to-combustible construction label. This furnace shall not be installed directly on carpeting, tile, or any combustible material other than wood flooring.

B. Location Relative to Cooling Equipment

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

→ C. Hazardous Locations



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WARNING: When furnace is installed in a residential garage, it must be installed so that burners and ignition sources are located a minimum of 18 in. above floor. The furnace must be located or protected to avoid physical damage by vehicles. When furnace is installed in a public garage, airplane hangar, or other building having a hazardous atmosphere, unit must be installed in accordance with requirements of National Fire Protection Association, Inc.

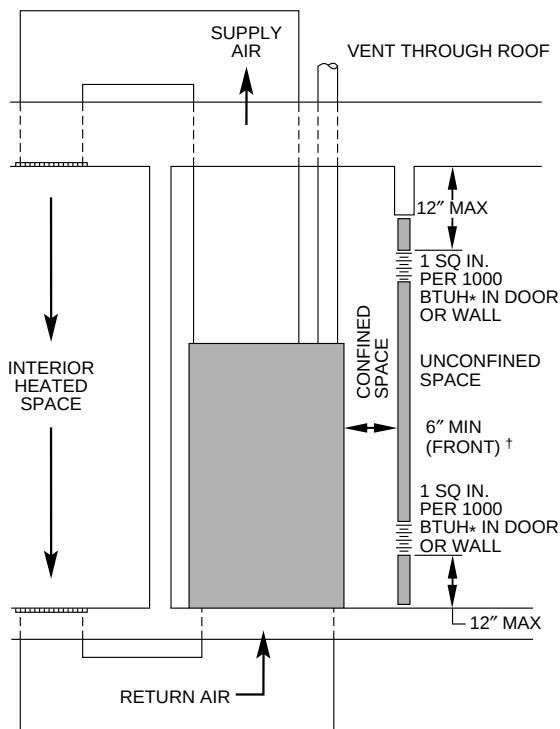
II. AIR FOR COMBUSTION AND VENTILATION

Provisions for adequate combustion and ventilation air must be provided in accordance with Section 5.3, Air for Combustion and Ventilation, of the NFGC or applicable provisions of the local building codes.

Canadian installations must be in accordance with NSCNPGIC 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.

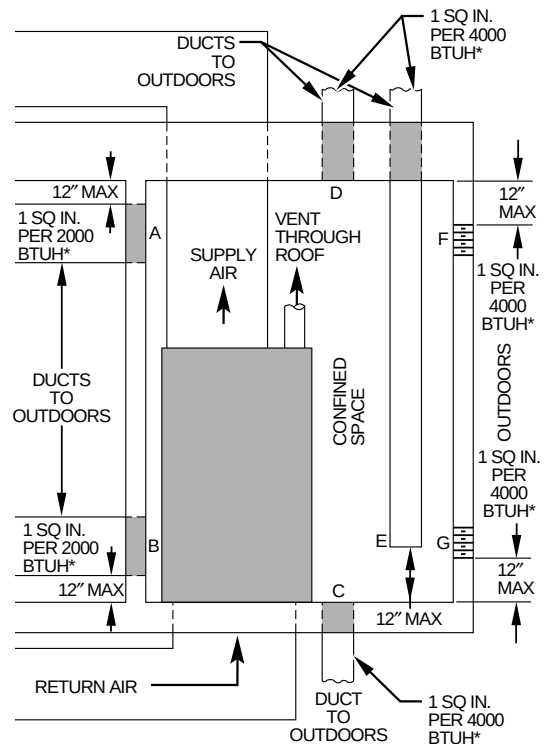
All fuel-burning equipment must be supplied with air for combustion of fuel. Sufficient air **MUST** be provided to ensure there will not be a negative pressure in the equipment room or space. In addition, a positive seal **MUST** be made between furnace cabinet and return-air duct to prevent pulling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



* Minimum opening size is 100 sq in. with minimum dimensions of 3 in.
† Minimum of 3 in. when type-B1 vent is used.

Fig. 3—Confined Space: Air for Combustion and Ventilation from an Indoor Unconfined Space

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*Minimum dimensions of 3 in.

NOTE: Use any of the following combinations of openings:
A & B C & D D & E F & G

Fig. 4—Confined Space: Air for Combustion and Ventilation from Outdoors

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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 these devices, in addition to that required by the furnace.

Combustion and ventilation air requirements are determined by whether the furnace is located in a **CONFINED** or **UNCONFINED** space.

A. Unconfined Space

An unconfined space has volume of at least 50 cu ft for each 1000 Btuh of total input for all appliances (such as furnaces, clothes dryers, water heaters, etc.) in the space.

For Example:

333BAV AND 333JAV FURNACES HIGH-STAGE INPUT BTUH	MINIMUM SQ FT WITH 7-1/2 FT CEILING
60,000	400
80,000	534
100,000	667
117,000	780

If the unconfined space is of unusually tight construction, 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 is defined as a space whose volume is less than 50 cu ft per 1000 Btuh of total input ratings of all appliances installed in that space. A confined space **MUST** have provisions for supplying air for combustion, ventilation, and dilution of flue gases using 1 of the following methods. (See Fig. 3 or 4, and Table 2.)

NOTE: In determining free area of an opening, the blocking effect of louvers, grilles, and screens must be considered. If free area of 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 air comes from outside of the structure or an unconfined space inside the structure.

1. All air from inside the structure requires 2 openings (for structures not usually tight):
 - a. Each opening **MUST** have at least 1 sq in. of free area per 1000 Btuh of total input for all equipment within the confined space, but not less than 100 sq in. per opening. (See Fig. 3 and Table 2.) The minimum dimension of air openings shall not be less than 3 in.
 - b. If building is constructed unusually tight, a permanent opening directly communicating with the outdoors shall be provided. (See item 2 below.)
 - c. If furnace is installed to obtain a return-air directly from hallway or space adjacent to furnace, all air for combustion must come from outdoors.

TABLE 2—MINIMUM FREE AREA OF COMBUSTION AIR OPENING*

333BAV/333JAV FURNACE HIGH-FIRE INPUT (BTUH)	AIR FROM INDOOR UNCONFINED SPACE	OUTDOOR AIR THROUGH VERTICAL DUCTS		OUTDOOR AIR THROUGH HORIZONTAL DUCTS		OUTDOOR AIR THROUGH SINGLE DUCT	
	Free Area of Opening (Sq In.)	Free Area of Opening and Duct (Sq In.)	Round Pipe (In. Dia)	Free Area of Opening and Duct (Sq In.)	Round Pipe (In. Dia)	Free Area of Opening and Duct (Sq In.)	Round Pipe (In. Dia)
60,000	100	15.0	5	30.0	7	20.0	6
80,000	100	20.0	6	40.0	8	26.7	6
100,000	100	25.0	6	50.0	8	33.4	7
117,000	117	29.3	7	58.5	9	39.0	8

* Free area shall be equal to or greater than the sum of the areas of all vent connectors in the confined space. Opening area must be increased, if other gas appliances in the space require combustion air.

2. Air from outside the structure requires 1 of the following methods:

- If combustion air is taken from outdoors through 2 vertical ducts, the openings and ducts **MUST** have at least 1 sq in. of free area per 4000 Btuh of total input for all equipment within the confined space. (See Fig. 4 and Table 2.)
- If combustion air is taken from outdoors through 2 horizontal ducts, the openings and ducts **MUST** have at least 1 sq in. of free area per 2000 Btuh of total input for all equipment within the confined space. (See Fig. 4 and Table 2.)
- If combustion air is taken from outdoors through a single opening or duct (horizontal or vertical) commencing within 12 in. of the top of the confined space, opening and duct **MUST** have at least 1 sq in. of free area per 3000 Btuh of the total input for all equipment within the confined space and not less than the sum of the areas of all vent connectors in the confined space. (See Fig. 4 and Table 2.) Equipment clearances to the structure shall be at least 1 in. from the sides and back and 6 in. from the front of the appliances.

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 ducts must not be less than 3 in. (See Fig. 4.)

→ III. AIR DUCTS

A. General Requirements

The duct system should be designed and sized according to accepted national standards such as those published by: Air Conditioning Contractors Association (ACCA), Sheet Metal and Air Conditioning Contractors National Association (SMACNA) or American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) or consult factory *The Air Systems Design Guidelines* reference tables available from your local distributor. The duct system should be sized to handle the required system design airflow CFM at the design external static pressure.

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.

Secure ductwork with proper fasteners for type of ductwork used. Seal supply- and return-duct connections to furnace with code approved tape or duct sealer.

Flexible connections should be used between ductwork and furnace to prevent transmission of vibration. Ductwork passing through unconditioned space should be insulated to enhance system performance. When air conditioning is used, a vapor barrier is recommended.

Maintain a 1-in. clearance from combustible materials to supply air ductwork for a distance of 36 in. horizontally from the furnace. See NFPA 90B or local code for further requirements.

B. Ductwork Acoustical Treatment

Metal duct systems that do not have a 90 degree elbow and 10 ft of main duct to the first branch take-off may require internal acoustical lining. As an alternative, fibrous ductwork may be used if constructed and installed in accordance with the latest edition of SMACNA construction standard on fibrous glass ducts. Both acoustical lining and fibrous ductwork shall comply with NFPA 90B as tested by UL Standard 181 for Class 1 Rigid air ducts.

C. Supply Air Connections

1. Upflow Furnace

Connect supply-air duct to 3/4-in. flange on furnace supply-air opening outlet. The supply-air duct attachment must **ONLY** be connected to furnace supply/outlet flanges or air conditioning coil casing (when used). **DO NOT** cut main furnace casing to attach supply side air duct, humidifier, or other accessories. All accessories **MUST** be connected external to furnace main casing.

2. Horizontal Furnaces

Connect supply-air duct to 3/4-in flange on supply air opening on furnace. The supply-air duct attachment must **ONLY** be connected to furnace supply/outlet or air conditioning coil casing (when used). **DO NOT** cut main furnace casing to attach supply side air duct, humidifier, or other accessories. All accessories **MUST** be connected external to furnace main casing.

D. Return Air Connections



WARNING: Never connect return-air ducts to back of furnace. A failure to follow this warning can cause a fire, personal injury, or death.

1. Upflow Furnaces

The return-air duct must be connected to bottom, sides (left or right), or a combination of bottom and sides(s) of main furnace casing as shown in Fig. 1. Bypass humidifier may be attached into unused side return air portion of the furnace casing. **DO NOT** connect any portion of return-air duct to back of furnace casing.

2. Horizontal Furnaces

The return-air duct must be connected to return-air opening provided as shown in Fig. 1. **DO NOT** cut into casing sides or back to attach any portion of return-air duct. Bypass humidifier connections should be made at ductwork or coil casing sides exterior to furnace.

E. 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 factory-supplied filter(s) are shipped in the blower compartment. Determine location for the filter and move filter retaining hardware, if necessary, before attaching the return-air duct. After the return-air duct has been connected to the furnace, install the filter(s) inside the furnace blower compartment. See Fig. 5 for side return application and Fig. 6 for bottom return application.

A bottom closure panel is factory installed in bottom of furnace. When bottom return inlet is desired, remove and discard enclosure panel.

Filter retaining brackets, supports, and retainers are factory assembled and shipped installed for side return application, with 1 set of all required hardware on each furnace. (See Fig. 5.)

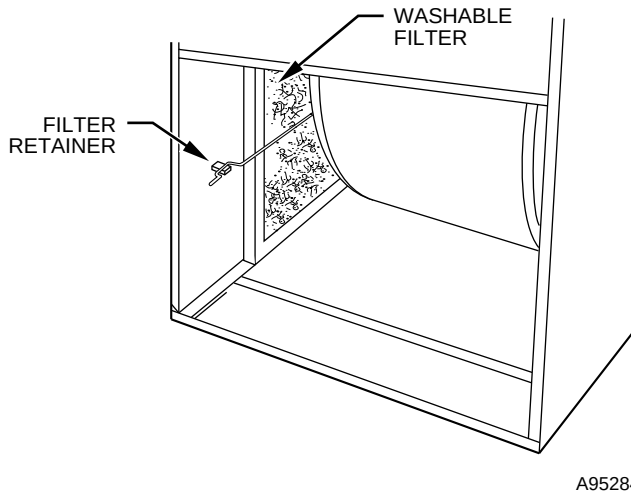


Fig. 5—Side Filter Arrangement

For bottom return applications, remove front and back brackets and supports from each side. The back bracket(s) are installed in the rear of the furnace casing. Dimples are provided to mark mounting screw locations.

Rotate filter side supports 180° so filter will rest on support and reinstall. Install small U-shaped end of filter retaining rod in rear bracket. Install front of filter retainer rod as shown in Fig. 6. Two sets of hardware are needed for furnaces in 24-1/2 in. casings using 2 filters for bottom return. All hardware is provided for filter installation.

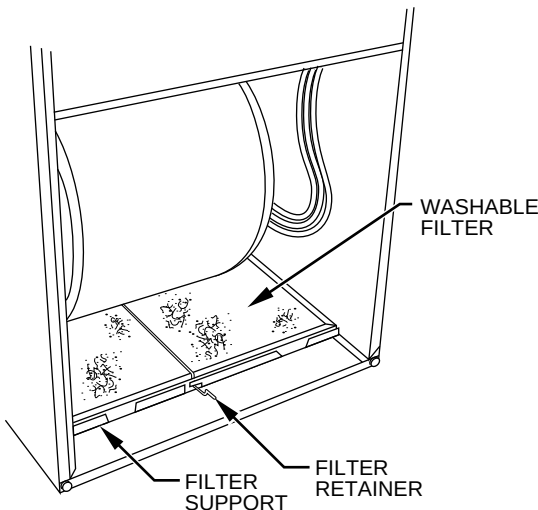


Fig. 6—Bottom Filter Arrangement

TABLE 3—FILTER INFORMATION (IN.)

FURNACE CASING WIDTH	FILTER SIZE*		FILTER TYPE
	Side Return	Bottom Return	
14-3/16‡	(1) 16 X 25 X 1†	(1) 14 X 25 X 1	Cleanable
21	(1) 16 X 25 X 1	(1) 20 X 25 X 1†	Cleanable
24-1/2	(2) 16 X 25 X 1†	(1) 24 X 25 X 1	Cleanable

* Filters can be field modified by cutting the frame as marked and folding to the desired size. Alternate sizes can be ordered from your distributor or dealer.
† Factory-provided with the furnace.
‡ External side filter rack must be used for upflow right-side return.

INSTALLATION

I. UPFLOW FURNACE INSTALLATION

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

NOTE: Door clip on control door may be removed for upflow installations.

1. Position furnace in desired location.
2. Connect gas supply pipe.
3. Connect supply- and return-air ducts.

II. HORIZONTAL FURNACE ATTIC INSTALLATION

WARNING: Do not install the furnace on its back; safety control operation will be adversely affected. Never connect return-air ducts to back, top, or bottom of the furnace (See Figs. 7 and 8). A failure to follow this warning could result in fire, personal injury, or death.

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

A. Construct a Working Platform

Construct working platform on location where all required furnace clearances are met. (See Figs. 2 and 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 24 X 24-in. sheet metal shield on platform in front of louvered control panel as shown in Fig. 7.

III. HORIZONTAL FURNACE CRAWLSPACE INSTALLATION

The furnace can be installed horizontally with either the LH or RH side up. In a crawlspace, furnace can either be hung from floor joist (See Fig. 8) or installed on suitable blocks or pad. (See Fig. 9.) 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.)

Since horizontal furnace crawlspace installation is very similar to attic, refer to Horizontal Furnace Attic Installation section. The installation of a sheet metal shield in front of the louvered control panel is covered in Horizontal Furnace Attic Installation section. For a crawlspace installation, this same sheet metal shield must be installed above the louvered control panel. Extend sheet metal shield over furnace top far enough to cover gas pipe entry hole.

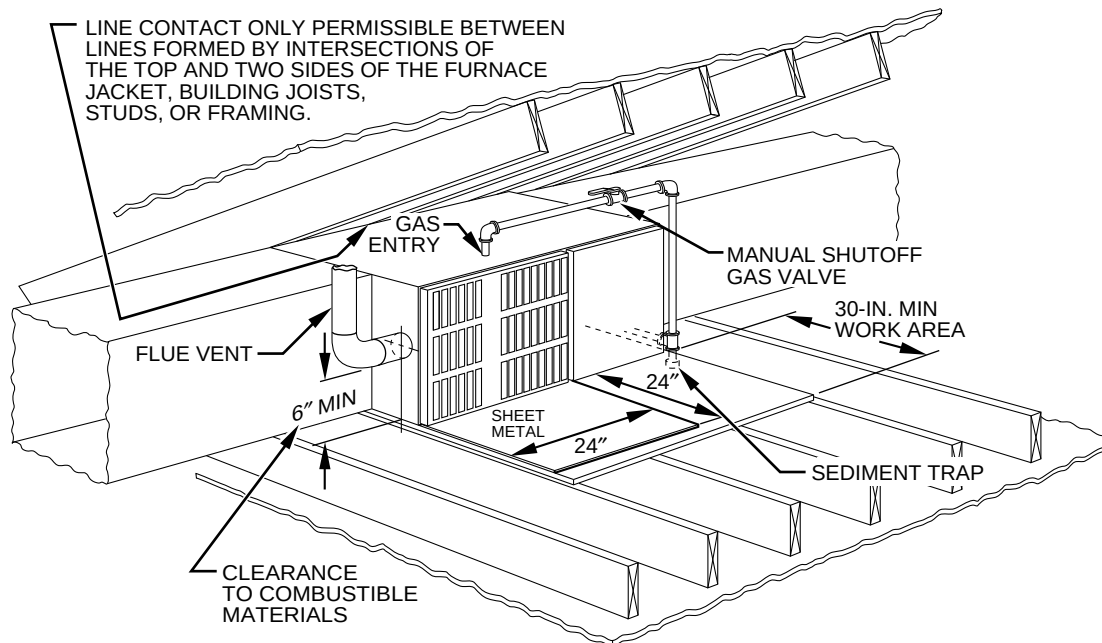


Fig. 7—Horizontal Furnace Attic Installation

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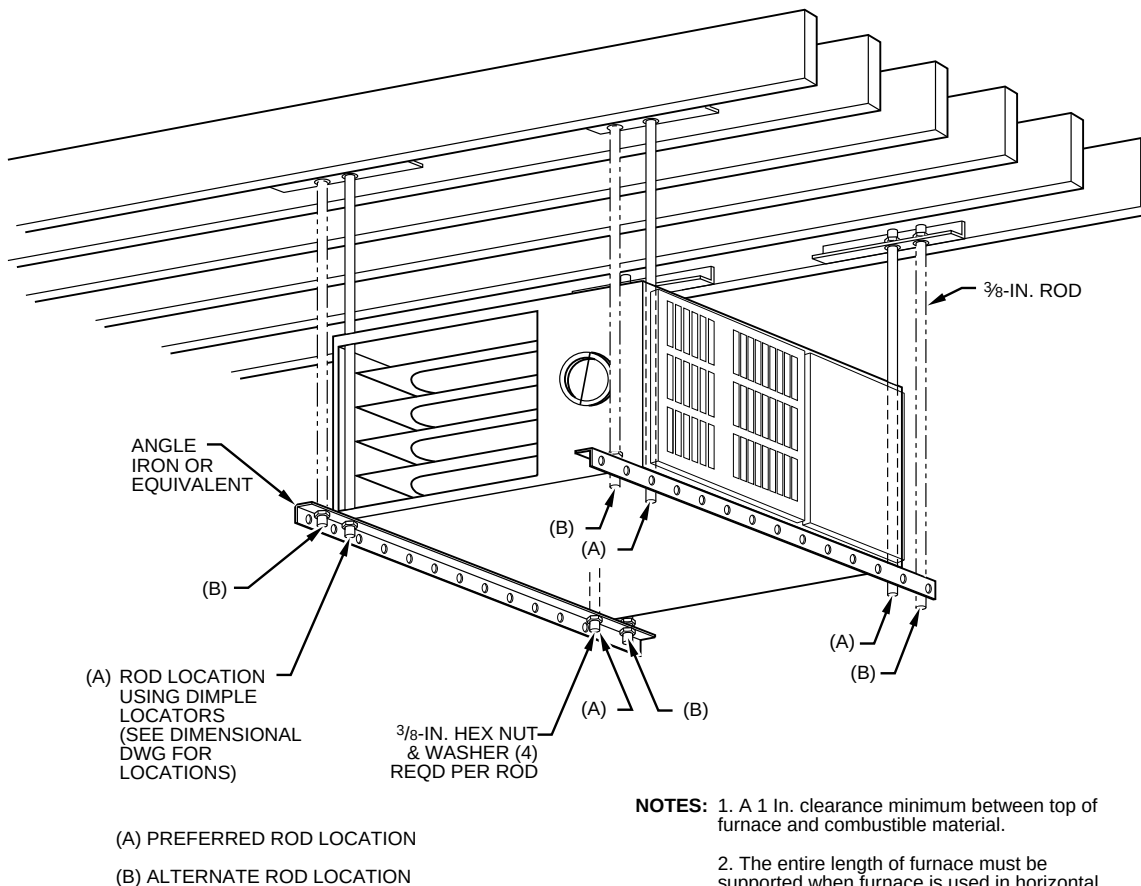


Fig. 8—Horizontal Furnace Crawlspace Installation on Hanger Rods

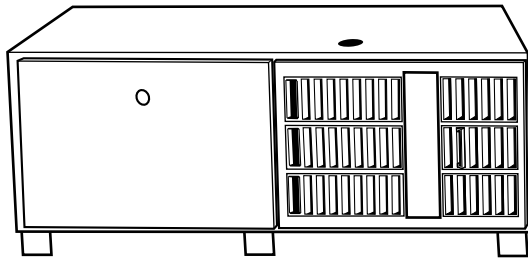
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IV. LEVELING LEGS (IF REQUIRED FOR UPFLOW)

When furnace is used with side inlet(s) and leveling legs are required, refer to Fig. 10 and install field-supplied, corrosion-resistant 5/16-in. machine bolts and nuts.

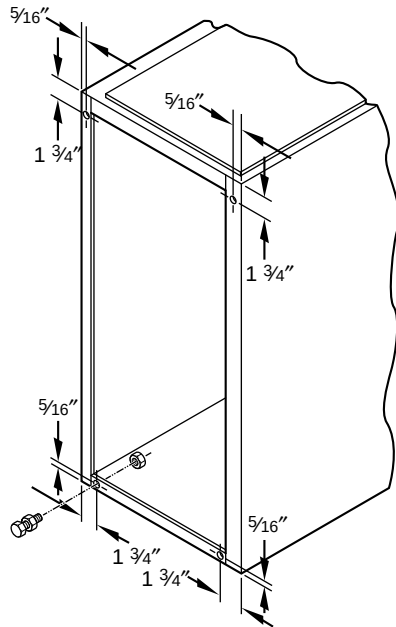
NOTE: The length of the bolt should not exceed 1-1/2 in.

1. Lay furnace on its back. Locate and drill 5/16-in. diameter hole in each bottom corner of furnace as shown in Fig. 10.



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Fig. 9—Horizontal Furnace Installation on Blocks



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Fig. 10—Leveling Leg Installation

2. Install nut on bolt and install bolt with nut in hole. (Install flat washer if desired.)
3. Install another nut on other side of furnace base. (Install flat washer if desired.)
4. Adjust outside nut to provide desired height and tighten inside nut to secure arrangement.

V. GAS PIPING



CAUTION: Emissions control devices located at the heat exchanger inlets **MUST** be removed for propane installations (Refer to gas conversion kit for instructions).

Gas piping must be installed in accordance with national and local codes. Refer to the NFGC. Canadian installations must be installed in accordance with NSCNGPIC and all authorities having jurisdiction.

The gas supply line should be a separate line running directly from gas meter to furnace, if possible. Refer to Table 4 for recommended gas pipe size. Risers must be used to connect furnace to gas meter.



WARNING:

If a flexible connector is required or allowed by the authority having jurisdiction, black iron pipe shall be installed at the furnace gas control valve and extend a minimum of 2 in. outside the furnace casing. A failure to follow this warning could result in fire, personal injury, or death.



WARNING:

Use the proper length of pipes to avoid stress on the gas control manifold. A failure to follow this warning can cause a gas leak resulting in a fire, explosion, personal injury, or death.



CAUTION:

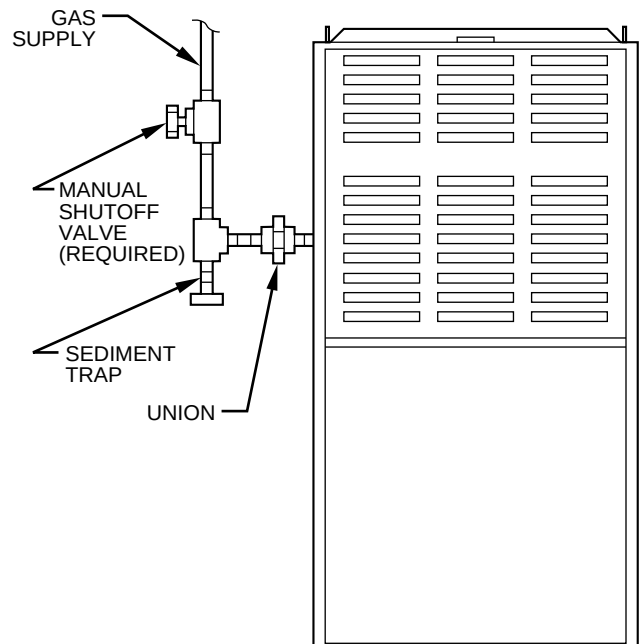
Use a backup wrench at the furnace gas control when connecting the gas pipe to the furnace to avoid damaging gas controls or manifold.



WARNING:

Never purge a line into a combustion chamber. Never use matches, candles, flame, or other sources of ignition for the purpose of checking leakage. Use a soap-and-water solution to check for leakage. A failure to follow this warning can cause a fire, explosion, personal injury, or death.

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. 11.)



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Fig. 11—Typical Gas Pipe Arrangement

Apply joint compound (pipe dope) sparingly and only to the male threads of each joint. The compound 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 is provided on the gas valve for test gage

TABLE 4—MAXIMUM CAPACITY OF GAS 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

* Cubic ft of gas per hr for gas pressures of 0.5 psig (14-in. wc) or less, and a supply line pressure drop of 0.5-in. wc (based on a 0.60 specific gravity gas). Ref: Table 10-2, NFGC.

connection. Installation of an additional 1/8-in. NPT plugged tapping, accessible for test gage connection, installed immediately upstream of the gas supply connection to the furnace and downstream of the manual shutoff valve, is not required. Place ground joint union between the gas control manifold and the manual shutoff valve.

Piping should be pressure tested in accordance with local and national plumbing and gas codes BEFORE furnace has been attached. If test pressure exceeds 0.5 psig (14-in. wc), gas supply pipe must be disconnected from furnace and capped before pressure test. If test pressure is equal to or less than 0.5 psig (14-in. wc), turn OFF electric shutoff switch on gas valve before test. It is recommended that ground joint union be loosened before pressure testing. After all connections have been made, purge lines and check for leakage with regulated gas supply pressure.

VI. ELECTRICAL CONNECTIONS

A. 115-v Wiring

Refer to the unit rating plate or Table 5 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 National Electrical Code (NEC) ANSI/NFPA 70-1999 and local codes or ordinances that apply. For Canadian installations, all electrical connections must be made in accordance with CSA C22.1 Canadian Electrical Code, or authorities having jurisdiction.

WARNING: The cabinet MUST have an uninterrupted or unbroken ground according to NEC ANSI/NFPA 70-1999 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. Failure to follow this warning could result in electrical shock, fire, or death.

The junction box can be moved to left-hand side of furnace when a left-hand side power supply is desired. Remove 2 screws holding the junction box. Mount junction box on left-hand side of furnace. Holes have been provided in casing. When moved, tuck wiring harness behind clip provided to keep extra wire lengths out of the way.

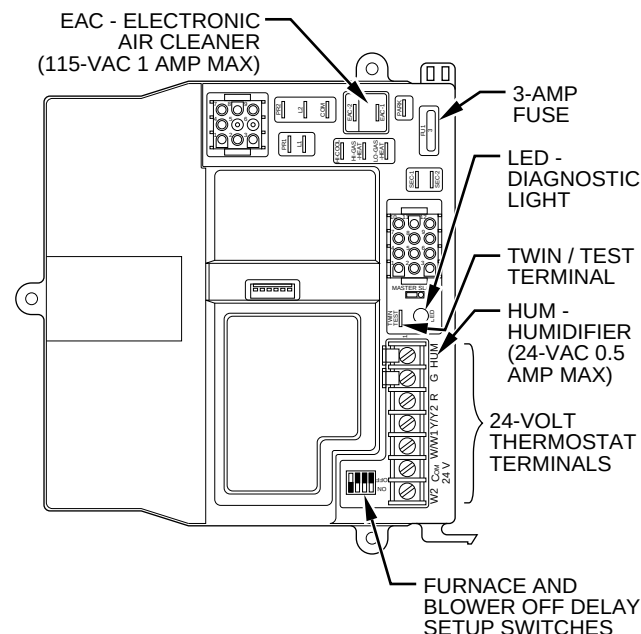
NOTE: Proper polarity must be maintained for 115-v wiring. If polarity is incorrect, the furnace control status LED will flash rapidly and prevent heating operation.

B. 24-v Wiring

Refer to ESD Precautions Procedure before proceeding with 24-v connections.

Make field 24-v connections at 24-v terminal block. (See Fig. 12.) Connect terminal Y/Y2 as shown in Fig. 13 or 14 for proper cooling operation. Use only AWG No. 18 or larger, color-coded copper thermostat wire.

The 24-v circuit contains an automotive-type, 3-amp fuse located on main control. Any 24-v 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 fuse needs replacement.



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Fig. 12—Furnace Control

C. Accessories

1. Electronic air cleaner (EAC)

A terminal block (EAC-1 [hot] and EAC-2 [neutral]) is provided for EAC connection. (See Fig. 12.) The terminals are energized with 115v, 1.0-amp maximum during blower motor operation.

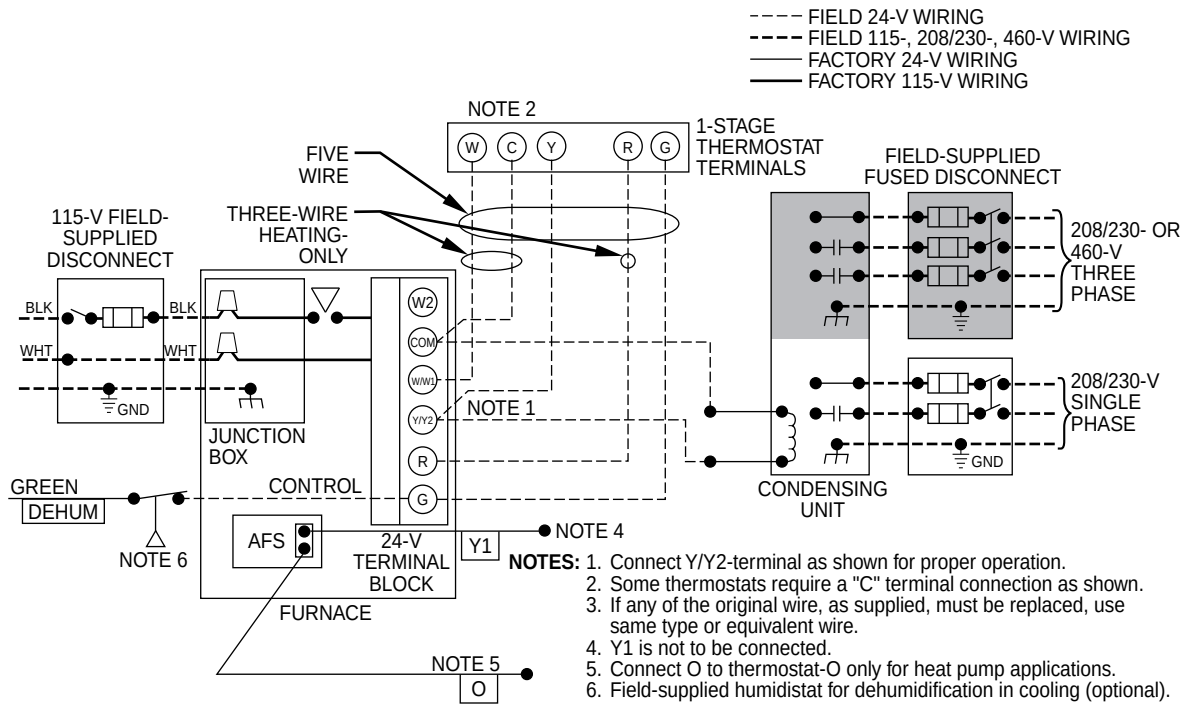
TABLE 5—ELECTRICAL DATA

UNIT SIZE	VOLTS— HERTZ— PHASE	OPERATING VOLTAGE RANGE		MAX UNIT AMPS	MIN WIRE GAGE	MAX WIRE LENGTH (FT)‡	MAX FUSE OR CKT BKR AMPS†
		Max*	Min*				
036060	115—60—1	127	104	10.1	14	36	15
048080	115—60—1	127	104	10.6	14	34	15
060100	115—60—1	127	104	12.6	14	29	15
060120	115—60—1	127	104	13.9	14	26	15

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

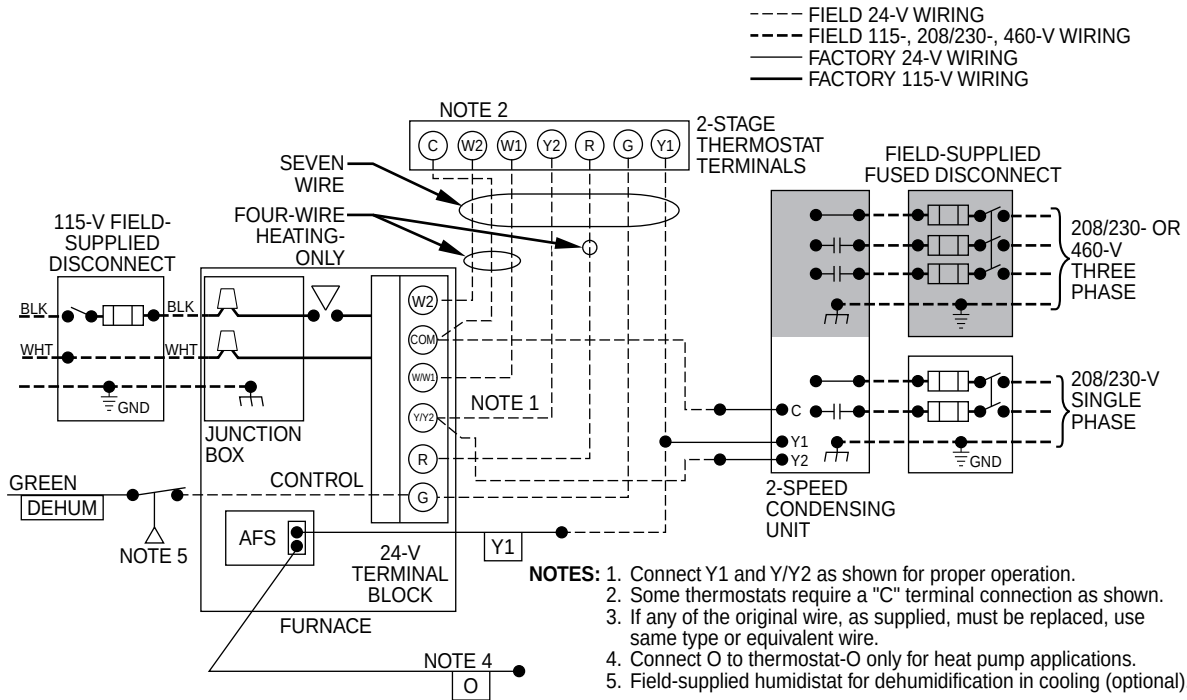
† Time-delay fuse is recommended.

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



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Fig. 13—Heating and Cooling Application Wiring Diagram: Single-Stage Thermostat and Single-Speed Condensing Unit



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Fig. 14—Heating and Cooling Application Wiring Diagram: Two-Stage Thermostat and Two-Speed Condensing Unit

2. Humidifier (HUM)

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

WARNING: Do not connect furnace control HUM terminal to HUM (humidifier) terminal on Thermostat™, Zone Controller, or similar device. See Thermostat, Zone Controller, thermostat, or controller manufacturer's instructions for proper connection. A failure to follow this warning could result in fire.

TABLE 6—SETUP SWITCH DESCRIPTION

SETUP SWITCH NO.	NORMAL POSITION	DESCRIPTION OF USE
SW-1 Only High-Gas Heat	OFF (Staged Gas Heat)	Turn switch on to obtain only 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 (Adaptive Mode)	OFF (Single-Stage Thermostat)	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 are closed.
SW-3 and SW4	OFF, ON	Switches control gas heating mode blower-off delay. (See Table 7.)

→ **NOTE:** A field-supplied, 115-v controlled relay connected to EAC terminals may be added, if humidifier operation is desired during blower operation.

VII. VENTING

→ Refer to the enclosed Installation Instructions, (Vent Tables For 1- and 2-Stage Category I Fan-Assisted Furnaces) for quick, easy reference and national or local code such as NFGC in the United States, or NSCNPIC in Canada, for proper vent sizing and installation requirements.

→ After fully assembling the vent connector to the furnace flue collar, securely fasten the vent connector to the collar with 2 field-supplied, corrosion-resistant, sheet metal screws located 180 degrees apart and midway up the collar.

The horizontal portion of the venting system shall maintain a minimum of 1/4-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.

VIII. 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 gas heating operation.

The gas service pressure must not exceed 0.5 psig (14-in. wc), and 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. Y/Y2 and G are required to be connected to the furnace for cooling and heat pumps. G is required for continuous-fan. Com 24v is required for some clock thermostats. These connections must be made at the 24-v terminal block on furnace control. (See Fig. 12.) O is required for heat pumps only. Y1 is required for 2-stage cooling and 2-stage heat pumps. The O and Y1 connectors must be made to the ICM2+ furnace's orange and blue leads, flagged "O" and "Y1," respectively.

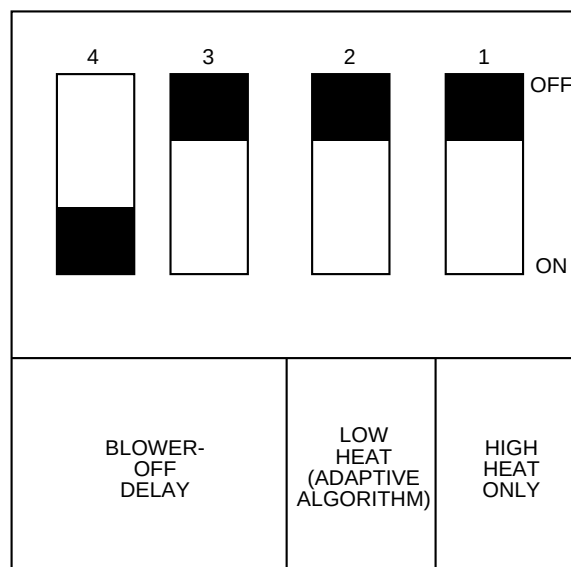
This furnace can be installed with either a single-stage heating or a 2-stage heating thermostat.

For single-stage thermostats, connect thermostat R to W/W1 at the furnace control terminal block. (See Fig. 13.) For single-stage thermostats, the control will determine, based on length of previous heating on and off cycles, when to operate in low- and high-stage for optimum comfort. Setup switch-2 (SW-2) must be in the factory-shipped OFF position. See Fig. 15 and Tables 6 and 7 for setup switch information.

If a 2-stage heating thermostat is to be used, move SW-2 to the ON position at end of furnace installation. This overrides built-in control process for selecting high- and low-stage and allows the 2-stage thermostat to select gas heating modes. The W2 from thermostat must be connected to W2 on control terminal block. (See Fig. 14.)

TABLE 7—BLOWER-OFF DELAY SETUP SWITCH (SW) POSITION

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



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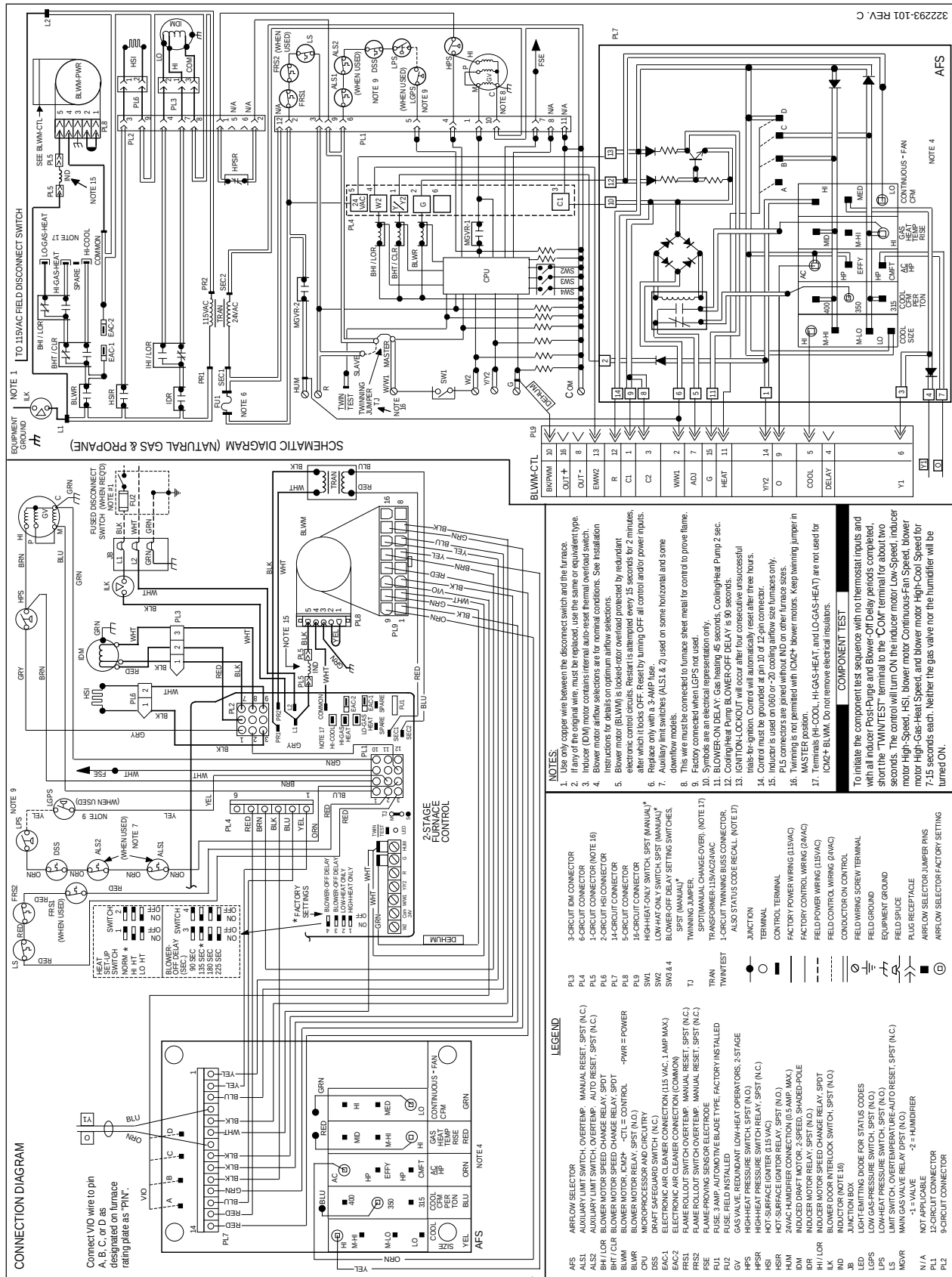
Fig. 15—Setup Switches on Furnace Control (Factory Settings)

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

→ Before operating furnace, check each manual reset switch for continuity. If necessary, press and release the button to reset switch. The blower compartment door must be in place to complete the 115-v circuit to furnace.

B. Sequence of Operation

Using schematic diagram in Fig. 16, follow the sequence of operation through the different modes. Read and follow diagram very carefully.



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NOTE: The GE ICM2+ BLWM speeds are infinitely variable from 300 to 1400 rpm and are dynamically controlled to precisely control airflow rate (CFM). The ICM2+ motor ramps to speed at a controlled rate to reduce start-up noise perception (4 to 11 sec, depending on the target CFM). The ICM2+ motor ramps down slowly to a stop in the same time as ramp-up time. ICM2+ ramp-up and ramp-down times are additive to blower-on and -off delays, respectively. The ICM2+ is 115-v energized whenever power is available at furnace control, but operates only when 24-v motor control input(s) are on.

NOTE: If a power interruption occurs during a call for heat (W/W1 or W/W1 and W2) and if the thermostat is still calling for gas heating, the control will start a 90-sec blower only on period 2 sec after power is restored. The red LED will flash code 12 during the 90-sec period, after which the LED will be on continuously as long as no faults are detected. The ICM2+ motor will operate at low-gas heat CFM after a power interruption in either low- or high-heat. After 90-sec period, furnace will respond to the thermostat normally.

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

1. Adaptive Heating Mode—Single-Stage Thermostat with 2-Stage Heating (See Fig. 13 for thermostat connections.)

NOTE: In response to thermostat call for heat R to W/W1, control selects high-heat heating only with HIGH HEAT ONLY switch (SW1) set to ON regardless of LOW HEAT switch (SW2) setting. With HIGH HEAT ONLY switch set to OFF, LOW HEAT switch selects either low-heat heating only mode when set to ON, or the adaptive heating mode when set to OFF in response to a thermostat call for heat R to W/W1. (See Tables 6 and 7, and Fig. 15 for description of switch settings or Fig. 16 for control circuit diagram.)

This furnace can operate as a 2-stage furnace with a single-stage thermostat because furnace control CPU includes a programmed adaptive sequence of controlled operation, which selects low- or high-gas heat operation. This selection is based upon the stored history of the lengths of previous gas heating on/off 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-heat, the control CPU determines low-heat on time (from 0 to 16 minutes) which is permitted before switching to high-heat.

If power is interrupted, the stored history is erased. When this happens, the control CPU selects low-heat for 16 minutes and then switches to high-heat, as long as the thermostat continues to call for heat. Subsequent selection is based on stored history of thermostat cycle times.

When thermostat calls for heat, R-W/W1 circuit closes. The furnace control performs a self-check, verifies that the pressure switch contacts for low- and high-heat (LPS and HPS) are open, and starts motor IDM in low speed or high speed as appropriate.

- a. Inducer prepurge period—A 15 sec prepurge period begins when LPS contacts close. For high-heat operation, both LPS and HPS must be closed. For low-heat operation, only LPS must be closed.
- b. Igniter warm-up—At end of the prepurge period, the HSI is energized for a 17-sec igniter warm-up period.
- c. Trial-for-ignition sequence—When igniter warm-up period is completed, the main gas valve relay contacts (MGVR-1 and -2) (and high-heat pressure switch relay HPSR for high-heat operation) close to energize low-

and high-heat gas valve solenoid(s) (GV) and humidifier terminal (HUM). The gas valve opens, and 24-v power is supplied for a field-installed humidifier at terminals HUM and COM 24v. The GV permits gas flow to the burners where it is ignited. After 5 sec, the HSI is de-energized, and a 2-sec flame-proving period begins.

If the HPS fails to close on a call for high-gas heat and LPS closes, the furnace operates at low-heat gas flow rate until HPS closes.

- d. Flame-proving—When burner flame is proved at flame-proving sensor electrode (FSE), the control CPU begins the blower-on delay period and continues to hold GV open. If burner flame is not proved within 2 sec, the control CPU closes GV, and the control CPU repeats the ignition sequence for up to 3 more trials-for-ignition before going to ignition lockout. The CONTROL TERMINATES LOCKOUT AUTOMATICALLY after 3 hr, or by momentarily interrupting 115-v power to furnace, or by interrupting 24-v power at SEC1 or SEC2 to the control CPU (not at W/W1, G, R, etc.). Opening thermostat R-W circuit will not terminate an ignition lockout.

If flame is proved when flame should not be present, the control CPU locks out of gas heating mode and operates IDM on high speed until flame is no longer proved.

- e. Blower-on delay—If burner flame is proved, 45 sec after GV is opened BLWM is energized at the appropriate heating airflow: low- or high-heat CFM. Simultaneously, the EAC terminals are energized with 115v and remain energized as long as BLWM is energized.
- f. Switching from low- to high-gas heat—If furnace control CPU switches from low- to high-heat, control CPU switches the IDM speed from low to high. The high-heat pressure switch relay (HPSR) closes. When IDM provides sufficient pressure to close HPS, the high-heat gas valve solenoid GV is energized. The BLWM switches to high-heat airflow 5 sec after the control CPU switches from low-gas heat to high-gas heat.
- g. Switching from high- to low-gas heat—The control CPU will not switch from high- to low-gas heat while the thermostat R-W circuit is closed when a single-stage thermostat is used.
- h. Blower-off delay—When the thermostat is satisfied, the R-W circuit is opened, the GV is de-energized, stopping gas flow to burners, and terminals HUM and COM 24v are de-energized. The IDM remains energized for a 5 sec post-purge period. The BLWM, which had been operating at low- or high-heat airflow, will operate at low-heat airflow for 90 sec.
 - (1.) When in low-gas heat and thermostat is satisfied, blower will continue to operate at low-gas heat CFM until the blower-off delay reaches 90 sec. If blower-off delay switches (on the 2-stage furnace control) are set for more than 90 sec, blower will operate at the selected continuous fan CFM for remaining blower-off delay time.
 - (2.) When in high-gas heat and thermostat is satisfied, blower will continue to operate at high-gas heat CFM until the blower-off delay expires, for all settings of the gas heat blower-off delay switches on the 2-stage furnace control.
- i. The furnace control is factory set for a 135-sec blower-off delay.

2. Non-Adaptive Heating Mode—Two-Stage Thermostat and 2-Stage Heating (See Fig. 14 for thermostat connections).

NOTE: In response to thermostat call for heat R to W/W1 and with HIGH HEAT ONLY switch SW1 set to OFF, the control selects low-heat only with LOW HEAT switch SW2 set to ON, or the control selects adaptive heating mode with LOW HEAT switch SW2 set to ON. The control selects high-heat only with HIGH-HEAT ONLY switch SW1 set to ON. In response to thermostat call for high-gas heat R to W1 and W2, the control selects high-heat regardless of switch SW1 and SW2 settings. See Tables 6 and 7, and Fig. 15 for description of switch settings or Fig. 16 for control circuit diagram.

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

- a. When thermostat calls for heat, the R-W/W1 circuit closes for low-gas heat or the R to W1-and-W2 circuits close for high-gas heat. The furnace control performs a self-check, verifies pressure switch contacts for low- and high-heat LPS and HPS are normally open, and starts IDM in low speed or high speed as appropriate.
- b. Switching from low- to high-gas heat—If the thermostat R-W/W1 circuit for low-gas heat is closed and the R-W2 circuit for high-gas heat closes, the control CPU switches IDM speed from low to high. The HPSR closes. When IDM provides sufficient pressure to close HPS, high-heat gas valve solenoid GV is energized. The BLWM switches to high-stage airflow 5 sec after R-W2 circuit closes.
- c. Switching from high- to low-gas heat—If thermostat R-W2 circuit for high-stage opens and R-W/W1 circuit for low-gas heat remains closed, the control CPU switches IDM speed from high to low. The HPSR opens to de-energize high-heat gas valve solenoid GV. When IDM reduces pressure sufficiently, HPS opens. The low-heat gas valve solenoid GV remains energized as long as LPS remains closed. The BLWM switches to low-heat airflow 5 sec after R-W2 circuit opens.

3. Cooling Mode

- a. Single-Speed Cooling Outdoor Unit (See Fig. 13 for thermostat connections.)
 - (1.) The thermostat closes R to G-and-Y circuits. The R-Y circuit starts outdoor unit, and R to G-and-Y/Y2 circuits start the furnace BLWM on cooling speed.
 - (2.) The EAC terminals are energized with 115v when BLWM is operating.
 - (3.) When thermostat is satisfied, the R to G-and-Y circuits are opened. The outdoor unit stops, and furnace BLWM continues operating at cooling airflow for an additional 90 sec.
- b. Two-Speed Cooling Outdoor Unit (See Fig. 14 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-Y/Y2 circuits for high cooling. The R to Y1 circuit operates the outdoor unit on low-cooling speed. The R to G-and-Y1 circuit operates the furnace BLWM at low-cooling airflow (65 percent of single-speed cooling airflow; different airflow than for low-gas heat). The R to Y1-and-Y2 circuits operate the outdoor unit on high-cooling airflow, and the R to G-and-Y/Y2-and-Y1 circuits operate furnace

BLWM at high-cooling airflow. Two-speed high-cooling airflow is 105 percent of single-speed cooling airflow.

NOTE: Y1 is found in the furnace and in the outdoor unit. The furnace control CPU controls BLWM airflow by sensing only G-and-Y1 for low-cooling airflow and G-and-Y1-and-Y/Y2 for high-cooling airflow.

- (2.) Terminals EAC-1 and EAC-2 are energized with 115v when the BLWM is operating on either cooling airflow.
- (3.) When the thermostat is satisfied, the R to G-and-Y1 or R to G-and-Y1-and-Y/Y2 circuits open. The outdoor unit stops, the furnace blower continues operating on same cooling airflow for an additional 90 sec.

4. Continuous-Blower Mode

- a. When R to G circuit is closed by the thermostat, BLWM operates at LOW, MED, or HI (50 percent, 65 percent, or 100 percent of single-speed cooling airflow; different than low-gas heat airflow). LOW, MED, and HI selections are described in Set-up Procedures. Terminals EAC-1 and EAC-2 are energized with 115v as long as the BLWM is operating.
- b. During a call for heat, the BLWM stops during igniter warm-up (17 sec), ignition (7 sec), and blower-on delay (45 sec), allowing the furnace heat exchangers to heat up quickly, after which the BLWM operates at the appropriate gas heating airflow.
- c. The BLWM reverts to continuous blower airflow after the heating cycle is completed. In high-gas heat, the furnace control CPU and ICM2+ motor control hold the BLWM at low-heat airflow for a 90-sec blower-off delay period (regardless of selected blower-off delay) before reverting to continuous-blower airflow.
- d. When thermostat "calls for low-cooling," the BLWM switches to low-cool airflow or the selected continuous-blower airflow, whichever is greater. Note that a HI selection for continuous-blower airflow will provide more than normal airflow during 2-speed low-cooling. When the thermostat is satisfied, the BLWM switches to continuous-blower airflow.
- e. When the thermostat calls for high cooling, the BLWM operates at high-cool airflow. When the thermostat is satisfied, BLWM operates an additional 2 sec at high-cool airflow before reverting back to continuous-blower airflow.
- f. When R-G circuit is opened, BLWM continues operating for an additional 90 sec, if no other function requires BLWM operation.

5. Heat Pump Mode

NOTE: A dual-fuel thermostat is required with single-speed heat pumps. See dual-fuel thermostat Installation Instructions for single-speed heat pump thermostat connections. No interface kit is needed for 2-speed heat pumps. See 2-speed heat pump Installation Instructions to determine whether a standard or dual-fuel heat pump thermostat is required and for thermostat connections.

a. Single-Speed Heat Pump Cooling

- (1.) The thermostat and interface kit close the R to Y/Y2-and-G-and-O circuits to operate the furnace BLWM at cooling airflow. The Y/Y2 input to the furnace control is necessary to provide adequate cooling airflow.

- (2.) Terminals EAC-1 and EAC-2 are energized with 115v when BLWM is operating.
- (3.) When thermostat is satisfied, furnace BLWM continues operating at cooling airflow for an additional 90 sec.

b. Two-Speed Heat Pump Cooling

- (1.) The thermostat R to G-and-Y1-and-O circuits operate the furnace BLWM at low-cool airflow. The thermostat R to G-and-Y/Y2-and-Y1-and-O circuits operate the furnace BLWM at high-cool airflow (105 percent of single-speed cooling airflow).

NOTE: The furnace control CPU controls blower airflow by sensing G, Y1, and O for low-cool airflow and G, Y1, Y/Y2, and O for 2-speed high-cool airflow.

- (2.) Terminals EAC-1 and EAC-2 are energized with 115v when the BLWM is operating at either cooling airflow.
- (3.) When the thermostat is satisfied, the furnace BLWM continues operating at the same cooling airflow for an additional 90 sec.

c. Single-Speed Heat Pump Heating

- (1.) The thermostat and accessory interface kit R to G-and-Y/Y2 circuits operate the furnace BLWM at heat pump heating airflow. Heating airflow is the same as cooling airflow for airflow selection HP-EFFY and 90 percent of cooling airflow for HP-CMFT selection.
- (2.) Terminals EAC-1 and EAC-2 are energized with 115v when the BLWM is operating.
- (3.) When thermostat is satisfied, the furnace BLWM continues operating at same heat pump heating airflow for an additional 90 sec.

d. Two-Speed Heat Pump Heating

- (1.) The thermostat closes R to Y1-and-G circuits for low heat and operates the furnace BLWM at heat pump low-heat airflow (may not be identical to low-cooling airflow, depending on HP selection at airflow selector). Closing R-Y/Y2, Y1 and G circuits to furnace provides BLWM heat pump high-heat airflow.

NOTE: The furnace control CPU controls BLWM airflow by sensing G and Y1 for heat pump low-heat airflow, and G, Y1, and Y/Y2 for heat pump high-heat airflow (105 percent of single-speed heating airflow).

- (2.) Terminals EAC-1 and EAC-2 are energized with 115v when BLWM is operating at either heating airflow.
- (3.) When the thermostat is satisfied, the furnace BLWM continues operating at same heating airflow for an additional 90 sec.
- (4.) Opening only R-Y/Y2 circuit switches BLWM to heat pump low-heat airflow.

6. Defrost

- a. When furnace control R to W/W1-and-Y/Y2 circuits are closed, furnace control CPU continues BLWM operation at heat pump heating airflow until the end of prepurge period, then shuts off until the end of HSI igniter-on period (22 sec).
- b. When installed with a heat pump, the furnace control CPU automatically holds the blower-off time to 22 sec during HSI igniter-on period. After 17 sec of the HSI

igniter-on period, a trial-for-ignition sequence occurs as described above for gas heating. After flame is proven and without a blower-on delay, BLWM then operates at high-gas-heat airflow during defrost. For both single-speed and 2-speed heat pumps, defrost mode is in high-gas heat only.

- c. When furnace control R-W/W1 circuit is opened, the furnace control CPU begins the normal inducer post-purge period and the BLWM continues operating for the blower-off delay period. If the R-G circuit remains closed, the BLWM reverts to continuous-blower operation.

C. Set-up Procedures

The ICM2+ blower motor operating mode selections are made on the airflow selector (AFS) control with color-coded jumper wires. The factory jumper settings have large bold circles marked around the pins. (See Fig. 17.)

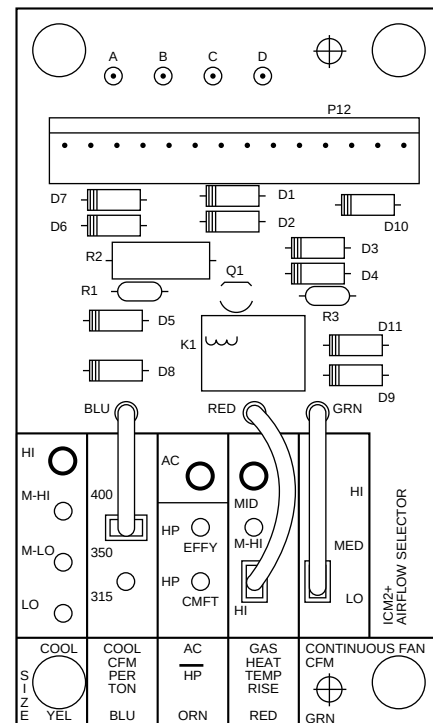


Fig. 17—Airflow Selector Control

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NOTE: The ICM2+ furnaces are not approved for twinning.

1. Gas Heating

- a. The VIOLET wire is factory connected to 1 of 4 pins: A, B, C, or D on airflow selector. The factory pin selection can be checked by noting PIN marking in lower right-hand corner of furnace rating plate.
- b. The gas heating air temperature rise is selected on airflow selector (See Figs. 16 and 17.) with RED and VIOLET jumper wires. The selections are MID, HI, and MED-HI. MID gives mid point of temperature rise range marked on rating plate. HI gives high end of temperature rise range. MID-HI gives temperature rise about halfway between MID and HI. Select the rise by moving WHITE connectors on RED and VIOLET jumper wires to desired pin positions. These settings select the rise for high and low heat. See Table 8 for air temperature rise.

2. Cooling and Heat Pump Heating

TABLE 8—GAS HEAT AIRFLOW—NOMINAL CFM AT UP TO 0.70-IN. W.C. ESP (WITH FILTER)

FURNACE SIZE	GAS HEAT TEMP RISE*		GAS HEAT TEMP RISE (°F)†		GAS HEAT AIRFLOW (CFM)	
	Jumper Position		High-Stage	Low-Stage	High-Stage	Low-Stage
	Red Wire	Violet Wire				
060	HI	A	51	45	925	615
	M-HI	A	46	38	1085	730
	MID	D	40	30	1250	1135
080	HI	A	58	44	970	790
	M-HI	A	51	39	1140	925
	MID	D	45	29	1310	1395
100**	HI	A	51	44	1430	1035
	M-HI	A	45	39	1685	1215
	MID	D	40	30	1935	1630
120**	HI	A	69	49	1330	1240
	M-HI	A	59	43	1560	1460
	MID	D	55	40	1720	1605

*Use listed jumper position combinations only.

†Within ± 2°F

→ ** Air delivery may be reduced by as much as 3% when using a single side return.

- a. The cooling and heat pump selections can be determined from Tables 9 and 10. The selections are made by moving the WHITE connector on appropriately colored jumper wire to desired pin position.

NOTE: Power must be cycled off and then on for the cool size selection to take effect. Power need not be cycled off and on for the CFM/TON to take effect.

- b. The YELLOW COOL SIZE jumper is used to select airflow to match the needed tons for the cooling or heat pump system. The BLUE CFM/TON jumper is used to select a slight adjustment to airflow. The traditional CFM per ton is 400 for cooling and heat pump airflow. 350 CFM per ton is the airflow used to attain best efficiency with these units. 315 CFM per ton is the airflow used for improved dehumidification and/or with undersized ducts. Additional humidity control can be attained by using a humidistat. (See Set-up Procedures section, item 4.)
- c. The ORANGE jumper wire selects airflow for cooling-only (AC) or heat pump heating and cooling, and selects heat pump heating best efficiency (HP EFFY) or enhanced comfort (HP CMFT). HP EFFY provides the same heating airflow as used for cooling. HP CMFT reduces the heating airflow to 90 percent of the cooling airflow for a higher air temperature rise and better comfort.

3. Continuous-fan

The GREEN jumper wire selects airflow CFM for continuous-fan. LO provides 50 percent of airflow used for single-speed cooling or 2-speed cooling. MED provides 65 percent of cooling airflow. HI provides 100 percent of cooling airflow for continuous-fan operation.

NOTE: If HI is selected with a 2-speed cooling or heat pump system, the airflow will remain at 100 percent of high-cooling/heating when the system is in low-cool and heat pump low-heat mode. Continuous-fan selection has no effect on gas-heating airflow.

4. As an alternative to selecting 315 CFM per ton for cooling airflow, additional dehumidification on demand can be achieved with use of a field-supplied humidistat. Remove the factory-installed GREEN wire marked DEHUM from the 1/4-in. quick-connect at the G terminal on furnace control. Connect a humidistat that opens-on-humidity-rise

between the green wire marked DEHUM and the G terminal on the furnace control. When humidistat contacts open, airflow will be reduced to 80 percent of selected airflow, but not less than 280 CFM per ton.

→ The humidistat may be located in the return air duct or the conditioned space. Follow instructions included with humidistat.

NOTE: When a humidistat is calling for reduced airflow and the thermostat is satisfied, blower will not operate on continuous-fan LOW setting to prevent re-evaporation of condensate at the evaporator coil. When continuous-fan MED or HI setting is selected, normal airflow will be reduced to 80 percent.

D. 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 all time delays have expired. Short the TWIN/TEST terminal to ground or Com 24v for 1 to 4 sec. (See Fig. 14.)

NOTE: The component test feature will not operate if the control is receiving any thermostat signals or until all time delays have expired. The ICM2+ blower motor speed ramp-up will slightly delay blower response times.

The component test sequence is as follows:

- a. The furnace control checks itself, operates the inducer motor on low speed for 7 sec and on high speed for 7 sec, then stops.
- b. The hot surface igniter is energized for 15 sec, then de-energized.
- c. The blower motor operates at continuous-fan airflow for 7 sec then stops.
- d. The blower motor operates at high-gas heat airflow for 7 sec. The gas valve and humidifier terminal HUM are not energized for safety reasons.
- e. The blower motor operates at single-speed cooling/heat pump heating airflow (or 2-speed heat pump high-heat/high-cooling) for 7 sec, then stops.

NOTE: The EAC terminals are energized when the blower is energized.

2. After all connections have been made, purge gas lines and check for leaks.

**TABLE 9— COOLING AND HEAT PUMP EFFICIENCY HEATING AIRFLOW NOMINAL CFM
AT UP TO 0.70-IN. W.C. ESP† (WITH FILTER)**

AC/HP JUMPER POSITION:		AC HP—EFFY HP—CFMT	AIR CONDITIONING, COOLING AIRFLOW HEAT PUMP—EFFICIENCY, COOLING AND HEATING AIRFLOW HEAT PUMP—COMFORT, COOLING AIRFLOW								
Furnace Size	Airflow Selection		Single-Speed CFM			Two-Speed (High/Low) CFM					
	Cool Size Jumper Position	Tons	Cool CFM Per Ton Jumper Position			Cool CFM Per Ton Jumper Position					
						400		350		315	
			400	350	315	High	Low	High	Low	High	Low
060	LO	1-1/2	600	530	500*	630	500*	550	500*	500*	500*
	M-LO	2	800	700	630	865	510	735	500*	660	500*
	M-HI	2-1/2	1000	880	790	1060	650	920	570	825	510
	HI	3	1200	1050	945	1260	780	1100	680	990	585
080	LO	2-1/2	1000	875	790	1050	660	920	595	830	545
	M-LO	3	1215	1050	945	1260	790	1100	700	990	625
	M-HI	3-1/2	1400	1225	1100	1470	910	1280	805	1155	715
	HI	4	1600†	1400	1350	1635†	1040	1470	915	1325	820
100**	LO	3	1195	1045	950	1260	780	1090	775	990	700*
	M-LO	3-1/2	1400	1225	1090	1470	910	1285	830	1155	715
	M-HI	4	1600	1400	1260	1680	1040	1465	915	1325	820
	HI	5	2000	1750	1575	2085	1300	1840	1150	1655	1025
120**	LO	3	1160	1050	955	1195	865	1085	785	985	785
	M-LO	3-1/2	1400	1220	1090	1420	970	1265	875	1150	845
	M-HI	4	1600	1395	1250	1650	1070	1465	975	1315	930
	HI	5	2000	1750	1565	2110	1300	1865	1140	1640	1080

* Minimum airflow is set for use with electronic air cleaner: 060—500 CFM, 080—500 CFM, 100—700 CFM, 120—700 CFM

→ † Maximum available external static pressure is 0.70-in. w.c. for all furnace model sizes and operating modes, except maximum available external static pressure is 0.50-in. w.c. for HI cool size airflow at 400 CFM per ton selection with the 080 size furnace.

→ ** Air delivery may be reduced by as much as 3% when using a single side return.

NOTES:

1. A humidistat can be added to reduce airflow for better dehumidification when needed. This feature reduces the selected cooling airflow by 20% (280 CFM per ton limit).
2. Continuous-fan settings are 50%, 65%, or 100% of selected cooling airflow.

TABLE 10—HEAT PUMP COMFORT HEATING NOMINAL CFM AT UP TO 0.70-IN. W.C. ESP (WITH FILTER)

AC/HP JUMPER POSITION:		HP—CMFT	HEAT PUMP—COMFORT, HEATING AIRFLOW								
Furnace Size	Airflow Selection		Single-Speed CFM			Two-Speed (High/Low) CFM					
	Cool Size Jumper Position	Tons	Cool CFM Per Ton Jumper Position			Cool CFM Per Ton Jumper Position					
						400		350		315	
			400	350	315	HIGH	LOW	HIGH	LOW	HIGH	LOW
060	LO	1-1/2	540	500*	500*	565	500*	500*	500*	500*	500*
	M-LO	2	720	630	570	780	500*	660	500*	595	500*
	M-HI	2-1/2	900	790	710	945	585	830	515	740	500*
	HI	3	1080	945	855	1135	700	990	610	895	555
080	LO	2-1/2	900	785	710	945	605	825	535	755	500*
	M-LO	3	1080	945	850	1135	715	990	630	895	560
	M-HI	3-1/2	1260	1100	990	1325	830	1150	725	1040	655
	HI	4	1440	1260	1135	1510	940	1325	825	1190	740
100**	LO	3	1075	940	855	1130	700	980	700	890	700*
	M-LO	3-1/2	1260	1100	990	1325	820	1155	750	1040	700*
	M-HI	4	1440	1260	1130	1510	935	1320	825	1190	740
	HI	5	1800	1575	1420	1890	1170	1655	1035	1490	920
120**	LO	3	1045	945	860	1075	780	975	750	885	750
	M-LO	3-1/2	1260	1100	980	1280	875	1140	790	1035	760
	M-HI	4	1440	1255	1125	1485	965	1320	880	1185	835
	HI	5	1800	1575	1410	1900	1170	1650	1025	1475	970

* Minimum airflow is set for electronic air cleaner: 060—500 CFM, 080—500 CFM, 100—700 CFM, 120—700 CFM

→ ** Air delivery may be reduced by as much as 3% when using a single side return.

NOTES:

1. A humidistat can be added to reduce airflow for better dehumidification when needed. This feature reduces the selected cooling airflow by 20% (280 CFM per ton limit).
2. Continuous-fan settings are 50%, 65%, or 100% of selected cooling airflow.

⚠	WARNING: Never purge a gas line into a combustion chamber. Never use matches, candles, flame, or other sources of ignition for the purpose of checking leakage. Use a soap-and-water solution to check for leakage. A failure to follow this warning can cause a fire, explosion, personal injury, or death.
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3. To operate furnace, follow procedures on operating instructions 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.

E. Adjustments

1. Set gas input rate.

→ The gas input rate must be set for both high- and low-stage heat. Each adjustment is made independently at the gas control regulators. The gas valve regulator has been nominally set at 1.5-in. wc for low-stage and 3.5-in. wc for high-stage for natural gas.

Furnace gas input rate on rating plate is for installations at altitudes up to 2000 ft.

In the U.S.A., input rating for altitudes above 2000 ft must be reduced by 4 percent for each 1000 ft above sea level.

In Canada, input rating must be derated by 10 percent for altitudes of 2000 ft to 4500 ft above sea level.

Furnace input rate must be within ± 2 percent of input on furnace rating plate.

2. Determine natural gas orifice size and manifold pressure for correct input.
 - a. Obtain yearly gas heat value average (at installed altitude) from local gas supplier.
 - b. Obtain yearly gas specific gravity average from local gas supplier.
 - c. Verify furnace model. Table 11 can only be used for model 333BAV and 333JAV Furnaces.
 - d. Find installation altitude in Table 11.

NOTE: For Canada altitudes of 2000 to 4500 ft, use U.S.A. altitudes of 2001 to 3000 ft in Table 11.

- e. Find closest natural gas heat value and specific gravity in Table 11.
- f. Follow heat value and specific gravity lines to point of intersection to find orifice size and low- and high-heat manifold pressure settings for proper operation.

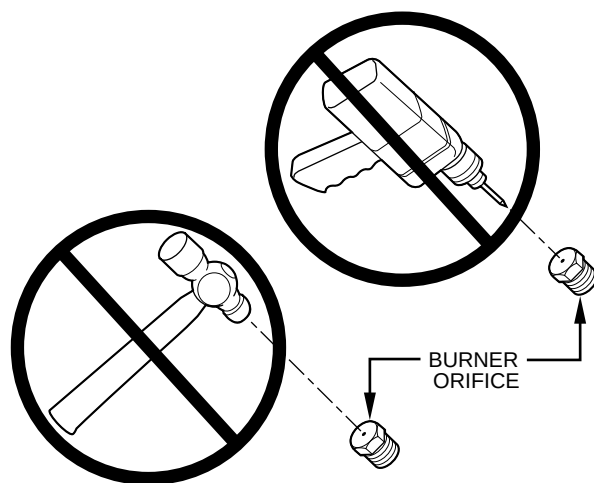
EXAMPLE: (0—2000 ft altitude)
 Heating value = 1075 Btu/cu ft
 Specific gravity = 0.62
 Therefore: Orifice No. 45
 Manifold pressure: 3.4-in. wc for high heat
 1.4-in. wc for low heat
 * Furnace is shipped with No. 45 orifices.
 In this example, all main burner orifices are the correct size and do not need to be changed to obtain proper input rate.

- g. Check and verify burner orifice size in furnace. NEVER ASSUME ORIFICE SIZE; ALWAYS CHECK AND VERIFY.
3. Adjust manifold pressure to obtain input rate.
 - a. Remove caps that conceal adjustment screws for low- and high-heat gas valve regulators. (See Fig. 18.)

- b. Move setup switch SW-2 on control to ON position. (See Fig. 15.) This keeps furnace locked in low-heat operation.
- c. Jumper R and W/W1 thermostat connections on control to start furnace.
- d. Turn low-heat adjusting screw (5/64 hex Allen wrench) counterclockwise (out) to decrease input rate or clockwise (in) to increase input rate.

NOTE: DO NOT set low-heat 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.

⚠	CAUTION: DO NOT bottom out gas valve regulator adjusting screw. This can result in unregulated manifold pressure and result in excess overfire and heat exchanger failures.
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⚠	CAUTION: DO NOT redrill orifices. Improper drilling (burrs, out-of-round holes, etc.) can cause excessive burner noise and misdirection of burner flames. This can result in flame impingement of burners and heat exchangers, causing failures.
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NOTE: If orifice hole appears damaged or it is suspected to have been redrilled, check orifice hole with a numbered drill bit of correct size. Never redrill an orifice. A burr-free and squarely aligned orifice hole is essential for proper flame characteristics.

- e. Move setup switch SW-2 to OFF position after completing low-heat adjustment.
 - f. Jumper R and W2 thermostat connections on control center. (See Fig. 14.) This keeps furnace locked in high-heat operation.
 - g. Turn high-heat adjusting screw (5/64 hex Allen wrench) counterclockwise (out) to decrease input rate or clockwise (in) to increase rate.
- NOTE:** DO NOT set high-heat 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.
- h. When correct input is obtained, replace caps that conceal gas valve regulator adjustment screws. Main burner flame should be clear blue, almost transparent. (See Fig. 19.)
 - i. Remove jumper R to W2.

**TABLE 11—MODEL 333BAV AND 333JAV ORIFICE SIZE* AND MANIFOLD PRESSURE FOR CORRECT INPUT
(TABULATED DATA BASED ON 20,000 BTUH HIGH HEAT/13,000 BTUH LOW HEAT PER BURNER
DERATED 4% FOR EACH 1000 FT ABOVE SEA LEVEL)**

ALTITUDE RANGE (FT)		AVG GAS HEAT VALUE AT ALTITUDE (BTU/CU FT)	SPECIFIC GRAVITY OF NATURAL GAS									
			0.58		0.60		0.62		0.64		0.66	
			Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low
U.S.A. and Canada	0 to 2000	850	43	3.7/1.5	43	3.8/1.6	42	3.2/1.4	42	3.3/1.4	42	3.4/1.4
		875	43	3.5/1.5	43	3.6/1.5	43	3.7/1.6	43	3.8/1.6	42	3.2/1.4
		900	44	3.7/1.6	43	3.4/1.4	43	3.5/1.5	43	3.6/1.5	43	3.7/1.6
		925	44	3.5/1.5	44	3.7/1.6	44	3.8/1.6	43	3.4/1.4	43	3.5/1.5
		950	44	3.4/1.4	44	3.5/1.5	44	3.6/1.5	44	3.7/1.6	44	3.8/1.6
		975	44	3.2/1.3	44	3.3/1.4	44	3.4/1.4	44	3.5/1.5	44	3.6/1.5
		1000	45	3.7/1.6	45	3.8/1.6	44	3.2/1.4	44	3.4/1.4	44	3.5/1.5
		1025	45	3.5/1.5	45	3.6/1.5	45	3.7/1.6	44	3.2/1.3	44	3.3/1.4
		1050	45	3.3/1.4	45	3.4/1.5	45	3.6/1.5	45	3.7/1.6	45	3.8/1.6
		1075	45	3.2/1.3	45	3.3/1.4	45	3.4/1.4	45	3.5/1.5	45	3.6/1.5
		1100	47	3.6/1.5	47	3.7/1.6	45	3.2/1.4	45	3.4/1.4	45	3.5/1.5
ALTITUDE RANGE (FT)		AVG GAS HEAT VALUE AT ALTITUDE (BTU/CU FT)	SPECIFIC GRAVITY OF NATURAL GAS									
			0.58		0.60		0.62		0.64		0.66	
			Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low
U.S.A. and Canada	U.S.A. Altitudes 2001 to 3000 or Canada Altitudes 2000 to 4500	775	43	3.4/1.4	43	3.5/1.5	43	3.6/1.5	43	3.7/1.6	43	3.8/1.6
		800	44	3.6/1.5	44	3.8/1.6	43	3.4/1.4	43	3.5/1.5	43	3.6/1.5
		825	44	3.4/1.4	44	3.5/1.5	44	3.7/1.5	44	3.8/1.6	43	3.4/1.4
		850	44	3.2/1.4	44	3.3/1.4	44	3.4/1.5	44	3.6/1.5	44	3.7/1.5
		875	45	3.7/1.6	45	3.8/1.6	44	3.2/1.4	44	3.4/1.4	44	3.5/1.5
		900	45	3.5/1.5	45	3.6/1.5	45	3.7/1.6	45	3.8/1.6	44	3.3/1.4
		925	45	3.3/1.4	45	3.4/1.4	45	3.5/1.5	45	3.6/1.5	45	3.7/1.6
		950	47	3.7/1.6	45	3.2/1.4	45	3.3/1.4	45	3.4/1.5	45	3.6/1.5
		975	47	3.5/1.5	47	3.6/1.5	45	3.2/1.3	45	3.3/1.4	45	3.4/1.4
		1000	48	3.8/1.6	47	3.5/1.5	47	3.6/1.5	47	3.7/1.6	45	3.2/1.4
		1025	48	3.6/1.5	48	3.8/1.6	47	3.4/1.4	47	3.5/1.5	47	3.6/1.5
ALTITUDE RANGE (FT)		AVG GAS HEAT VALUE AT ALTITUDE (BTU/CU FT)	SPECIFIC GRAVITY OF NATURAL GAS									
			0.58		0.60		0.62		0.64		0.66	
			Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low
U.S.A. Only	3001 to 4000	750	44	3.6/1.5	44	3.8/1.6	43	3.4/1.4	43	3.5/1.5	43	3.6/1.5
		775	44	3.4/1.4	44	3.5/1.5	44	3.6/1.5	44	3.8/1.6	43	3.4/1.4
		800	44	3.2/1.4	44	3.3/1.4	44	3.4/1.4	44	3.5/1.5	44	3.6/1.5
		825	45	3.6/1.5	45	3.8/1.6	44	3.2/1.4	44	3.3/1.4	44	3.4/1.4
		850	45	3.4/1.4	45	3.5/1.5	45	3.7/1.5	45	3.8/1.6	44	3.2/1.4
		875	45	3.2/1.4	45	3.3/1.4	45	3.5/1.5	45	3.6/1.5	45	3.7/1.6
		900	47	3.6/1.5	45	3.2/1.3	45	3.3/1.4	45	3.4/1.4	45	3.5/1.5
		925	47	3.4/1.5	47	3.6/1.5	47	3.7/1.6	45	3.2/1.4	45	3.3/1.4
		950	48	3.7/1.6	48	3.8/1.6	47	3.5/1.5	47	3.6/1.5	47	3.7/1.6
		975	48	3.5/1.5	48	3.7/1.5	48	3.8/1.6	47	3.4/1.4	47	3.5/1.5
		1000	48	3.4/1.4	48	3.5/1.5	48	3.6/1.5	48	3.7/1.6	48	3.8/1.6

* Orifice numbers shown in **BOLD** are factory installed.

TABLE 11—MODEL 333BAV AND 333JAV ORIFICE SIZE* AND MANIFOLD PRESSURE FOR CORRECT INPUT (Continued)
(TABULATED DATA BASED ON 20,000 BTUH HIGH HEAT/13,000 BTUH LOW HEAT PER BURNER
DERATED 4% FOR EACH 1000 FT ABOVE SEA LEVEL)

ALTITUDE RANGE (FT)		AVG GAS HEAT VALUE AT ALTITUDE (BTU/CU FT)	SPECIFIC GRAVITY OF NATURAL GAS									
			0.58		0.60		0.62		0.64		0.66	
			Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low
U.S.A. Only	4001 to 5000	725	44	3.4/1.4	44	3.5/1.5	44	3.6/1.5	44	3.8/1.6	43	3.4/1.4
		750	44	3.2/1.3	44	3.3/1.4	44	3.4/1.4	44	3.5/1.5	44	3.6/1.5
		775	45	3.6/1.5	45	3.7/1.6	44	3.2/1.3	44	3.3/1.4	44	3.4/1.4
		800	45	3.4/1.4	45	3.5/1.5	45	3.6/1.5	45	3.7/1.6	44	3.2/1.3
		825	45	3.2/1.3	45	3.3/1.4	45	3.4/1.4	45	3.5/1.5	45	3.6/1.5
		850	47	3.6/1.5	47	3.7/1.6	45	3.2/1.4	45	3.3/1.4	45	3.4/1.4
		875	48	3.8/1.6	47	3.5/1.5	47	3.6/1.5	47	3.7/1.6	45	3.2/1.4
		900	48	3.6/1.5	48	3.8/1.6	47	3.4/1.4	47	3.5/1.5	47	3.6/1.5
		925	48	3.4/1.5	48	3.6/1.5	48	3.7/1.6	48	3.8/1.6	47	3.4/1.5
		950	49	3.8/1.6	48	3.4/1.4	48	3.5/1.5	48	3.6/1.5	48	3.7/1.6
ALTITUDE RANGE (FT)		AVG GAS HEAT VALUE AT ALTITUDE (BTU/CU FT)	SPECIFIC GRAVITY OF NATURAL GAS									
			0.58		0.60		0.62		0.64		0.66	
			Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low
U.S.A. Only	5001 to 6000	700	44	3.2/1.3	44	3.3/1.4	44	3.4/1.4	44	3.5/1.5	44	3.6/1.5
		725	45	3.6/1.5	45	3.7/1.6	45	3.8/1.6	44	3.3/1.4	44	3.4/1.4
		750	45	3.4/1.4	45	3.5/1.5	45	3.6/1.5	45	3.7/1.6	45	3.8/1.6
		775	45	3.2/1.3	45	3.3/1.4	45	3.4/1.4	45	3.5/1.5	45	3.6/1.5
		800	47	3.5/1.5	47	3.6/1.5	45	3.2/1.3	45	3.3/1.4	45	3.4/1.4
		825	48	3.8/1.6	47	3.4/1.4	47	3.5/1.5	47	3.7/1.5	45	3.2/1.3
		850	48	3.6/1.5	48	3.7/1.6	48	3.8/1.6	47	3.4/1.5	47	3.5/1.5
		875	48	3.4/1.4	48	3.5/1.5	48	3.6/1.5	48	3.7/1.6	48	3.8/1.6
		900	49	3.7/1.6	49	3.8/1.6	48	3.4/1.4	48	3.5/1.5	48	3.6/1.5
		925	49	3.5/1.5	49	3.6/1.5	49	3.8/1.6	48	3.3/1.4	48	3.4/1.4
		950	49	3.3/1.4	49	3.5/1.5	49	3.6/1.5	49	3.7/1.6	49	3.8/1.6
		975	50	3.7/1.6	49	3.3/1.4	49	3.4/1.4	49	3.5/1.5	49	3.6/1.5
		1000	50	3.6/1.5	50	3.7/1.6	50	3.8/1.6	49	3.3/1.4	49	3.4/1.4
ALTITUDE RANGE (FT)		AVG GAS HEAT VALUE AT ALTITUDE (BTU/CU FT)	SPECIFIC GRAVITY OF NATURAL GAS									
			0.58		0.60		0.62		0.64		0.66	
			Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low
U.S.A. Only	6001 to 7000	650	44	3.2/1.4	44	3.3/1.4	44	3.4/1.4	44	3.5/1.5	44	3.6/1.5
		675	45	3.6/1.5	45	3.7/1.6	45	3.8/1.6	44	3.3/1.4	44	3.4/1.4
		700	45	3.3/1.4	45	3.5/1.5	45	3.6/1.5	45	3.7/1.6	45	3.8/1.6
		725	47	3.7/1.6	45	3.2/1.4	45	3.3/1.4	45	3.4/1.5	45	3.5/1.5
		750	47	3.5/1.5	47	3.6/1.5	47	3.7/1.6	45	3.2/1.4	45	3.3/1.4
		775	48	3.7/1.6	48	3.8/1.6	47	3.5/1.5	47	3.6/1.5	47	3.7/1.6
		800	48	3.5/1.5	48	3.6/1.5	48	3.7/1.6	48	3.8/1.6	47	3.5/1.5
		825	49	3.8/1.6	48	3.4/1.4	48	3.5/1.5	48	3.6/1.5	48	3.7/1.6
		850	49	3.6/1.5	49	3.7/1.6	48	3.3/1.4	48	3.4/1.4	48	3.5/1.5
		875	49	3.4/1.4	49	3.5/1.5	49	3.6/1.5	49	3.8/1.6	48	3.3/1.4

* Orifice numbers shown in **BOLD** are factory installed.

TABLE 11—MODEL 333BAV AND 333JAV ORIFICE SIZE* AND MANIFOLD PRESSURE FOR CORRECT INPUT (Continued)
(TABULATED DATA BASED ON 20,000 BTUH HIGH HEAT/13,000 BTUH LOW HEAT PER BURNER
DERATED 4% FOR EACH 1000 FT ABOVE SEA LEVEL)

ALTITUDE RANGE (FT)		AVG GAS HEAT VALUE AT ALTITUDE (BTU/CU FT)	SPECIFIC GRAVITY OF NATURAL GAS									
			0.58		0.60		0.62		0.64		0.66	
			Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low
U.S.A. Only	7001 to 8000	625	45	3.6/1.5	45	3.7/1.6	44	3.2/1.3	44	3.3/1.4	44	3.4/1.4
		650	45	3.3/1.4	45	3.5/1.5	45	3.6/1.5	45	3.7/1.6	45	3.8/1.6
		675	47	3.7/1.6	45	3.2/1.4	45	3.3/1.4	45	3.4/1.4	45	3.5/1.5
		700	47	3.4/1.4	47	3.5/1.5	47	3.7/1.5	45	3.2/1.3	45	3.3/1.4
		725	48	3.6/1.5	48	3.8/1.6	47	3.4/1.4	47	3.5/1.5	47	3.6/1.5
		750	48	3.4/1.4	48	3.5/1.5	48	3.6/1.5	48	3.8/1.6	47	3.4/1.4
		775	49	3.7/1.6	48	3.3/1.4	48	3.4/1.4	48	3.5/1.5	48	3.6/1.5
		800	49	3.5/1.5	49	3.6/1.5	49	3.8/1.6	48	3.3/1.4	48	3.4/1.4
		825	49	3.3/1.4	49	3.4/1.4	49	3.5/1.5	49	3.6/1.5	49	3.8/1.6
		850	50	3.7/1.6	50	3.8/1.6	49	3.3/1.4	49	3.4/1.4	49	3.5/1.5
ALTITUDE RANGE (FT)		AVG GAS HEAT VALUE AT ALTITUDE (BTU/CU FT)	SPECIFIC GRAVITY OF NATURAL GAS									
			0.58		0.60		0.62		0.64		0.66	
			Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low
U.S.A. Only	8001 to 9000	600	45	3.4/1.4	45	3.5/1.5	45	3.6/1.5	45	3.7/1.6	45	3.8/1.6
		625	47	3.7/1.6	45	3.2/1.4	45	3.3/1.4	45	3.4/1.4	45	3.5/1.5
		650	47	3.4/1.4	47	3.5/1.5	47	3.6/1.5	45	3.2/1.3	45	3.3/1.4
		675	48	3.6/1.5	48	3.7/1.6	48	3.8/1.6	47	3.5/1.5	47	3.6/1.5
		700	48	3.3/1.4	48	3.5/1.5	48	3.6/1.5	48	3.7/1.6	48	3.8/1.6
		725	49	3.7/1.5	49	3.8/1.6	48	3.3/1.4	48	3.4/1.5	48	3.5/1.5
		750	49	3.4/1.4	49	3.5/1.5	49	3.7/1.5	49	3.8/1.6	48	3.3/1.4
		775	50	3.8/1.6	49	3.3/1.4	49	3.4/1.4	49	3.5/1.5	49	3.6/1.5
		800	50	3.6/1.5	50	3.7/1.6	50	3.8/1.6	49	3.3/1.4	49	3.4/1.4
ALTITUDE RANGE (FT)		AVG GAS HEAT VALUE AT ALTITUDE (BTU/CU FT)	SPECIFIC GRAVITY OF NATURAL GAS									
			0.58		0.60		0.62		0.64		0.66	
			Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low	Orifice No.	Manifold Pressure High/Low
U.S.A. Only	9001 to 10,000	575	47	3.7/1.6	45	3.2/1.4	45	3.3/1.4	45	3.4/1.4	45	3.5/1.5
		600	47	3.4/1.4	47	3.5/1.5	47	3.6/1.5	47	3.7/1.6	45	3.2/1.4
		625	48	3.6/1.5	48	3.7/1.6	48	3.8/1.6	47	3.5/1.5	47	3.6/1.5
		650	48	3.3/1.4	48	3.4/1.4	48	3.5/1.5	48	3.6/1.5	48	3.7/1.6
		675	49	3.6/1.5	49	3.7/1.6	49	3.8/1.6	48	3.4/1.4	48	3.5/1.5
		700	49	3.3/1.4	49	3.4/1.5	49	3.6/1.5	49	3.7/1.6	49	3.8/1.6
		725	50	3.7/1.6	50	3.8/1.6	49	3.3/1.4	49	3.4/1.4	49	3.5/1.5
		750	50	3.4/1.5	50	3.6/1.5	50	3.7/1.6	50	3.8/1.6	49	3.3/1.4
775	51	3.8/1.6	50	3.3/1.4	50	3.4/1.5	50	3.5/1.5	50	3.7/1.5		

* Orifice numbers shown in **BOLD** are factory installed.

4. Verify natural gas input rate by clocking gas meter.
 - a. Calculate high-altitude adjustment (if required).

UNITED STATES

At altitudes above 2000 ft, this furnace has been approved for a 4 percent derate for each 1000 ft above sea level. See Table 13 for derate multiplier factor and example.

EXAMPLE:

85,000 Btuh input furnace installed at 4300 ft.

Furnace Input Rate at Sea Level	X	Derate Multiplier Factor	=	Furnace Input Rate at Installation Altitude
85,000	X	0.82	=	69,700

CANADA

At installation altitudes from 2000 to 4500 ft, this furnace must be derated 10 percent by an authorized Gas Conversion Station or Dealer. To determine correct input rate for altitude, see example above and use 0.90 as derate multiplier factor.

- b. Check that gas valve adjustment caps are in place for proper input to be clocked.
- c. Obtain yearly gas heat value average for local gas supply.

NOTE: Be sure heating value of gas used for calculations is correct for your altitude. Consult local gas utility for altitude adjustment of gas heating value.

- d. Check and verify orifice size in furnace. NEVER ASSUME THE ORIFICE SIZE. ALWAYS CHECK AND VERIFY.

TABLE 12—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	106	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	110	33	65	164
46	78	157	391	112	32	64	161
47	76	153	383	116	31	62	155
48	75	150	375	120	30	60	150
49	73	147	367				

- e. Turn off all other gas appliances and pilots.
- f. Move setup switch SW-2 to ON position. (See Fig. 15.) This keeps furnace locked in low-heat operation.
- g. Jumper R to W/W1.
- h. Let furnace run for 3 minutes in low-heat operation.
- i. Measure time (in sec) for gas meter to complete 1 revolution. Note reading.
- j. Refer to Table 12 for cubic ft of gas per hr.
- k. Multiply gas rate cu ft/hr by heating value (Btu/cu ft).
- l. Move setup switch SW-2 to OFF position and jumper R and W2 thermostat connections. (See Fig. 15.) This keeps furnace locked in high-heat operation. Repeat items h through k for high-heat operation.

EXAMPLE: (High-heat operation at 0—2000 ft altitude)

Furnace input from rating plate is 85,000 Btuh

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

Heating value of gas = 1050 Btu/cu ft

Time for 1 revolution of 2-cu ft dial = 90 sec

Gas rate = 80 cu ft/hr (from Table 12)

Btu heating input = 1050 X 80 = 84,000 Btuh In this example, the orifice size and manifold pressure adjustment is within ±2 percent of the furnace input rate.

NOTE: Measured gas inputs (high heat and low heat) must be within ±2 percent of that stated on furnace rating plate when installed at sea level or derated per that stated above when installed at higher altitudes.

- m. Remove jumper across R, W/W1, and W2 thermostat connections to terminate call for heat.

5. Set air temperature rises.

Place SW-2 in ON position. Jumper R to W/W1 and W2 to check high-gas heat temperature rise. To check low-gas heat temperature rise, remove jumper to W2. Determine air temperature rises for both high and low heat. Do not exceed temperature rise ranges specified on unit rating plate for high and low heat.

- a. 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.

- b. When thermometer readings stabilize, subtract return-air temperature from supply-air temperature to determine temperature rise.

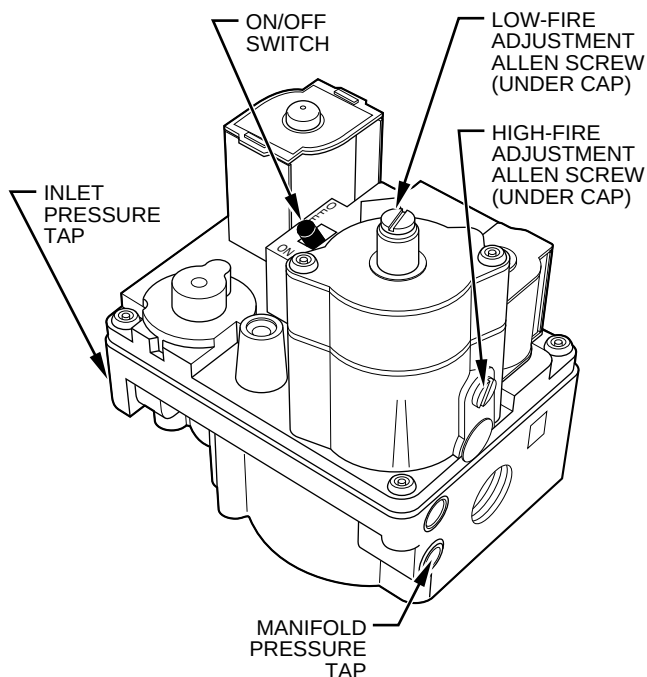
NOTE: If the temperature rise is outside this range, first check:

- (1.) Gas input for low- and high-heat operation.
- (2.) Derate for altitude if applicable.

TABLE 13—ALTITUDE DERATE MULTIPLIER FOR U.S.A.

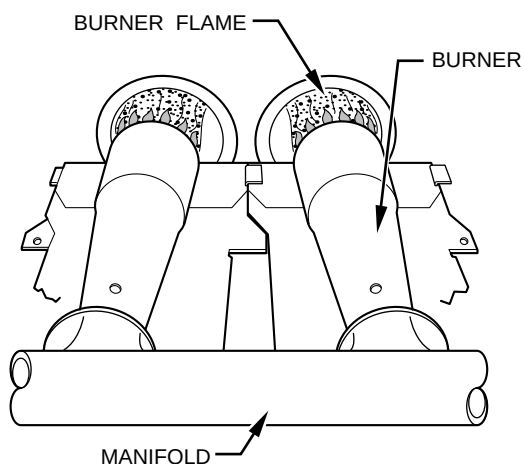
ALTITUDE (FT)	% OF DERATE	DERATE MULTIPLIER FACTOR FOR U.S.A.*
0—2000	0	1.00
2001—3000	8—12	0.90
3001—4000	12—16	0.86
4001—5000	16—20	0.82
5001—6000	20—24	0.78
6001—7000	24—28	0.74
7001—8000	18—32	0.70
8001—9000	32—36	0.66
9001—10,000	36—40	0.62

* Derate multiplier factor is based on midpoint altitude for altitude range.



A97358

Fig. 18—Redundant Automatic Gas Control Valve



A89020

Fig. 19—Burner Flame

(3.) Return and supply ducts for excessive restrictions causing static pressures greater than 0.70-in. wc.

- c. Adjust air temperature rise by adjusting airflow. Move the RED jumper wire on the airflow selector control to MID, HI, or M-HI for mid-point of the air temperature rise range, high end of the rise range, or in-between, respectively. The single RED jumper selection is used for both high- and low-heat rises. Power need not be reset after making this selection.

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

6. Set thermostat heat anticipator.

- a. When using a nonelectronic thermostat, 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 the wires normally connected to thermostat subbase terminals R and W/W1. Fig. 20 illustrates an easy method of obtain-

ing actual amp draw. The amp reading should be taken after blower motor has started and furnace is operating in low heat. To operate furnace in low heat, first move SW-2 to ON position, THEN connect ammeter wires as shown in Fig. 20. The thermostat anticipator should NOT be in this circuit while measuring current. If thermostat has no subbase, the thermostat MUST be disconnected from the R and W/W1 wires during the current measurement. Return SW-2 to final desired location after completing the reading. See the thermostat manufacturer's instructions for adjusting heat anticipator and for varying heating cycle length.

- b. When using an electronic thermostat, set cycle rate for 3 cycles per hr, if possible.

F. 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.

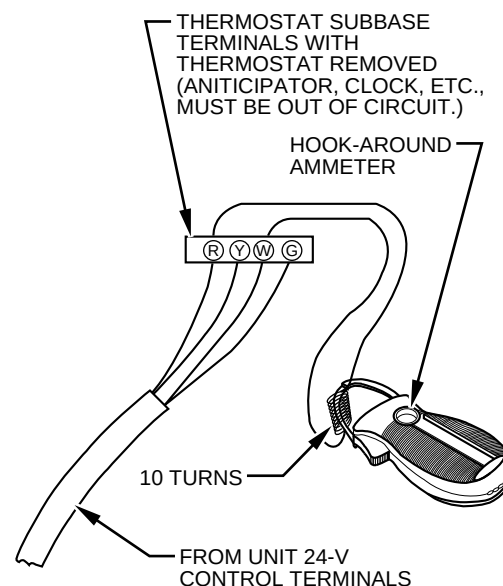
This control shuts off the combustion control system and energizes the circulating-air blower motor if the furnace overheats.

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 limit has shut off 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.

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

- a. Disconnect power to furnace and remove vent connector from furnace flue collar. Be sure to allow time for vent connector pipe to cool down before removing.



EXAMPLE: $\frac{5.0 \text{ AMPS ON AMMETER}}{10 \text{ TURNS AROUND JAWS}} = 0.5 \text{ AMPS FOR THERMOSTAT ANTICIPATOR SETTING}$

A96316

Fig. 20—Amp Draw Check With Ammeter

- b. Restore power to furnace and set room thermostat above room temperature.
- c. 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 connector to furnace flue collar.
- e. Wait 5 minutes and then reset draft safeguard switch.

3. Check flow-sensing pressure switches.

This control proves operation of draft-inducer blower.

- a. Turn off 115-v power to furnace.
- b. Remove gas control door and disconnect inducer motor leads from wire harness.
- c. Turn on 115-v power to furnace.

→

- d. Close thermostat switch as if making normal furnace start. If hot surface igniter does not glow within several minutes and control flashes code 32, then flow-sensing switches are functioning properly. If hot surface igniter glows when inducer motor is disconnected, shut down furnace immediately. Determine reason pressure switch did not function properly and correct condition.
- e. Turn off 115-v power to furnace.

- f. Reconnect inducer motor wires, replace gas control door, and turn on 115-v power.

G. Checklist

- 1. Put away tools and instruments, and clean up debris.
- 2. Check SW-1 through SW-4 after completing installation to ensure desired settings for thermostat type (SW-1 and SW-2) and blower-off delay (SW-3 and SW-4). Refer to Tables 6 and 7.
- 3. Verify manual reset switches have continuity.
- 4. Ensure blower and gas control access doors are properly installed.
- 5. Cycle-test furnace with room thermostat.
- 6. Check operation of accessories per manufacturer's instructions.
- 7. Review User's Manual with owner.
- 8. Leave literature packet near furnace.

CHECKLIST—INSTALLATION
LOAD CALCULATION

_____ Heating Load (Btuh)
_____ Cooling Load (Btuh)
_____ Furnace Model Selection

AIR FOR COMBUSTION AND VENTILATION

_____ Unconfined Space
_____ Confined Space

VENTING

_____ NFGC (United States)
_____ NSCNGPIC (Canada)
_____ Local Codes
_____ 1/4-in. Upward Slope
_____ Joints Secure
_____ See Attached Vent Table Instructions

CHECKLIST—START-UP

_____ Gas Input Rate
(Set Within 2 percent of Rating Plate)
_____ Temperature Rise Adjusted
_____ Thermostat Anticipator Setting Adjusted or
_____ Thermostat Cycle Rate (3 Cycles per Hr) Se-
lected

CHECK SAFETY CONTROLS OPERATION

_____ Primary Limit
_____ Pressure Switches
_____ Draft Safeguard Switch
_____ Auxiliary Limit Switch(es)

THERMOSTATS

_____ Manufacturer
_____ Model Number

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Packaged Service Training programs are an excellent way to increase your knowledge of the equipment discussed in this manual, including:

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- Maintenance
- Installation Overview
- Operating Sequence

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