



installation, start-up, and operating instructions

DOWNFLOW/HORIZONTAL 2-SPEED, 2-STAGE, INDUCED- COMBUSTION GAS-FIRED FURNACE

331AAV Series C or D

Cancels: II 331A-63-6

II 331A-63-7
10-00

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

This symbol → indicates a change since the last issue.


	Page
Index	4
SAFETY CONSIDERATIONS	1
ELECTROSTATIC DISCHARGE (ESD) PRECAUTIONS PROCEDURE	2
INTRODUCTION	2-4
Dimensional Drawing	2
Clearances to Combustibles	3
LOCATION	4
General	4
Location Relative to Cooling Equipment	4
Hazardous Locations	5
AIR FOR COMBUSTION AND VENTILATION	5-6
Unconfined Space	5
Confined Space	5-6
AIR DUCTS	6-7
General Requirements	6
Ductwork Acoustical Treatment	6
Supply Air Connections	6
Return Air Connections	6-7
SUPPLY-AIR PLENUM INSTALLATION	
(DOWNFLOW)	7
HORIZONTAL ATTIC INSTALLATION	7
HORIZONTAL CRAWLSPACE INSTALLATION	7
FILTER ARRANGEMENT	7
GAS PIPING	7-8
ELECTRICAL CONNECTIONS	9-11
115-v Wiring	9
24-v Wiring	11
Accessories	11
VENTING	11
START-UP, ADJUSTMENT, AND SAFETY CHECK	12-24
General	12-13
Sequence of Operation	13-17
Adaptive Heating Mode	14
Non-Adaptive Heating Mode	14-16
Cooling Mode	16
Continuous Blower Mode	16
Heat Pump Mode	16
Defrost Mode	17
Start-Up Procedures	17
Adjustments	17-23
Set Gas Input Rate	17-22
Set Temperature Rise	22-23
Set Thermostat Heat Anticipator	23
Check Safety Controls	23
Checklist	24



REGISTERED QUALITY SYSTEM

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 (NFGC) NFPA 54-1999/ANSI Z223.1-1999 and the Installation Standards. In Canada, refer to the current edition of 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 a fire extinguisher available during start-up and adjustment procedures and service calls.

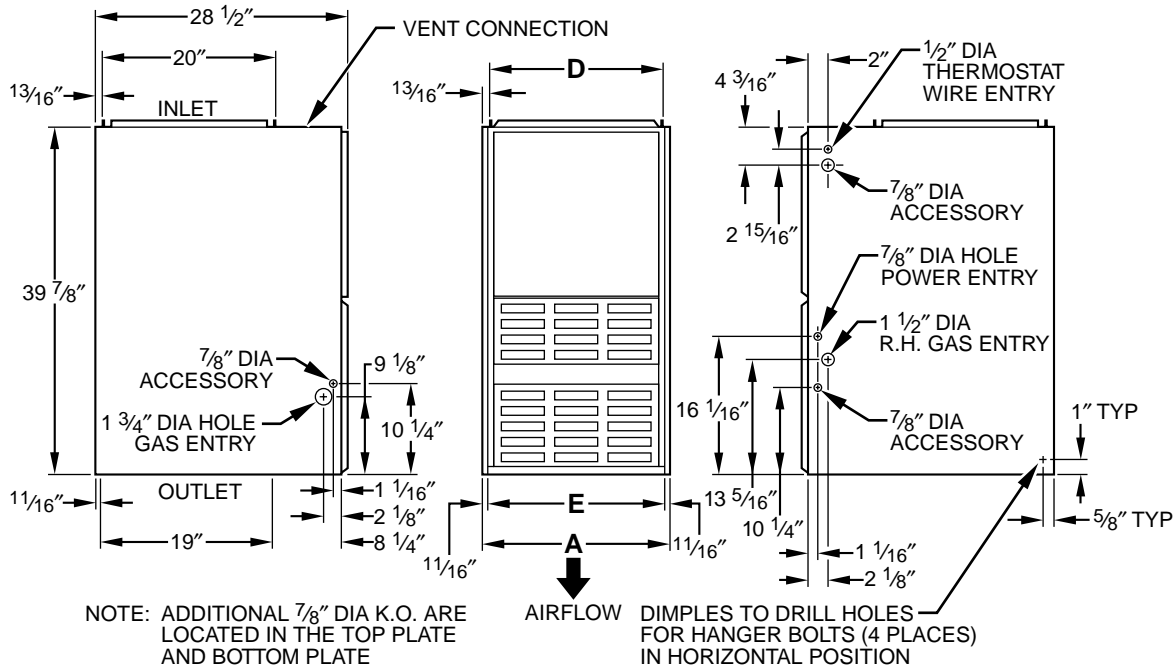
Recognize safety information. This is the safety-alert symbol . When you see this symbol on the unit and in instructions or manuals, be alert to the potential for personal injury.

Understand the signal words DANGER, WARNING, and CAUTION. These words are used with the safety-alert symbol. DANGER identifies the most serious hazards which **will** result in severe personal injury or death. WARNING signifies hazards 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.

SAFETY CONSIDERATIONS

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



- NOTES:**
1. Two additional 7/8-in. dia holes are located in the top plate.
 2. Minimum return-air openings at furnace, based on metal duct. If flex duct is used, see flex duct manufacturer's recommendations for equivalent diameters.
 - a. For 800 CFM—16-in. round or 14½ x 12-in. rectangle.
 - b. For 1200 CFM—20-in. round or 14½ x 19½-in. rectangle.
 - c. For 1600 CFM—22-in. round or 14½ x 23¼-in. rectangle.
 - d. For airflow requirements above 1800 CFM, must use entire return air opening.

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Fig. 1—Dimensional Drawing

TABLE 1—DIMENSIONS (IN.)

UNIT SIZE	A	D	E	VENT CONN	SHIP. WT
024065	14-3/16	12-9/16	12-11/16	4	141
036065	14-3/16	12-9/16	12-11/16	4	145
036085	17-1/2	15-7/8	16	4	154
048085	17-1/2	15-7/8	16	4	154
048105	17-1/2	15-7/8	16	4	171
060105	21	19-3/8	19-1/2	4	181
060125	24-1/2	22-7/8	23	5	192

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.

1. 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.**

2. 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.
3. 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.).
4. If you touch ungrounded objects (recharge your body with static electricity), firmly touch furnace again before touching control or wires.
5. Use this procedure for installed and uninstalled (ungrounded) furnaces.
6. 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

MINIMUM INCHES CLEARANCE TO COMBUSTIBLE CONSTRUCTION

This forced air furnace is equipped for use with natural gas at altitudes 0-10,000 ft (0-3,050m).

An accessory kit, supplied by the manufacturer, shall be used to convert to propane gas use or may be required for some natural gas applications.

This furnace is for indoor installation in a building constructed on site. This furnace may be installed on combustible flooring in alcove or closet at minimum clearance from combustible material.

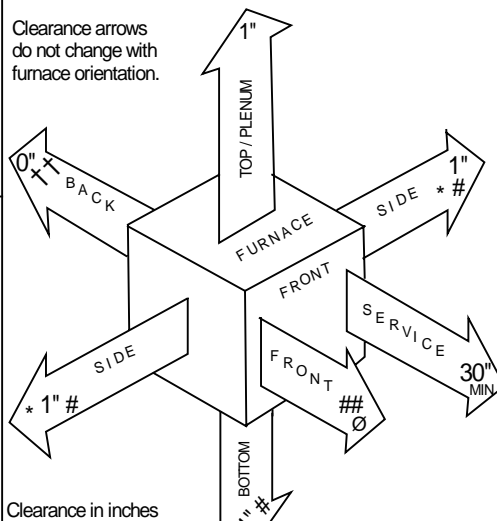
This furnace may be used with a Type B-1 Vent and may be vented in common with other gas-fired appliances.

For installation on non-combustible floors only.

- † For installation on combustible flooring only when installed on special base, Part No. KGASB0201ALL, Coil Assembly, Part No. CD5 or CK5, or Coil Casing, Part No. KCAKC.
- # For furnaces wider than 14.25 inches (362mm) may be 0 inches.
- ∅ 18 inches front clearance required for alcove.
- * Indicates supply or return sides when furnace is in the horizontal position. Line contact only permissible between lines formed by intersections of the Top and two Sides of the furnace jacket, and building joists, studs or framing.
- ## For single wall vent type 6 inches.
For Type B-1 vent type 3 inches.
- †† Clearance to Back 0 inches (0 po) in downflow and horizontal (attic/alcove & crawlspace) positions and 3 inches (3 po) in horizontal closet positions.

This furnace is approved for DOWNFLOW and HORIZONTAL installations.

Clearance arrows do not change with furnace orientation.



Vent Clearance to combustibles:
For Single Wall vents 6 inches (6 po).
For Type B-1 vent type 1 inch (1 po).

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→ Fig. 2—Clearances to Combustibles

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.

7. An ESD service kit (available from commercial sources) may also be used to prevent ESD damage.

INTRODUCTION

The model 331AAV Series C or D Furnace is available in sizes 65,000 through 123,000 Btuh input capacities.

The design of the downflow/horizontal gas-fired furnace is CSA (A.G.A. and C.G.A.) certified for natural and propane gases and for installation on noncombustible flooring. The furnace is factory-shipped for use with natural gas. The manufacturer's accessory gas conversion kit is required to convert furnace for use with propane gas.

These furnaces SHALL NOT be installed directly on carpeting, tile, or any other combustible material other than wood flooring. In downflow installations, the manufacturer's accessory floor base must be used when installed on combustible materials and wood flooring. Special base is not required when this furnace is installed on manufacturer's Coil Assembly Part No. CD5 or CK5, or when Coil Box Part No. KCAKC is used. This furnace is for installation in alcoves, attics, crawlspaces, basements, closets, or utility rooms. The design of this furnace line is **not** CSA (A.G.A. and C.G.A.) 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 NFPA 90B. For copies of the NFGC and NFPA 90B, contact the National Fire Protection Agency Inc., Batterymarch Park, Quincy, MA 02269; or the American Gas Association, 1515 Wilson Blvd., Arlington, VA. 22209.

Before installing the furnace in Canada, refer to the current edition of the NSCPGIC. For a copy of the NSCPGIC, contact Standard Sales, CSA International, 178 Rexdale Blvd., Etobicoke (Toronto), Ontario, Canada M9W 1R3.

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 the absence of local building codes, installation must comply with the NFGC in the United States and the NSCPGIC in Canada.

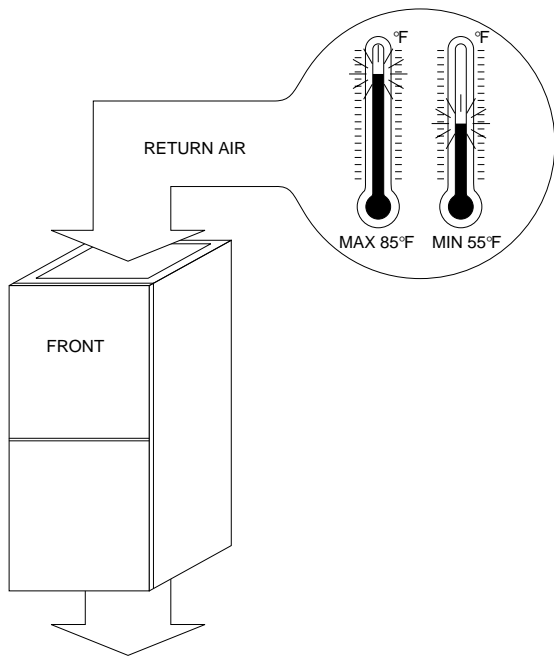
These instructions cover minimum requirements for a safe installation and conform to existing national standards and safety codes. In some instances, these instructions exceed certain local codes and ordinances, especially those that may not have kept pace with changing residential construction practices.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

The duct system should be designed and sized according to accepted national standards published by: Air Conditioning Contractors Association (ACCA), Sheet Metal and Air Conditioning Contractors National Association (SMACNA). Or consult the Residential Systems Design Guidelines reference tables available from your local distributor. The duct system should be sized to handle the maximum CFM capabilities of the equipment at the optimum design static pressure.

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

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

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



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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.

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

For high-altitude installation, the high-altitude conversion kit must be installed at or above 5500 ft above sea level.

For accessory installation details, refer to applicable installation literature.

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

I. LOCATION

A. General

CAUTION: DO NOT install furnace in a corrosive or contaminated atmosphere. Make sure all combustion and circulating air requirements are followed. 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 systems. Some of these compounds are released from paneling and dry wall adhesives, paints, thinners, masonry cleaning materials, and many other solvents commonly used in the construction process. Excessive exposure to contaminated combustion air will result in safety and performance related problems.

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

Locate furnace as near to center of air distribution system and chimney or vent as possible. The furnace should be installed as level as possible.

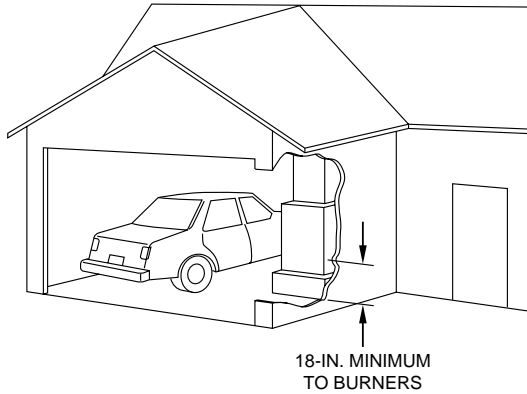
When furnace is installed so that supply ducts carry air to areas outside space containing furnace, the return air must also be handled by a duct(s) sealed to furnace casing and terminating outside space containing furnace.

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

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 furnace, dampers or other means used to control the 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-cooling 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 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.

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.

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

The requirements for combustion and ventilation air depend upon whether furnace is located in a **CONFINED** or **UNCONFINED** space.

A. Unconfined Space

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

For Example:

331AAV FURNACE HIGH-FIRE INPUT BTUH	MINIMUM SQ FT WITH 7-1/2 FT CEILING
63,000	420
84,000	560
105,000	700
123,000	820

If the unconfined space is constructed unusually tight, air for combustion and ventilation **MUST** come from either the outdoors or spaces freely communicating with 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 equal or greater amount of air is supplied to the room.

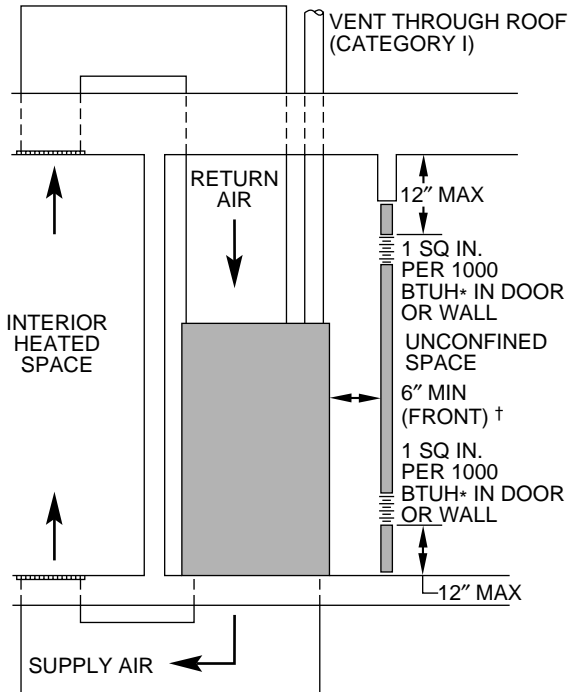
B. Confined Space

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.

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 an unconfined space 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 the 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 return air directly from hallway or space adjacent to furnace, all air for combustion must come from outdoors.
2. Air from outside the structure requires 1 of the following methods:
 - a. 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.)
 - b. 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.)
 - c. 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.



* Minimum opening size is 100 sq. in. with minimum dimensions of 3 in.
 † Minimum of 3 in. when type B-1 vent is used.

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

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 CFM at the design static pressure.

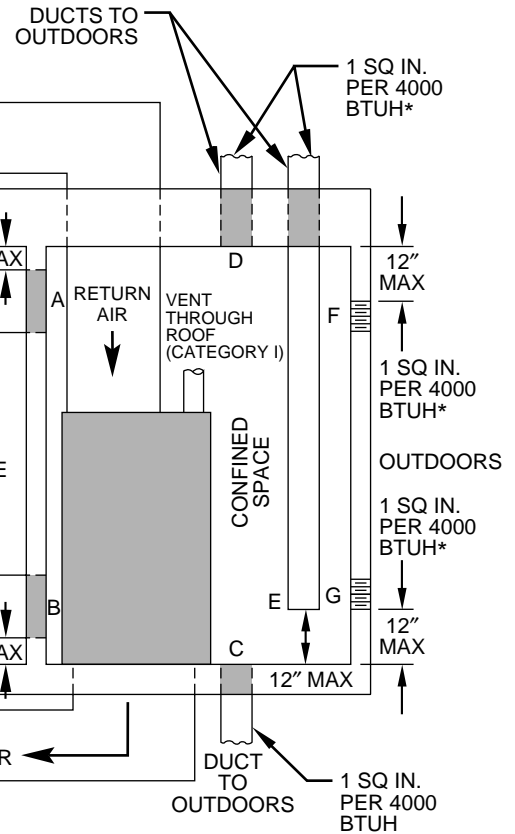
When a furnace is installed so that the supply ducts carry air to areas outside the space containing the furnace, the return air must also be handled by a duct(s) sealed to the furnace casing and terminating outside the space containing the furnace.

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.

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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

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

UPFLOW FURNACES

Connect supply-air duct to 3/4 in. flange on furnace supply-air outlet. The supply-air duct attachment must ONLY be connected to furnace supply-/outlet-air duct 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.

DOWNFLOW FURNACES

Connect supply-air duct to 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), when installed on non-combustible material. When installed on combustible material, supply-air duct attachment must ONLY be connected to an accessory subbase or factory approved air conditioning coil casing. 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.

HORIZONTAL FURNACES

Connect supply-air duct to supply air opening on furnace. The supply-air duct attachment must ONLY be connected to furnace

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TABLE 2—FREE AREA OF COMBUSTION AIR OPENING

331AAV FURNACE HIGH-FIRE INPUT (BTUH)	AIR FROM 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)
63,000	100	15.8	5	31.5	7	21.0	6
84,000	100	21.0	6	42.0	8	28.0	6
105,000	105	26.3	6	52.5	9	35.0	7
123,000	123	30.8	7	61.5	9	41.0	8

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

UPFLOW FURNACES

The return-air duct must be connected to bottom, sides (left or right), or a combination of bottom and side(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.

DOWNFLOW AND 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.

IV. SUPPLY AIR PLENUM INSTALLATION (DOWNFLOW)

A. Downflow Installation

NOTE: This furnace is approved for use on combustible flooring when manufacturer’s accessory floor base Part No. KGASB0201ALL is used. Manufacturer’s accessory floor base is not required when this furnace is installed on manufacturer’s Coil Assembly Part No. CD5 or CK5, or Coil Box Part No. KCAKC is used.

1. Determine application being installed from Table 3.
2. Construct hole in floor per dimensions specified in Table 3 and Fig. 5.
3. Construct plenum to dimensions specified in Table 3.
4. If downflow subbase (KGASB) is used, install as shown in Fig. 6.
If coil assembly CD5, CK5, or Coil Box KCAKC is used, install as shown in Fig. 7.

B. Installation On Combustible Floor

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

V. HORIZONTAL ATTIC INSTALLATION

The furnace can be installed horizontally on either the left-hand (LH) or right-hand (RH) side. A typical attic installation is shown in Fig. 9.

A. Construct Working Platform

Construct working platform on location where all required furnace clearances are met. (See Table 1 and Fig. 9.)

B. Install Furnace

Position furnace in desired location.

3. Connect gas supply pipe. See Fig. 9 for typical piping entry.
4. Connect supply- and return-air ducts.

5. Install field-supplied filter retainers as indicated in Fig. 12 and Table 4 before connecting return-air duct to furnace.

6. Install 24- X 24-in. sheet metal shield on platform in front of louvered control panel as shown in Fig. 9.

VI. HORIZONTAL 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. 10) or installed on suitable blocks or pad. (See Fig. 11.) 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 crawlspace installation is very similar to attic installation, refer to Step 4. The installation of a sheet metal shield in front of louvered control panel is covered in Step 4. For a crawlspace installation, this same sheet metal shield must be installed above louvered control panel. Extend sheet metal shield over furnace top far enough to cover gas pipe entry hole.

VII. 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.
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The 2 factory-supplied filters are shipped in the blower compartment. After return-air duct has been connected to furnace, install filters in a V-formation inside return-air plenum. See Fig. 12 and Table 4 for horizontal applications. Horizontal filter retainers must be field supplied. See Fig. 13 for downflow applications.

VIII. GAS PIPING

Gas piping must be installed in accordance with national and local codes. Refer to the NFGC NFPA 54-1999/ANSI Z223.1-1999.

Canadian installations must be installed in accordance with NSC-NGPIC and all authorities having jurisdiction.

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

⚠	CAUTION: If flexible connector is required or allowed by authority having jurisdiction, black iron pipe shall be installed at gas valve and extend a minimum of 2 in. outside furnace casing.
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⚠	CAUTION: Use a backup wrench at furnace gas control when connecting gas pipe to furnace to avoid damaging gas controls or manifold.
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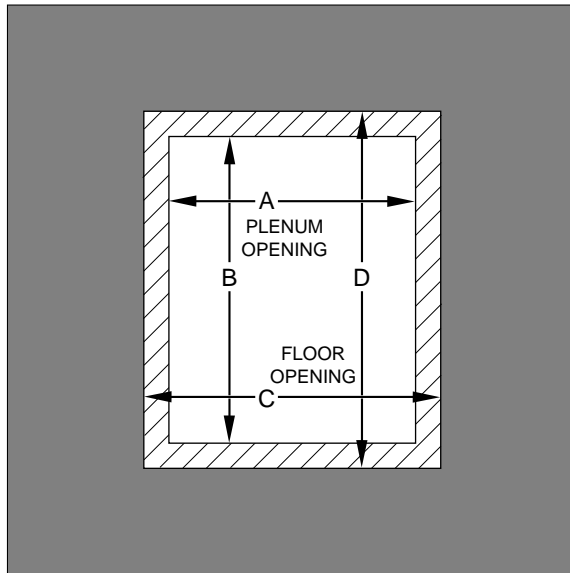


Fig. 5—Floor and Plenum Opening Dimensions

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TABLE 3—OPENING DIMENSIONS (IN.)

FURNACE CASING WIDTH	APPLICATION	PLENUM OPENING		FLOOR OPENING	
		A	B	C	D
14-3/16	Non-Combustible Flooring	12-11/16	19	13-3/8	19-5/8
	Combustible Flooring Using KGASB Subbase	11-13/16	19	13-7/16	20-3/8
	Combustible Flooring with CD5 or CK5 Coil Assembly or KCAKC Coil Box	12-5/16	19	13-5/16	20
17-1/2	Non-Combustible Flooring	16	19	16-5/8	19-5/8
	Combustible Flooring Using KGASB Subbase	15-1/8	19	16-3/4	20-3/8
	Combustible Flooring with CD5 or CK5 Coil Assembly or KCAKC Coil Box	15-1/2	19	16-1/2	20
21	Non-Combustible Flooring	19-1/2	19	20-1/8	19-5/8
	Combustible Flooring Using KGASB Subbase	18-5/8	19	20-1/4	20-3/8
	Combustible Flooring with CD5 or CK5 Coil Assembly or KCAKC Coil Box	19	19	20	20
24-1/2	Non-Combustible Flooring	23	19	23-5/8	19-5/8
	Combustible Flooring Using KGASB Subbase	22-1/8	19	23-3/4	20-3/8
	Combustible Flooring with CD5 or CK5 Coil Assembly or KCAKC Coil Box	22-1/2	19	23-1/2	20

WARNING: Use the proper length of pipes and adequate piping support 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.

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

turn off electric shutoff switch located on the gas valve before test. It is recommended that ground joint union be loosened before pressure testing.

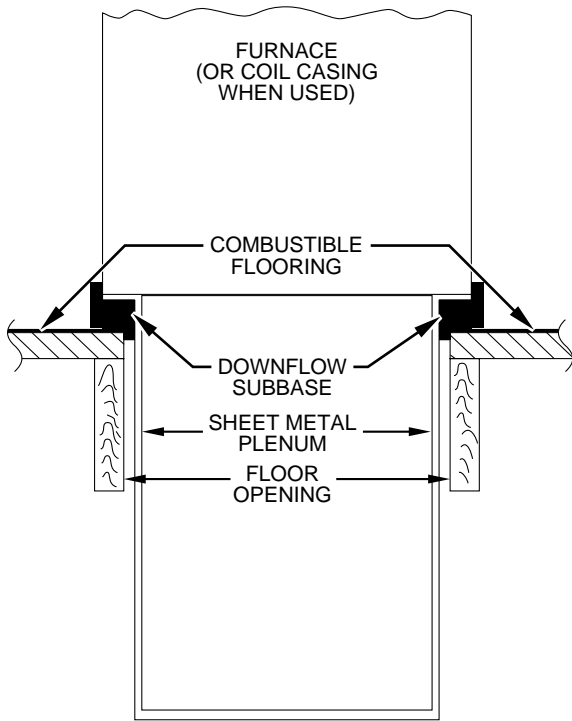
Joint compounds (pipe dope) should be applied sparingly and only to male threads of joints. This pipe dope must be resistant to action of propane gas.

Install accessible manual shutoff valve upstream of furnace gas controls and within 72 in. of furnace. A 1/8-in. NPT plugged tapping is provided on gas valve for test gage connection. Installation of additional 1/8-in. NPT plugged tapping, accessible for test gage connection, installed immediately upstream of gas supply connection to furnace and downstream of manual shutoff valve is not required. Place ground joint union between gas control manifold and manual shutoff.

Install sediment trap in riser leading to furnace. The trap can be installed by connecting a tee to riser leading from furnace. Connect capped nipple into lower end of tee. The capped nipple should extend below level of gas controls. (See Fig. 8.)

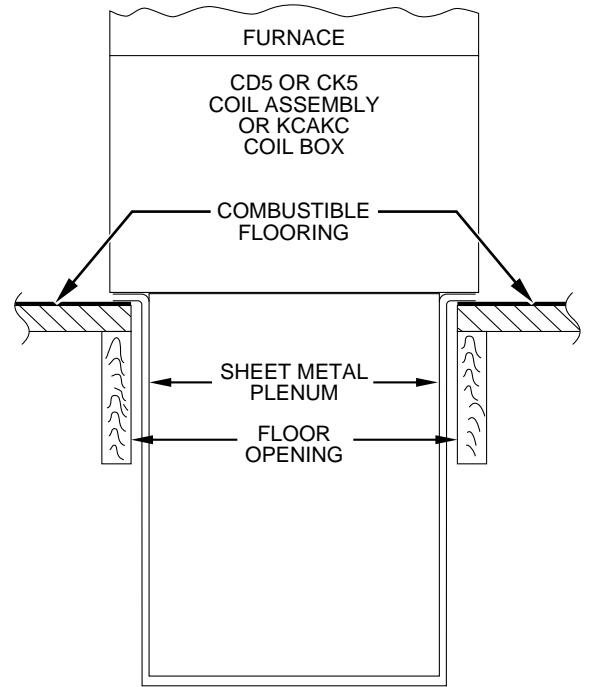
After all connections have been made, purge lines and check for gas leakage with regulated gas supply pressure.

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), the 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),



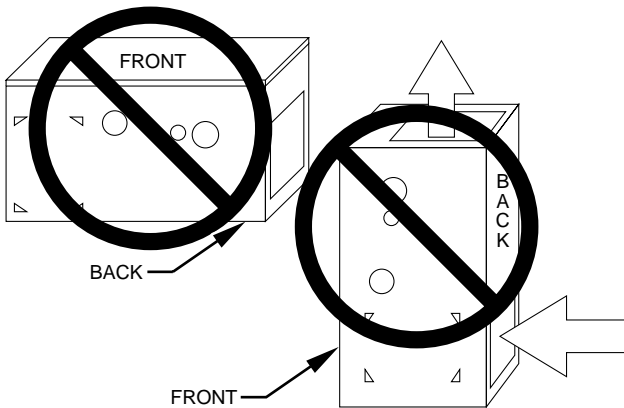
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Fig. 6—Furnace, Plenum, and Subbase Installed on a Combustible Floor



A96284

Fig. 7—Furnace, Plenum, and Coil Assembly or Coil Box Installed on a Combustible Floor



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

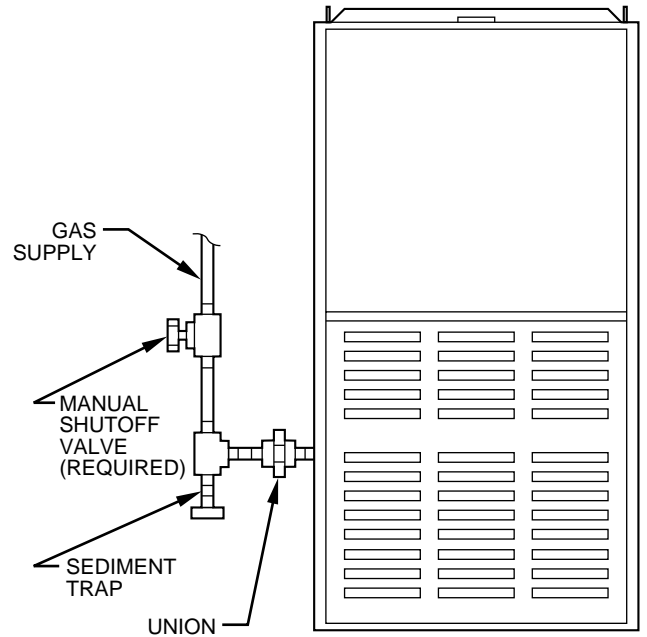


Fig. 8—Typical Gas Pipe Arrangement

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IX. ELECTRICAL CONNECTIONS

A. 115-v Wiring

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

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

Make all electrical connections in accordance with the current edition of the National Electrical Code (NEC) ANSI/NFPA

70-1999 and any local codes or ordinances that might apply. For Canadian installations, all electrical connections must be made in accordance with CSA C22.1 Canadian Electrical Code or authorities having jurisdiction.

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

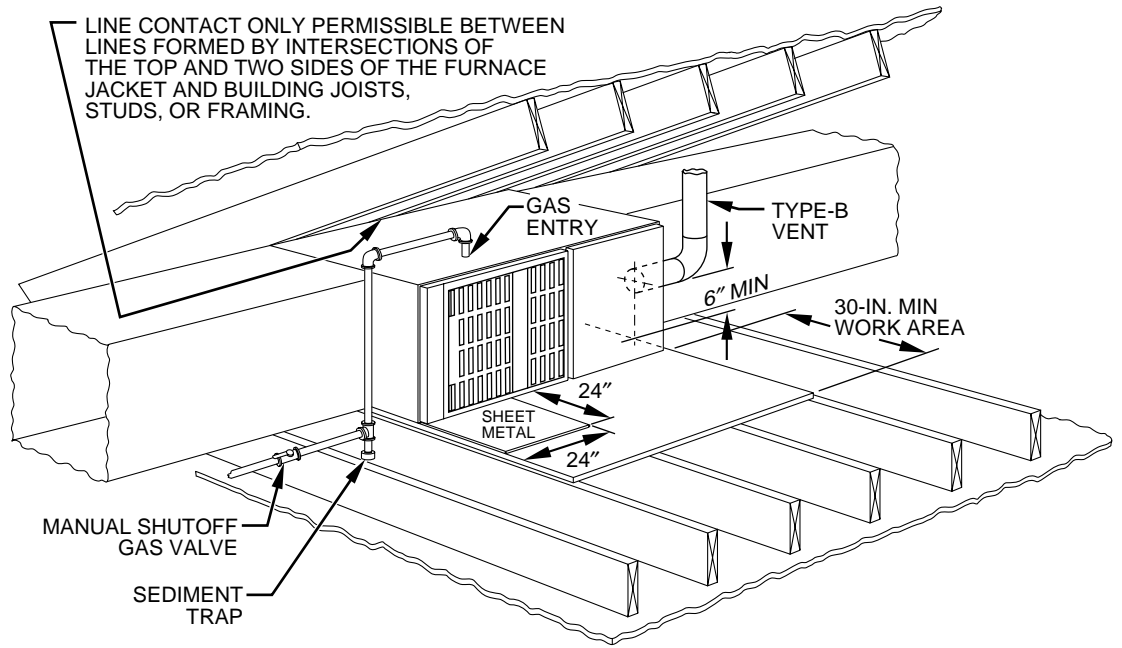


Fig. 9—Typical Attic Installation

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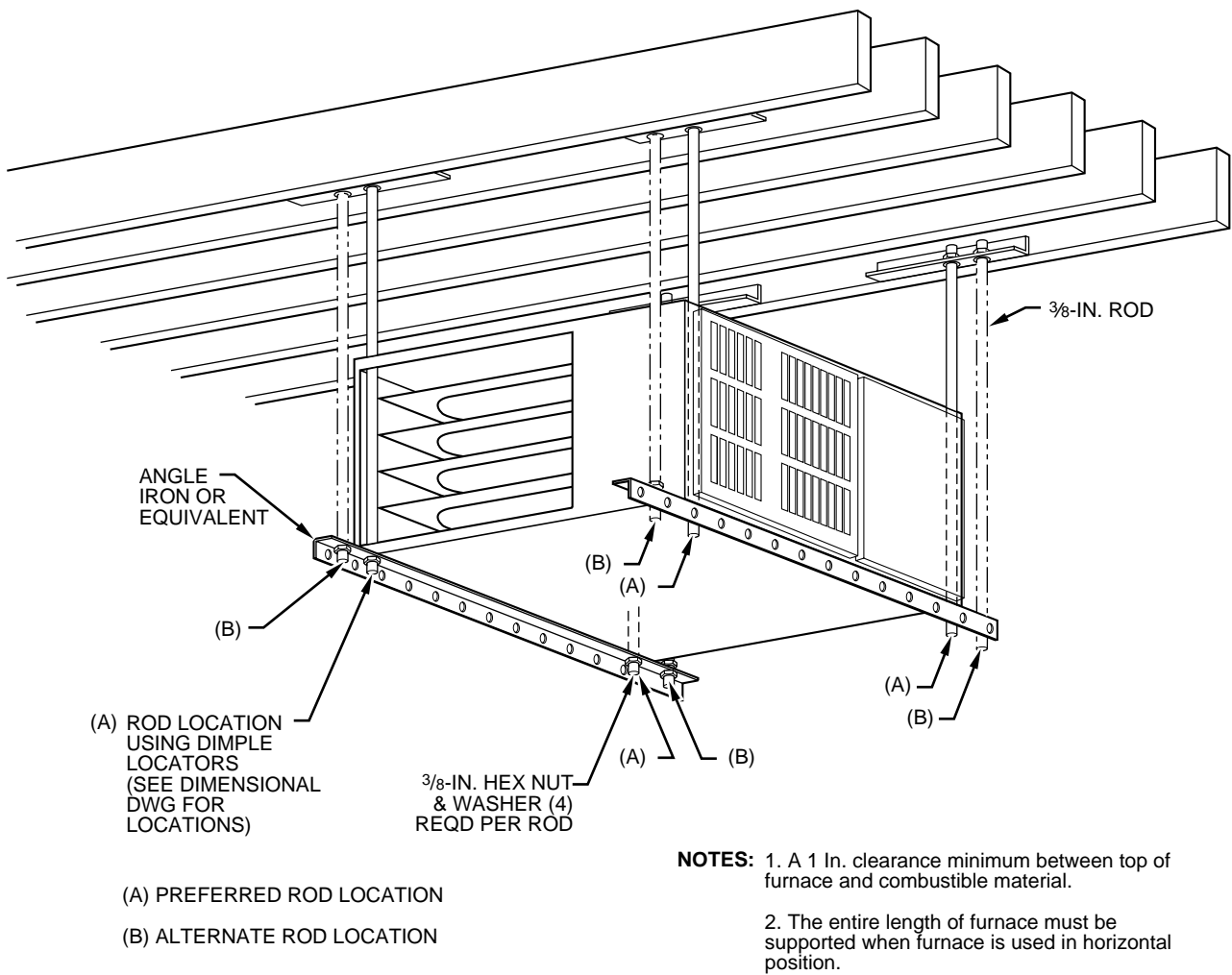
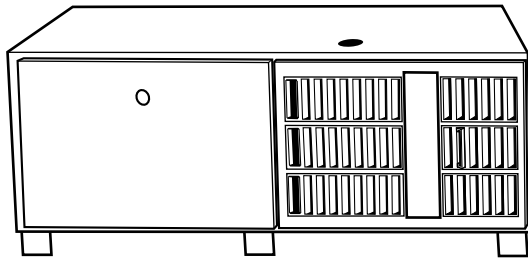


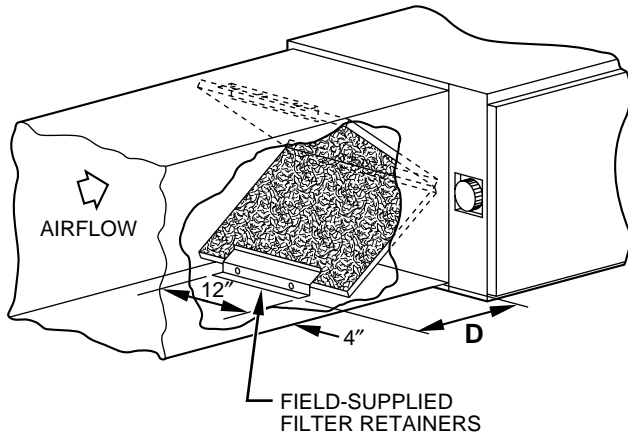
Fig. 10—Horizontal Crawlspace Installation on Hanger Rods

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Fig. 11—Horizontal Installation on Blocks



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Fig. 12—Horizontal Filter Arrangement
→TABLE 4—FILTER RETAINER (IN.)

FURNACE CASING WIDTH	FILTERS	D
14-3/16	(2) 16 X 20 X 1	15-3/8
17-1/2	(2) 16 X 20 X 1	14-3/4
21	(2) 16 X 20 X 1	13-3/4
24-1/2	(2) 16 X 20 X 1	12-1/2

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.

B. 24-v Wiring

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

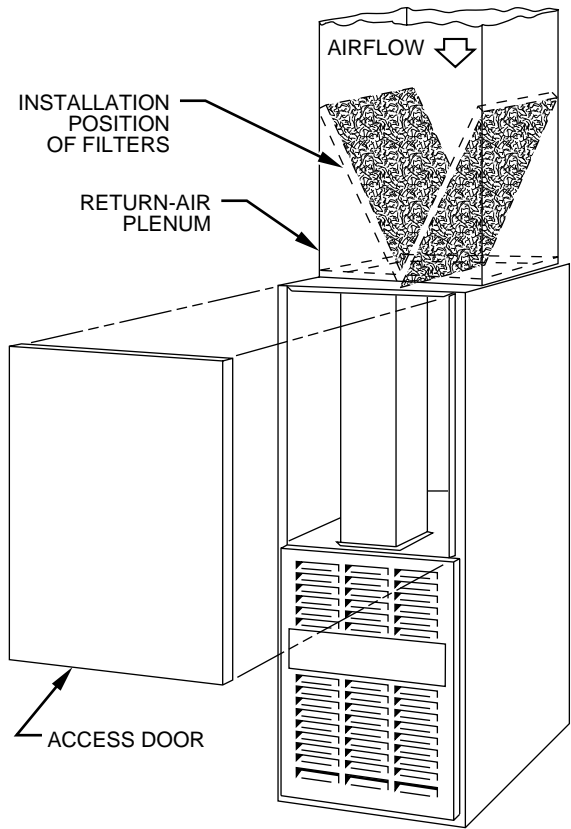
Make field 24-v connections at the 24-v terminal block. (See Fig. 14.) Connect terminal Y/Y2 as shown in Fig. 15 or 16 for proper operation in cooling mode. Use AWG No. 18 color-coded, copper thermostat wire only.

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

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.

C. Accessories

1. Electronic air cleaner (EAC)



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Fig. 13—Downflow Filter Arrangement

TABLE 5—MAXIMUM CAPACITY OF PIPE*

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

* 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, NFPA 54-1996.

A terminal block (EAC-1 [hot] and EAC-2 [neutral]) is provided for EAC connection. (See Fig. 14.) The terminals are energized with 115v, 1-amp maximum during blower motor operation.

2. Humidifier (HUM)

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

X. 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 installation code such as National Fuel Gas Code NFPA 54-1999/ANSI Z223.1-1999 in the United States, or the National Standard of Canada Natural and Propane Installation Codes CAN/CGA-B149.1- and .2-M95 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.

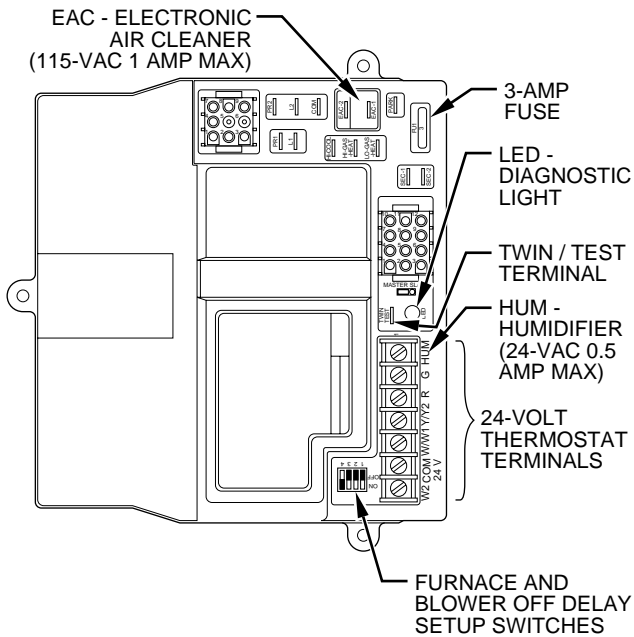


Fig. 14—Control Center

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XI. 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 be no less than 0.16 psig (4.5-in. wc).

Thermostat wire connections at R and W/W1 are the minimum required for gas heating operation. W2 must be connected for 2-stage heating thermostats. Com, Y/Y2, and G are required for cooling, heat pumps, and some clock thermostats. These must be made at 24-v terminal block on control. (See Fig. 14.)

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

For single-stage thermostats, connect thermostat W to W/W1 at furnace control terminal block. (See Fig. 15.) For single-stage thermostats the control determines, based on length of previous heating on and off cycles, when to operate in low- and high-gas heat for optimum comfort. Setup Switch-2 (SW-2) must be in the factory-shipped OFF position. See Fig. 17 and Tables 6 and 7 for setup switch information.

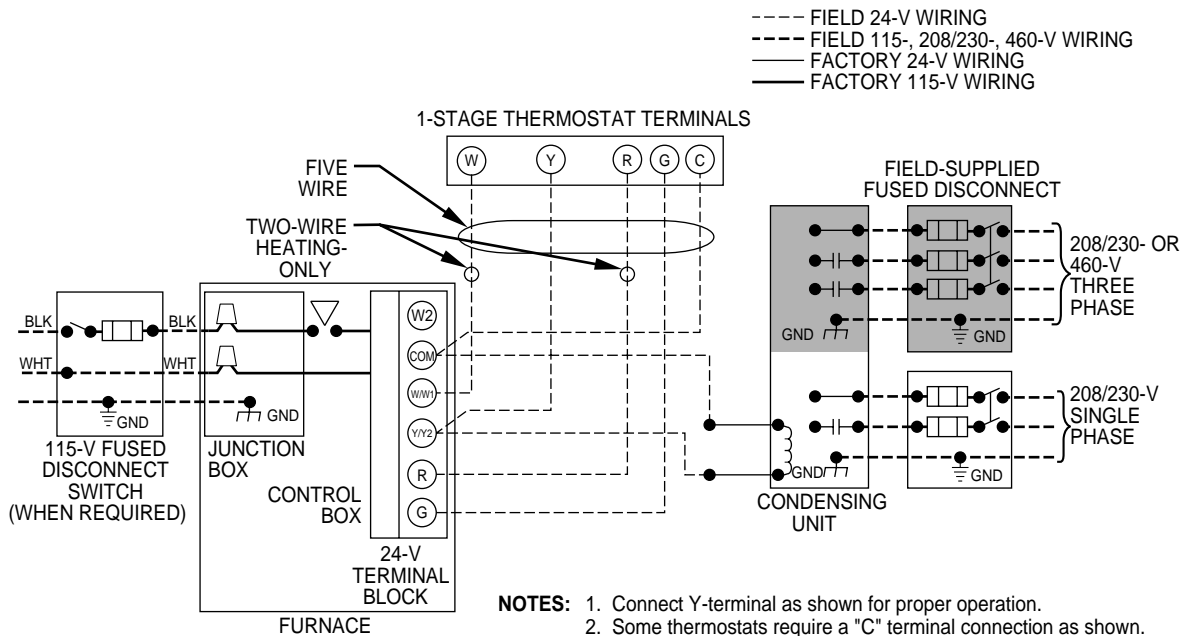
TABLE 6—ELECTRICAL DATA

UNIT SIZE	VOLTS—HERTZ—PHASE	OPERATING VOLTAGE RANGE		MAX UNIT AMPS	MIN WIRE GAGE	MAX WIRE LENGTH FT‡	MAXIMUM FUSE OR CKT BKR AMPS†
		Max*	Min*				
024065	115—60—1	127	104	8.0	14	46	15
036065	115—60—1	127	104	10.5	14	35	15
036085	115—60—1	127	104	12.0	14	30	15
048085	115—60—1	127	104	14.2	14	26	15
048105	115—60—1	127	104	13.2	14	29	15
060105	115—60—1	127	104	17.2	12	33	20
060125	115—60—1	127	104	17.9	12	32	20

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

† Time-delay type is recommended.

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



- NOTES: 1. Connect Y-terminal as shown for proper operation.
 2. Some thermostats require a "C" terminal connection as shown.
 3. If any of the original wire, as supplied, must be replaced, use same type or equivalent wire.

Fig. 15—Heating and Cooling Application Wiring Diagram With 1-Stage Thermostat and Condensing Unit

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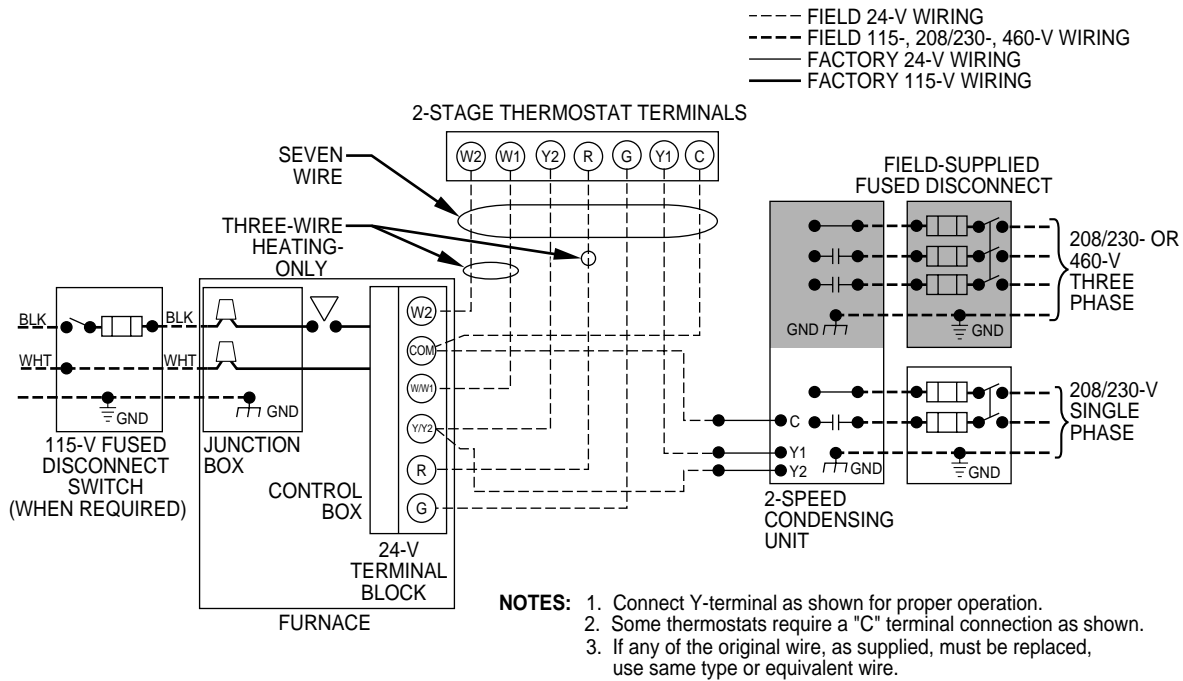


Fig 16—Heating and Cooling Application Diagram With 2-Stage Thermostat and Condensing Unit

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If 2-stage heating thermostat is to be used, move SW-2 to ON position at end of furnace installation. This overrides built-in control process for selecting high and low stage and allows 2-stage thermostat to select gas heating modes. The W2 from thermostat must be connected to W2 on control terminal block. (See Fig. 16.) Before operating furnace, check each manual reset switch for continuity. If necessary, press and release button to reset switch.

TABLE 7- 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 Algorithm)	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 is closed.
SW-3 and SW4	ON, OFF	Switches control gas heating algorithm blower off delay. (See Table 8.)

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

B. Sequence of Operation

Using the schematic diagram follow sequence of operation through different modes. (See Fig. 18.) Read and follow wiring diagram very carefully.

TABLE 8—BLOWER OFF DELAY SETUP SWITCH POSITION

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

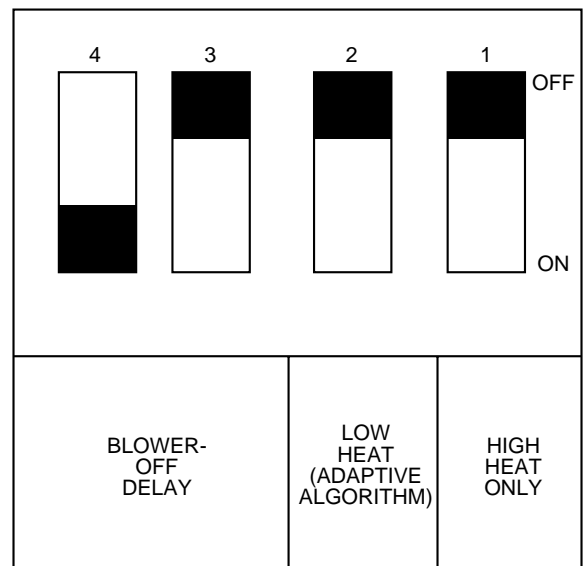


Fig. 17—Setup Switches on Control Center (Factory Settings)

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NOTE: If power interruption occurs during "call for heat" (W/W1 or W/W1-and-W2), control starts 90-sec blower only on period 2 sec after power is restored if thermostat is still calling for gas

heating. The red LED flashes code 12 during 90-sec period, after which LED will be on continuously as long as no faults are detected. After 90-sec period, furnace responds to thermostat normally.

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 and 2-Stage Heating

(See Fig. 16 for thermostat connections.)

NOTE: With high-heat-only switch SW-1 off, low-heat-only switch SW-2 selects either low-heat-only operation mode when on (see item 2. below), or adaptive heating mode when off in response to "call for heat." (See Fig. 17.) When high-heat-only switch SW-1 is on, it always causes high-gas-heat operation when R-W/W1 circuit is closed, regardless of the setting of low-heat-only switch SW-2.

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-gas-heat or high-gas-heat operation. This selection is based upon stored history of the length of previous gas heating on/off periods of single-stage thermostat.

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

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

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

- a. Inducer prepurge period—As inducer motor IDM comes up to low speed or high speed, the low-heat pressure switch contacts LPS (or LPS and HPS) close to begin a 15-sec prepurge period.
- b. Ignitor warm-up—At the end of prepurge period, hot surface ignitor HSI is energized for a 17-sec ignitor warm-up period.
- c. Trial-for-ignition sequence—When ignitor warm-up period is completed, main gas valve relay contacts MGVR-1 and -2 close to energize low-heat gas valve solenoid GV, gas valve opens, and 24-v power is supplied for a field-installed humidifier at terminals HUM and Com. Low-heat gas valve solenoid GV permits gas flow to the burners where it is ignited. After 5 sec, ignitor HSI is de-energized, and a 2-sec flame-proving period begins.

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

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

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

- e. Blower on delay—If burner flame is proven, 45 sec after gas valve GV is opened blower motor BLWM is energized on appropriate heating speed, low-gas-heat or high-gas-heat speed. Simultaneously, EAC terminals EAC-1 and EAC-2 are energized with 115v and remain energized as long as blower motor BLWM is energized.
- f. Switching from low- to high-gas heat—If furnace control CPU switches from low-gas heat to high-gas heat, control CPU switches inducer motor IDM speed from low to high. The high-heat pressure switch relay HPSR closes. When inducer motor IDM provides sufficient pressure to close high-heat pressure switch HPS, high-heat gas valve solenoid GV is energized. Blower motor BLWM switches speed for high-gas heat 5 sec after control CPU switches from low-gas heat to high-gas heat.
- g. Switching from high- to low-gas heat—Control CPU will not switch from high-gas heat to low-gas heat while thermostat R-W circuit is closed when a single-stage thermostat is used.
- h. Blower off delay—When thermostat is satisfied, R-W circuit is opened, de-energizing gas valve GV, stopping gas flow to burners, and de-energizing humidifier terminals HUM and Com. Inducer motor IDM remains energized for a 5-sec post-purge period. Blower motor BLWM and EAC terminals EAC-1 and EAC-2 remain energized for 90, 135, 180, or 225 sec (depending on selection at blower off delay switches SW-3 and SW-4). Furnace control CPU is factory set for a 135-sec blower off delay.

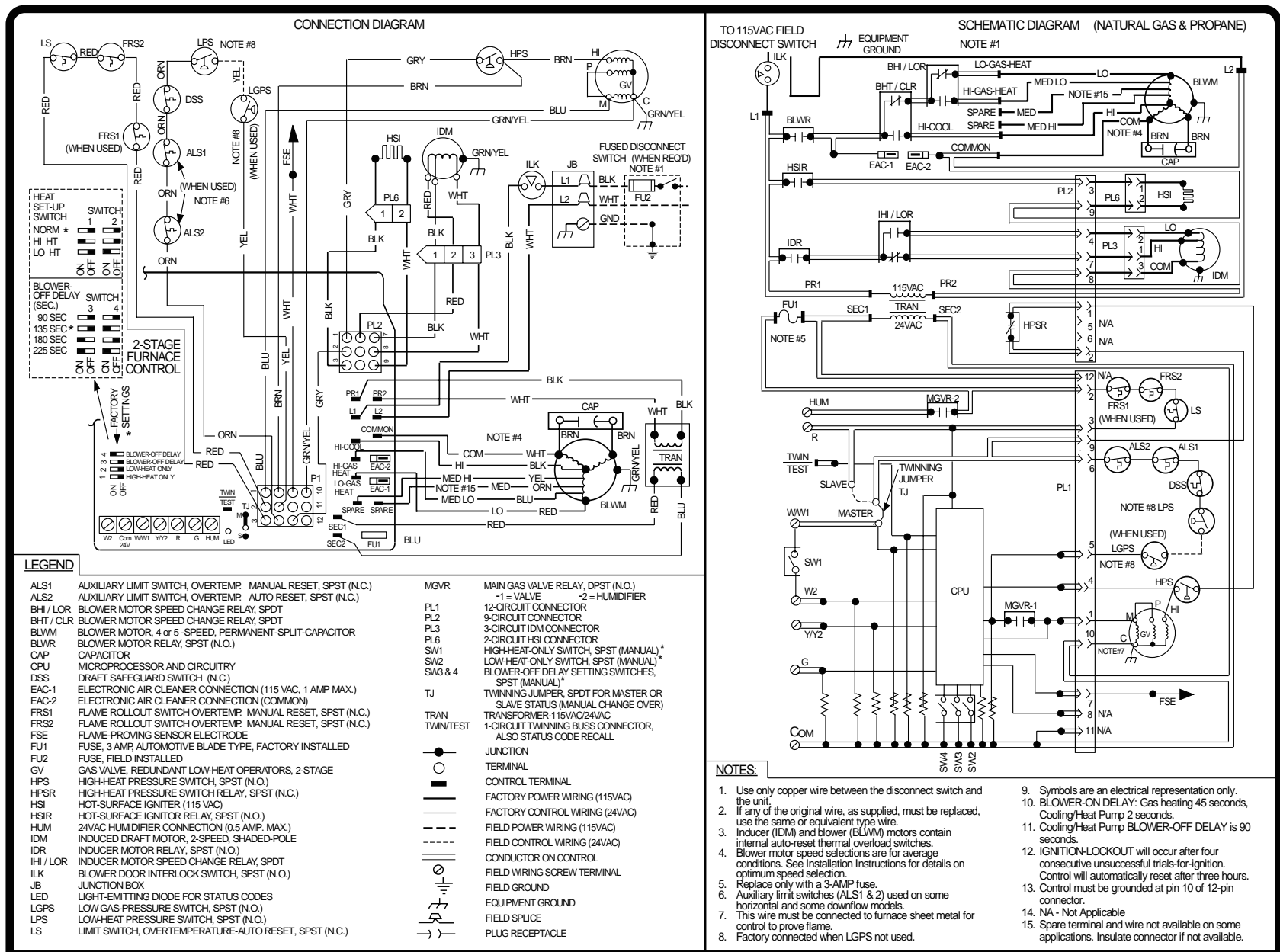
2. Non-Adaptive Heating Mode—Two-Stage Thermostat and 2-Stage Heating

(See Fig. 16 for thermostat connections.)

NOTE: The low-heat-only switch SW-2 ON selects low-heat-only operation mode in response to closing thermostat R-W/W1 circuit. When high-heat-only switch SW-1 is off, closing thermostat R to W1-and-W2 circuits is required for high-gas-heat operation. When high-heat-only switch SW-1 is on, it always causes high-gas-heat operation when R-W/W1 circuit is closed, regardless of setting of low-heat-only switch SW-2 and regardless of whether R-W2 circuit is closed or open.

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

- a. When wall thermostat "calls for heat," R-W/W1 circuit closes for low-gas heat or R to W1-and-W2 circuits close for high-gas heat. The furnace control performs a



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→Fig. 18—Unit Wiring Diagram

self-check, verifies low-heat and high-heat pressure switch contacts LPS and HPS are open, and starts inducer motor IDM in low speed or high speed as appropriate.

- b. Switching from low- to high-gas heat—If thermostat R-W/W1 circuit for low-gas heat is closed and R-W2 circuit for high-gas heat closes, control CPU switches inducer motor IDM speed from low to high. The high-heat pressure switch relay HPSR closes. When inducer motor IDM provides sufficient pressure to close high-heat pressure switch HPS, high-heat gas valve solenoid GV is energized. Blower motor BLWM switches speed for high-gas heat 5 sec after R-W2 circuit closes.
- c. Switching from high- to low-gas heat—If thermostat R-W2 circuit for high-gas heat opens and R-W/W1 circuit for low-gas heat remains closed, control CPU switches inducer motor IDM speed from high to low. The high-heat pressure switch relay HPSR opens to de-energize high-heat gas valve solenoid GV. When inducer motor IDM reduces pressure sufficiently, high-heat pressure switch HPS opens. The low-heat gas valve solenoid GV remains energized as long as low-heat pressure switch LPS remains closed. Blower motor BLWM switches speed for low-gas heat 5 sec after R-W2 circuit opens.

3. Cooling Mode

a. Single-Speed Cooling Outdoor Unit

(See Fig. 15 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 circuits start furnace blower motor BLWM on high-cool speed.
- (2.) The EAC terminals EAC-1 and EAC-2 are energized with 115v when blower motor BLWM is operating.
- (3.) When thermostat is satisfied, R to G-and-Y circuits are opened. The outdoor unit stops, and furnace blower motor BLWM continues operating on high-cool speed for an additional 90 sec.

b. Two-Speed Cooling Outdoor Unit

(See Fig. 16 for thermostat connections.)

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

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

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

4. Continuous Blower Mode

- a. When R to G circuit is closed by thermostat, blower motor BLWM operates on low-gas-heat speed (identical to low-cool speed). Terminals EAC-1 and EAC-2 are energized with 115v as long as blower motor BLWM is energized.
- b. During "call for heat," blower motor BLWM stops during ignitor warm-up (17 sec), ignition (7 sec), and blower on delay (45 sec), allowing furnace heat exchangers to heat up quickly.
 - (1.) The blower motor BLWM reverts to continuous blower speed after heating cycle is completed. In high-gas-heat, furnace control CPU holds blower motor BLWM at high-gas-heat speed during selected blower off delay period before reverting to continuous blower speed.
 - (2.) When thermostat "calls for low cooling," blower motor BLWM continues to operate on low-cool speed. When thermostat is satisfied, blower motor BLWM continues on continuous blower speed.
 - (3.) When thermostat "calls for high cooling," blower motor BLWM operates on high-cool speed. When thermostat is satisfied, blower motor BLWM operates an additional 2 sec on high-cool speed before reverting back to continuous blower speed.
 - (4.) When R to G circuit is opened, blower motor BLWM continues operating for an additional 90 sec if no other function requires blower motor BLWM operation.

5. Heat Pump

NOTE: An accessory interface kit or manufacturing accessory dual fuel thermostat is required with single-speed heat pumps. See interface kit Installation Instructions or manufacturing accessory dual fuel thermostat for single-speed heat pump thermostat and interface connections. No interface kit is needed for 2-speed heat pumps. See 2-speed heat pump Installation Instructions for thermostat connections.

a. Single-Speed Heat Pump Cooling

- (1.) The thermostat and interface kit close R to G-and-Y/Y2 circuit to start furnace blower motor BLWM on high-cooling speed. (Y/Y2 input to furnace control is necessary to provide adequate cooling airflow.)
- (2.) The EAC terminals EAC-1 and EAC-2 are energized with 115v when blower motor BLWM is operating.
- (3.) When thermostat is satisfied, furnace blower motor BLWM continues operating on high-cooling speed for an additional 90 sec.

b. Two-Speed Heat Pump Cooling

- (1.) The thermostat R to G circuits start furnace blower motor BLWM on low-cooling speed. Thermostat R to G-and-Y/Y2 circuits start furnace blower motor BLWM on high-cool speed.

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

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

- (3.) When thermostat is satisfied, furnace blower motor BLWM continues operating on cooling speed 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 start furnace blower motor BLWM on heat pump high-heat speed (identical to high-cool speed).
- (2.) The EAC terminals EAC-1 and EAC-2 are energized with 115v when blower motor BLWM is operating.
- (3.) When thermostat is satisfied, furnace blower motor BLWM continues operating on heat pump high-heat speed for an additional 90 sec.

d. Two-Speed Heat Pump Heating

- (1.) The thermostat closes R to G circuit for low heat and starts furnace blower motor BLWM on heat pump low-heat speed (identical to low-cooling speed). Closing R-Y/Y2 circuit to furnace provides blower motor BLWM heat pump high-heat speed.

NOTE: The furnace control CPU controls blower motor BLWM speed by sensing only G (for heat pump low-heat speed) and Y2 (for heat pump high-heat speed).

- (2.) The EAC terminals EAC-1 and EAC-2 are energized with 115v when blower motor BLWM is operating on either heating speed.
- (3.) When thermostat is satisfied, R to G or R to G-and-Y2 circuits are opened. After opening R to G-and-Y2 circuit, the furnace blower motor BLWM continues operating on heating speed for an additional 90 sec.
- (4.) Opening R-Y2 circuit reduces blower motor BLWM speed to heat pump low-heat speed.

6. Defrost

- a. When furnace control R to W/W1-and-Y/Y2 circuits are closed, furnace control CPU continues blower motor BLWM operation at heat pump heating speed until end of prepurge period, then shuts off until end of HSI ignitor on period (22 sec).
- b. When installed with a heat pump, furnace control CPU automatically holds blower off time to 22 sec during HSI ignitor on period. After 17 sec of HSI ignitor on period, a trial-for-ignition sequence occurs as described above for gas heating. After flame is proved and without blower on delay, blower motor BLWM then operates on high-gas-heat speed during defrost. For both single-speed and 2-speed heat pumps, defrost mode is in high-gas heat only.
- c. When furnace control R to W/W1 circuit is opened, furnace control CPU begins normal inducer post-purge period, and blower motor BLWM remains on for blower off delay period. If R-G circuit remains closed, blower motor BLWM reverts to continuous operation.

C. Start-Up Procedures

- 1. Component test—The furnace features a component test system to help diagnose a system problem in case of component failure. To initiate component test procedure, ensure that there are no thermostat inputs to control and that all time delays have expired. Short TWIN/TEST terminal to ground or Com for 1 to 4 sec. See Fig. 14 for terminal locations.


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

The component test sequence is as follows:

- a. The furnace control checks itself, operates inducer motor on low speed for 7 sec and on high speed for 7 sec, then stops.
- b. The hot surface ignitor is then energized for 15 sec, then de-energized.
- c. The blower motor operates on low-gas-heat/heat pump low-heat/low-cool/continuous fan speed for 7 sec, then stops.
- d. The blower motor operates on high-gas-heat speed for 7 sec, then stops. The gas valve and humidifier terminal HUM are not energized for safety reasons.

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

- e. The blower operates on heat pump high-heat/high-cool speed for 7 sec, then stops.
- 2. After all connections have been made, purge gas lines and check for leaks.

	<p>WARNING: Never purge a line into a combustion chamber. Never use matches, candles, flame, or other sources of ignition to check for gas leakage. Use a soap-and-water solution to check for gas leaks. A failure to follow this warning could result in fire, explosion, personal injury, or death.</p>
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- 3. To operate furnace, follow procedures on operating instruction label attached to furnace.
- 4. With furnace operating, set thermostat below room temperature and observe that furnace goes off. Set thermostat above room temperature and observe that furnace restarts.

D. Adjustments

- 1. Set gas input rate.
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.
 - a. Determine natural gas orifice size and manifold pressure for correct input.
 - (1.) Obtain yearly heat value average (at installed altitude) from local gas supplier.
 - (2.) Obtain yearly specific gravity average from local gas supplier.
 - (3.) Verify furnace model. Table 10 can only be used for model 331AAV Furnaces.
 - (4.) Find installation altitude in Table 10.

NOTE: For Canada altitudes of 2000 to 4500 ft, use U.S.A. altitudes of 2001 to 3000 ft in Table 10.

- (5.) Find closest natural gas heat value and specific gravity in Table 10.
- (6.) 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: 3.7-in. wc for high heat

1.5-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.

(7.) Check and verify burner orifice size in furnace. NEVER ASSUME ORIFICE SIZE; ALWAYS CHECK AND VERIFY.

b. Adjust manifold pressure to obtain input rate.

(1.) Remove caps that conceal adjustment screws for low- and high-heat gas valve regulators. (See Fig. 19.)

(2.) Move setup switch SW-2 on control center to ON position. (See Fig. 17.) This keeps furnace locked in low-heat operation.

(3.) Jumper R and W/W1 thermostat connections on control center to start furnace.

(4.) 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.

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.

(5.) Move setup switch SW-2 to OFF position after completing low-heat adjustment.

(6.) Jumper R and W2 thermostat connections on control center. (See Fig. 14.) This keeps furnace locked in high-heat operation.

(7.) 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.

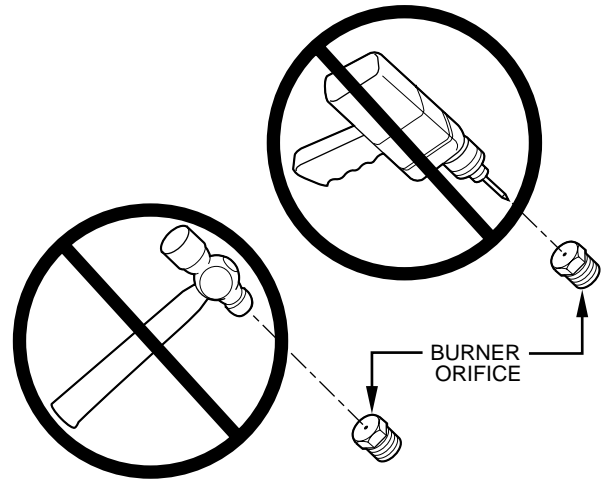
(8.) When correct input is obtained, replace caps that conceal gas valve regulator adjustment screws. Main burner flame should be clear blue, almost transparent. (See Fig. 20.)

(9.) Remove jumper R to W2.

c. Verify natural gas input rate by clocking gas meter.

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 9 for derate multiplier factor and example.



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CAUTION: DO NOT redrill orifices. Improper drilling (burrs, out-of-round can cause holes, etc.) excessive burner noise and misdirection of burner flames. This can result in flame impingement of burners and heat exchangers, causing failures.

TABLE 9—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.

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 0.82 as derate multiplier factor.

a. Check that gas valve adjustment caps are in place for proper input to be clocked.

b. Obtain yearly 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.

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

d. Turn off all other gas appliances and pilots.

e. Move setup switch SW-2 to ON position. (See Fig. 17.) This keeps furnace locked in low-heat operation.

f. Jumper R to W/W1.

**TABLE 10—MODEL 331AAV ORIFICE SIZE AND MANIFOLD PRESSURE FOR CORRECT INPUT
(TABULATED DATA BASED ON 21,000 BTUH HIGH HEAT/13,500 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	42	3.3/1.4	42	3.4/1.4	42	3.5/1.5	42	3.7/1.5	42	3.8/1.6
		875	43	3.8/1.6	42	3.2/1.3	42	3.3/1.4	42	3.5/1.4	42	3.6/1.5
		900	43	3.6/1.5	43	3.7/1.5	42	3.2/1.3	42	3.3/1.3	42	3.4/1.4
		925	43	3.4/1.4	43	3.5/1.5	43	3.6/1.5	43	3.8/1.6	42	3.2/1.3
		950	44	3.7/1.5	44	3.8/1.6	43	3.5/1.4	43	3.6/1.5	43	3.7/1.5
		975	44	3.5/1.5	44	3.6/1.5	44	3.8/1.6	43	3.4/1.4	43	3.5/1.4
		1000	44	3.3/1.4	44	3.5/1.4	44	3.6/1.5	44	3.7/1.5	44	3.8/1.6
		1025	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
		1050	45	3.7/1.5	45	3.8/1.6	44	3.2/1.3	44	3.4/1.4	44	3.5/1.4
		1075	46	3.7/1.5	46	3.8/1.6	45	3.7/1.5	44	3.2/1.3	44	3.3/1.4
1100	46	3.5/1.5	46	3.6/1.5	46	3.8/1.6	45	3.7/1.5	45	3.8/1.6		
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. and Canada	U.S.A. Altitudes 2001 to 3000 or Canada Altitudes 2000 to 4500	775	43	3.7/1.5	42	3.2/1.3	42	3.3/1.4	42	3.4/1.4	42	3.5/1.4
		800	43	3.5/1.4	43	3.6/1.5	43	3.7/1.5	42	3.2/1.3	42	3.3/1.3
		825	44	3.8/1.6	43	3.4/1.4	43	3.5/1.5	43	3.6/1.5	43	3.7/1.5
		850	44	3.6/1.5	44	3.7/1.5	44	3.8/1.6	43	3.4/1.4	43	3.5/1.5
		875	44	3.4/1.4	44	3.5/1.4	44	3.6/1.5	44	3.7/1.5	44	3.8/1.6
		900	44	3.2/1.3	44	3.3/1.4	44	3.4/1.4	44	3.5/1.4	44	3.6/1.5
		925	46	3.8/1.6	45	3.8/1.6	44	3.2/1.3	44	3.3/1.4	44	3.4/1.4
		950	46	3.6/1.5	46	3.7/1.5	45	3.7/1.5	45	3.8/1.6	44	3.2/1.3
		975	46	3.4/1.4	46	3.5/1.5	46	3.7/1.5	46	3.8/1.6	45	3.7/1.5
		1000	47	3.7/1.5	47	3.8/1.6	46	3.5/1.4	46	3.6/1.5	46	3.7/1.5
1025	47	3.5/1.5	47	3.6/1.5	47	3.8/1.6	46	3.4/1.4	46	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	3001 to 4000	750	43	3.5/1.4	43	3.6/1.5	43	3.7/1.5	42	3.2/1.3	42	3.3/1.4
		775	44	3.8/1.6	43	3.4/1.4	43	3.5/1.4	43	3.6/1.5	43	3.7/1.5
		800	44	3.5/1.5	44	3.7/1.5	44	3.8/1.6	43	3.4/1.4	43	3.5/1.4
		825	44	3.3/1.4	44	3.4/1.4	44	3.5/1.5	44	3.7/1.5	44	3.8/1.6
		850	45	3.8/1.6	44	3.2/1.3	44	3.3/1.4	44	3.4/1.4	44	3.6/1.5
		875	46	3.7/1.5	45	3.7/1.5	44	3.2/1.3	44	3.3/1.3	44	3.4/1.4
		900	46	3.5/1.5	46	3.7/1.5	46	3.8/1.6	45	3.7/1.5	44	3.2/1.3
		925	47	3.8/1.6	46	3.5/1.4	46	3.6/1.5	46	3.7/1.5	46	3.8/1.6
		950	47	3.6/1.5	47	3.7/1.5	46	3.4/1.4	46	3.5/1.5	46	3.6/1.5
		975	47	3.4/1.4	47	3.5/1.5	47	3.7/1.5	47	3.8/1.6	46	3.4/1.4
1000	48	3.7/1.5	48	3.8/1.6	47	3.5/1.4	47	3.6/1.5	47	3.7/1.5		

* For 060125 size only, input is 20,500 Btuh for high fire. Deduct 0.1-in. from manifold pressure shown in table. Change orifice size if manifold pressure falls below 3.2-in. wc.

TABLE 10—MODEL 331AAV ORIFICE SIZE AND MANIFOLD PRESSURE FOR CORRECT INPUT Continued
(TABULATED DATA BASED ON 21,000 BTUH HIGH HEAT/13,500 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	3.8/1.6	43	3.4/1.4	43	3.5/1.4	43	3.6/1.5	43	3.7/1.5
		750	44	3.5/1.5	44	3.6/1.5	44	3.8/1.6	43	3.4/1.4	43	3.5/1.4
		775	44	3.3/1.4	44	3.4/1.4	44	3.5/1.5	44	3.6/1.5	44	3.7/1.5
		800	45	3.7/1.5	44	3.2/1.3	44	3.3/1.4	44	3.4/1.4	44	3.5/1.5
		825	46	3.7/1.5	46	3.8/1.6	45	3.8/1.6	44	3.2/1.3	44	3.3/1.4
		850	46	3.5/1.4	46	3.6/1.5	46	3.7/1.5	46	3.8/1.6	45	3.8/1.6
		875	47	3.7/1.5	46	3.4/1.4	46	3.5/1.5	46	3.6/1.5	46	3.7/1.5
		900	47	3.5/1.5	47	3.6/1.5	47	3.8/1.6	46	3.4/1.4	46	3.5/1.5
		925	48	3.8/1.6	47	3.4/1.4	47	3.6/1.5	47	3.7/1.5	47	3.8/1.6
950	48	3.6/1.5	48	3.7/1.5	48	3.8/1.6	47	3.5/1.4	47	3.6/1.5		
U.S.A. Only	5001 to 6000	700	44	3.5/1.5	44	3.6/1.5	44	3.8/1.6	43	3.4/1.4	43	3.5/1.4
		725	44	3.3/1.4	44	3.4/1.4	44	3.5/1.4	44	3.6/1.5	44	3.7/1.5
		750	45	3.7/1.5	44	3.2/1.3	44	3.3/1.4	44	3.4/1.4	44	3.5/1.4
		775	46	3.6/1.5	46	3.8/1.6	45	3.7/1.5	44	3.2/1.3	44	3.3/1.4
		800	46	3.4/1.4	46	3.5/1.5	46	3.7/1.5	46	3.8/1.6	45	3.7/1.5
		825	47	3.7/1.5	47	3.8/1.6	46	3.4/1.4	46	3.6/1.5	46	3.7/1.5
		850	47	3.4/1.4	47	3.6/1.5	47	3.7/1.5	47	3.8/1.6	46	3.5/1.4
		875	48	3.7/1.5	48	3.8/1.6	47	3.5/1.4	47	3.6/1.5	47	3.7/1.5
		900	48	3.5/1.4	48	3.6/1.5	48	3.7/1.5	47	3.4/1.4	47	3.5/1.4
		925	48	3.3/1.4	48	3.4/1.4	48	3.5/1.5	48	3.6/1.5	48	3.8/1.6
		950	49	3.7/1.5	49	3.8/1.6	48	3.3/1.4	48	3.5/1.4	48	3.6/1.5
		975	49	3.5/1.4	49	3.6/1.5	49	3.7/1.5	48	3.3/1.4	48	3.4/1.4
		1000	49	3.3/1.4	49	3.4/1.4	49	3.6/1.5	49	3.7/1.5	49	3.8/1.6
U.S.A. Only	6001 to 7000	650	44	3.5/1.5	44	3.7/1.5	44	3.8/1.6	43	3.4/1.4	43	3.5/1.4
		675	44	3.3/1.4	44	3.4/1.4	44	3.5/1.4	44	3.6/1.5	44	3.7/1.5
		700	45	3.7/1.5	44	3.2/1.3	44	3.3/1.3	44	3.4/1.4	44	3.5/1.4
		725	46	3.6/1.5	46	3.7/1.5	45	3.7/1.5	45	3.8/1.6	44	3.2/1.3
		750	47	3.8/1.6	46	3.5/1.4	46	3.6/1.5	46	3.7/1.5	46	3.8/1.6
		775	47	3.6/1.5	47	3.7/1.5	47	3.8/1.6	46	3.5/1.4	46	3.6/1.5
		800	48	3.8/1.6	47	3.5/1.4	47	3.6/1.5	47	3.7/1.5	47	3.8/1.6
		825	48	3.6/1.5	48	3.7/1.5	48	3.8/1.6	47	3.5/1.4	47	3.6/1.5
		850	48	3.4/1.4	48	3.5/1.4	48	3.6/1.5	48	3.7/1.5	47	3.4/1.4
		875	49	3.8/1.6	48	3.3/1.4	48	3.4/1.4	48	3.5/1.5	48	3.6/1.5

* For 060125 size only, input is 20,500 Btuh for high fire. Deduct 0.1-in. from manifold pressure shown in table. Change orifice size if manifold pressure falls below 3.2-in. wc.

TABLE 10—MODEL 331AAV ORIFICE SIZE AND MANIFOLD PRESSURE FOR CORRECT INPUT Continued
(TABULATED DATA BASED ON 21,000 BTUH HIGH HEAT/13,500 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	44	3.3/1.4	44	3.4/1.4	44	3.5/1.5	44	3.6/1.5	44	3.7/1.5
		650	45	3.7/1.5	45	3.8/1.6	44	3.3/1.3	44	3.4/1.4	44	3.5/1.4
		675	46	3.6/1.5	46	3.7/1.5	46	3.8/1.6	45	3.8/1.6	44	3.2/1.3
		700	47	3.8/1.6	46	3.4/1.4	46	3.6/1.5	46	3.7/1.5	46	3.8/1.6
		725	47	3.5/1.5	47	3.6/1.5	47	3.8/1.6	46	3.4/1.4	46	3.5/1.5
		750	48	3.7/1.5	47	3.4/1.4	47	3.5/1.5	47	3.6/1.5	47	3.7/1.5
		775	48	3.5/1.5	48	3.6/1.5	48	3.8/1.6	47	3.4/1.4	47	3.5/1.4
		800	48	3.3/1.4	48	3.4/1.4	48	3.5/1.5	48	3.6/1.5	48	3.7/1.5
		825	49	3.6/1.5	49	3.8/1.6	48	3.3/1.4	48	3.4/1.4	48	3.5/1.5
		850	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
U.S.A. Only	8001 to 9000	600	45	3.7/1.5	44	3.2/1.3	44	3.3/1.4	44	3.4/1.4	44	3.5/1.4
		625	46	3.6/1.5	46	3.7/1.5	46	3.8/1.6	45	3.8/1.6	44	3.2/1.3
		650	47	3.8/1.6	46	3.4/1.4	46	3.5/1.5	46	3.7/1.5	46	3.8/1.6
		675	47	3.5/1.4	47	3.6/1.5	47	3.7/1.5	47	3.8/1.6	46	3.5/1.4
		700	48	3.7/1.5	48	3.8/1.6	47	3.5/1.4	47	3.6/1.5	47	3.7/1.5
		725	48	3.4/1.4	48	3.6/1.5	48	3.7/1.5	48	3.8/1.6	47	3.4/1.4
		750	49	3.8/1.6	48	3.3/1.4	48	3.4/1.4	48	3.5/1.5	48	3.7/1.5
		775	49	3.5/1.5	49	3.7/1.5	49	3.8/1.6	48	3.3/1.4	48	3.4/1.4
		800	49	3.3/1.4	49	3.4/1.4	49	3.5/1.5	49	3.7/1.5	49	3.8/1.6
		U.S.A. Only	9001 to 10,000	575	46	3.6/1.5	46	3.7/1.5	46	3.8/1.6	45	3.8/1.6
600	47			3.7/1.5	46	3.4/1.4	46	3.5/1.5	46	3.6/1.5	46	3.8/1.6
625	47			3.4/1.4	47	3.6/1.5	47	3.7/1.5	47	3.8/1.6	46	3.5/1.4
650	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
675	48			3.4/1.4	48	3.5/1.4	48	3.6/1.5	48	3.7/1.5	48	3.8/1.6
700	49			3.7/1.5	49	3.8/1.6	48	3.3/1.4	48	3.5/1.4	48	3.6/1.5
725	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
750	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
775	50			3.5/1.5	50	3.7/1.5	50	3.8/1.6	49	3.3/1.4	49	3.4/1.4

* For 060125 size only, input is 20,500 Btuh for high fire. Deduct 0.1-in. from manifold pressure shown in table. Change orifice size if manifold pressure falls below 3.2-in. wc.

TABLE 11—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				

- g. Let furnace run for 3 minutes in low-heat operation.
- h. Measure time (in sec) for gas meter to complete 1 revolution. Note reading.
- i. Refer to Table 11 for cubic ft of gas per hr.
- j. Multiply gas rate cu ft/hr by heating value (Btu/cu ft).
- k. Move setup switch SW-2 to OFF position and jumper R and W2 thermostat connections. (See Fig. 17.) 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 11)
 Btu heating input = 80 X 1050 = 84,000 Btuh In this example, the orifice size and manifold pressure adjustment is within ±2 percent of the furnace input rate.

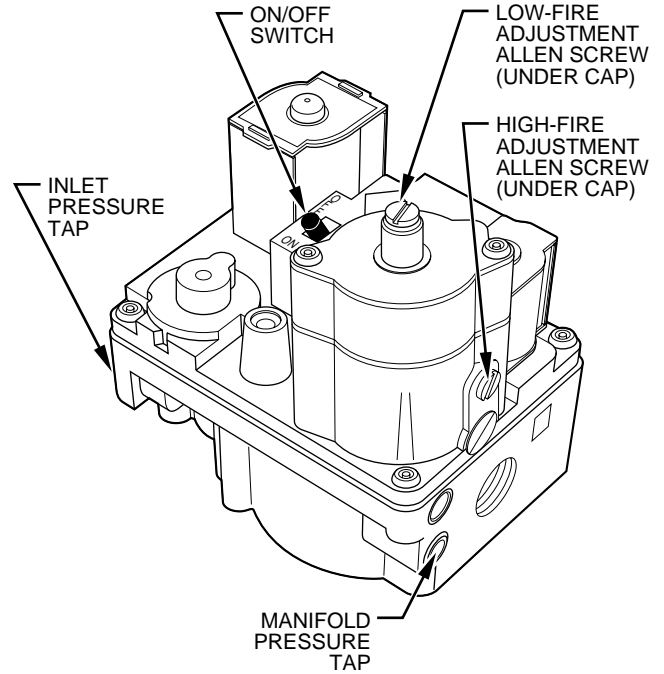
NOTE: Measured gas inputs (high heat and low heat) must be within ±2 percent of that stated on furnace rating plate when installed at sea level or derated per that stated above when installed at higher altitudes.

1. Remove jumper across R, W/W1, and W2 thermostat connections to terminate call for heat.
2. Set temperature rise.

Place SW-2 in ON position. Jumper R to W/W1 and W2 to check high-gas-heat temperature rise. To check low-gas-

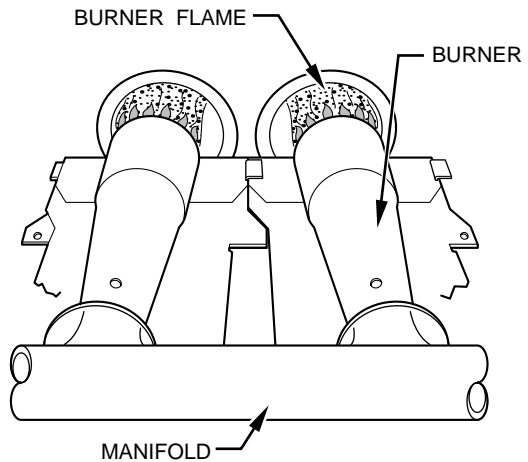
heat temperature rise, remove jumper to W2. Determine air temperature rise for both high and low heat using the following steps. DO NOT exceed temperature rise ranges specified on unit rating plate for high and low heat.

- 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.



A97358

Fig. 19—Redundant Automatic Gas Control Valve



A89020

Fig. 20—Burner Flame

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

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

- (1.) Gas input for low- and high-heat operation.
- (2.) Derate for altitude if applicable.
- (3.) Return and supply ducts for excessive restrictions causing static pressures greater than 0.50-in. wc.

- c. Adjust air temperature rise by adjusting blower speed. Increase blower speed to reduce temperature rise. Decrease blower speed to increase temperature rise. For

high heat, speed selection can be med-high, med (5-speed blowers only), or med-low (factory setting). For low heat, speed tap selection can be low (factory setting), med-low, or med (5-speed blowers only).

WARNING: Disconnect electrical power before changing speed tap (or removing cap on 5-speed motors). A failure to follow this warning can cause personal injury or death.

NOTE: For furnaces with 5-speed motors, ensure that unused speed tap is capped before power is restored.

- d. To change motor speed selection for high heat, remove blower motor lead from control HIGH-GAS-HEAT terminal. (See Fig. 14 and Fig. 18.) Select desired blower motor speed lead from 1 of the other terminals and relocate it to HIGH-GAS-HEAT terminal. See Table 12 for lead color identification. Reconnect original lead to PARK terminal (or cover with insulating cap, applies only to furnaces with 5-speed blower motors). Follow this same procedure for proper selection of cool and low-gas-heat speed selection.

TABLE 12—SPEED SELECTION

COLOR	SPEED	AS SHIPPED
White	Common	COM
Black	High	Cool
Orange†	Med	Capped
Yellow	Med-High	Park
Blue	Med-Low	High-Gas-Heat
Red	Low*	Low-Gas-Heat

* Continuous fan speed.

† Available on 5-speed blowers only.

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

3. Set thermostat heat anticipator.

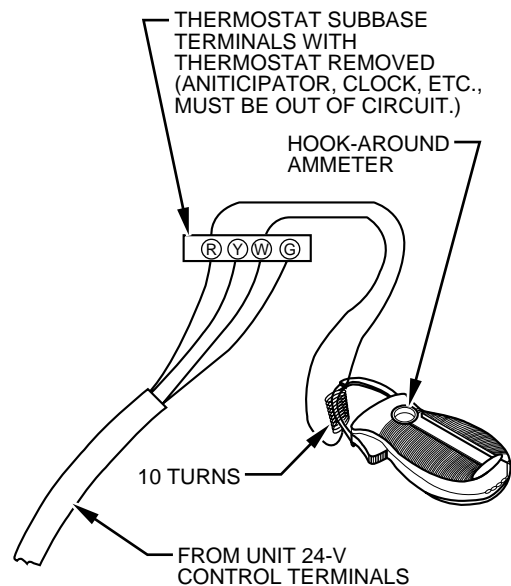
- a. When using a nonelectronic thermostat, the thermostat heat anticipation must be set to match amp draw of electrical components in R-W/W1 circuit. Accurate amp draw readings can be obtained at wires normally connected to thermostat subbase terminals R and W/W1. Fig. 21 illustrates an easy method of obtaining 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. 21. The thermostat anticipator should NOT be in this circuit while measuring current. If thermostat has no subbase, thermostat MUST be disconnected from R and W/W1 wires during current measurement. Return SW-2 to final desired location after completing reading. See 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.

E. Check Safety Controls

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

1. Check primary limit control.

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



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

A96316

Fig. 21—Amp Draw Check With Ammeter

The preferred method of checking limit control is to gradually block off return air after furnace has been operating for a period of at least 5 minutes. As soon as limit has shut off burners, return-air opening should be unblocked. By using this method to check 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 permit 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.
- 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 lead wires from wire harness.
- c. Turn on 115-v power to furnace
- d. Close thermostat switch as if making normal furnace start. If hot surface ignitor does not glow within several minutes and control flashes code 32, pressure switches are functioning properly.
- e. Turn off 115-v power to furnace.
- f. Reconnect inducer motor wires, replace gas control door, and turn on 115-v power to furnace.

4. Check auxiliary limits.

- a. Turn off 115-v power to furnace.

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

F. 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 7 and 8.
- 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.