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Installation, Start-Up, and Operating Instructions
Sizes 050-135, Series 161

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

This symbol → indicates a change since the last issue.

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SAFETY CONSIDERATIONS

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

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

Table 1—Clearances From Combustible Materials (In.)

UNIT SIZE		050 AND 070	096-135
DOWNFLOW (In Alcove or Closet)			
Sides	Single-Wall Vent	1	0
	Type B-1 Double-Wall Vent	0	0
Back		0	0
Top		1	1
Front	Single-Wall Vent	6†	6†
	Type B-1 Double-Wall Vent	3†	3†
Vent	Single-Wall Vent	6	6
	Type B-1 Double-Wall Vent	1	1
HORIZONTAL (Attic, Alcove, or Crawlspace)			
Sides *		1	0
Back		0	0
Top	Single-Wall Vent	1	1
	Type B-1 Double-Wall Vent	1	1
Front‡	Single-Wall Vent	6†	6†
	Type B-1 Double-Wall Vent	3†	3†
Vent	Single-Wall Vent	6	6
	Type B-1 Double-Wall Vent	1	1
HORIZONTAL (In Closet)			
Sides *		1	1
Back		3	3
Top	Single-Wall Vent	2	2
	Type B-1 Double-Wall Vent	2	2
Front	Single-Wall Vent	6	6
	Type B-1 Double-Wall Vent	3	3
Vent	Single-Wall Vent	6	6
	Type B-1 Double-Wall Vent	1	1

* Indicates supply or return sides when furnace is in the horizontal position.
† Clearance shown is for outlet end. The inlet end must maintain 6-in. minimum clearance from the vent to combustible materials when using single-wall vent.
‡ Minimum 18-in. front clearance required for alcove.
NOTES:
1. Provide 30-in. front clearance for servicing. An open door in front of the furnace can meet this requirement.
2. A minimum clearance of 3 in. must be provided in front of the furnace for combustion air and proper operation.
3. Line contact is permitted as shown in Fig. 7.

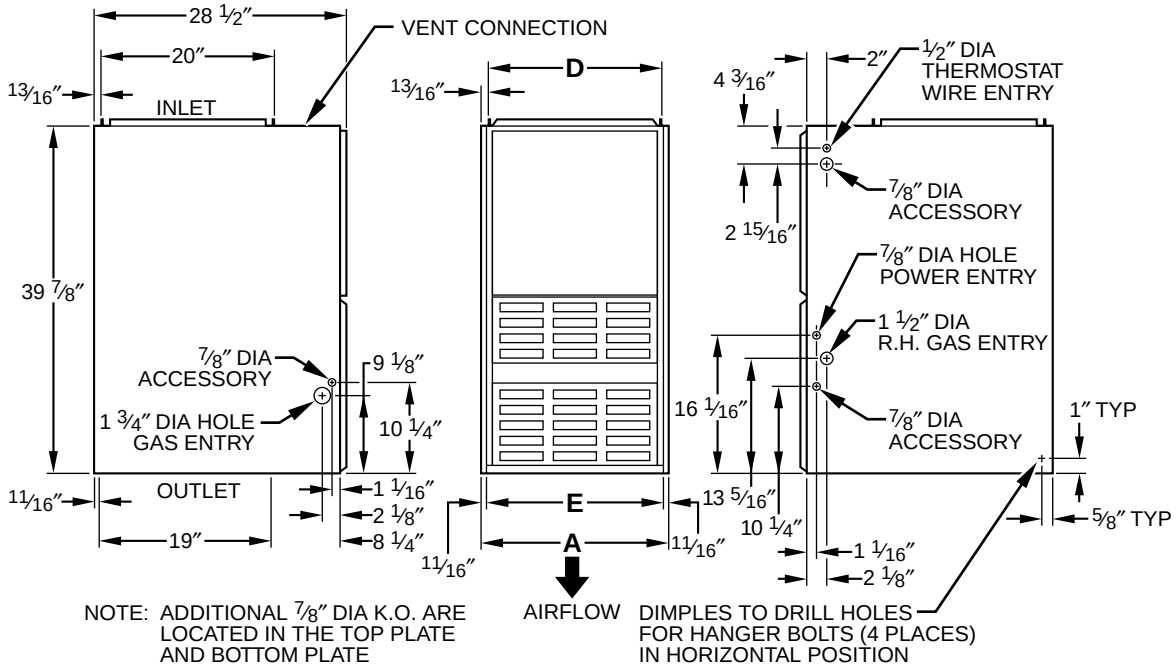

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Fig. 1—Dimensional Drawing

Table 2—Dimensions (In.)

UNIT SIZE	A	D	E	VENT CONN	SHIP. WT (LB)
050-08	14-3/16	12-9/16	12-11/16	4	124
050-12	14-3/16	12-9/16	12-11/16	4	127
070-08	14-3/16	12-9/16	12-11/16	4	141
070-12	14-3/16	12-9/16	12-11/16	4	145
096-12	17-1/2	15-7/8	16	4	154
096-16	17-1/2	15-7/8	16	4	154
115-16	17-1/2	15-7/8	16	4	171
115-20	21	19-3/8	19-1/2	4	181
135-20	24-1/2	22-7/8	23	5	192

→ Follow all safety codes. In the United States, follow all safety codes including the National Fuel Gas Code (NFGC) NFPA No. 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 current edition of the National Standard of Canada CAN/CGA-B149.1- and .2-M95 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 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 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.

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 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 58RAV Series 161 Furnaces are available in sizes 50,000 through 135,000 Btuh input capacities.

The design of the downflow/horizontal gas-fired furnace is A.G.A./C.G.A. certified for natural and propane gases and for installation on noncombustible flooring. The furnace 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** A.G.A./C.G.A. certified for installation in mobile homes, recreation vehicles, or outdoors.

Before installing the furnace, refer to the current edition of the NFGC and the NFPA 90B. Canadian installations must be installed in accordance NSCNGPIC and all authorities having jurisdiction. For a copy of the NFGC NFPA54/Z223.1, contact International Approval Services U.S. Inc., 8501 E. Pleasant Valley Road, Cleveland, OH 44131 or National Fire Protection Association Inc., Batterymarch Park, Quincy, MA 02269. For a copy of NFPA 90B, contact National Fire Protection Association Inc., Batterymarch Park, Quincy, MA 02269.

Before installing the furnace in Canada, refer to the current edition of the NSCNGPIC. Contact Standards Department of Canadian Gas Association, 55 Scarsdale Road, Don Mills, Ontario, Canada M3B 2R3

⚠ CAUTION

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

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

This furnace is designed for a minimum continuous return-air temperature of 60°F db or intermittent operation down to 55°F db such as when used with a night setback thermostat. Return-air temperature must not exceed a maximum of 85°F db.

⚠ 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. Failure to follow this warning could result in electrical shock, fire, personal injury, or death.

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

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

Step 1—Location

GENERAL

⚠ CAUTION

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

⚠ CAUTION

Do not use this furnace during construction when adhesives, sealers, and/or new carpets are being installed. If the furnace is required during construction, use clean outside air for combustion and ventilation. Compounds of chlorine and fluorine when burned with combustion air form acids which cause corrosion of the heat exchangers and metal vent system. Some of these compounds are found in 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 the electrical components are protected from water.

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

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

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

LOCATION RELATIVE TO COOLING EQUIPMENT — The cooling coil must be installed parallel with or on the downstream side of the furnace to avoid condensation in the heat exchangers. When installed parallel with a furnace, dampers or other means used to control the flow of air must prevent chilled air from

entering the unit. If the dampers are manually operated, they must be equipped with means to prevent operation of either unit unless the damper is in the full-heat or full-cool position.

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

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

Step 2—Air For Combustion and Ventilation

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

Canadian installations must be installed in accordance with NSC-NGPIC 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 PRESSURE CONDITION at the furnace. Make-up air MUST be provided for the ventilation devices, in addition to that required by the furnace.

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

The requirements for combustion and ventilation air depend upon whether the furnace is located in an unconfined or confined space.

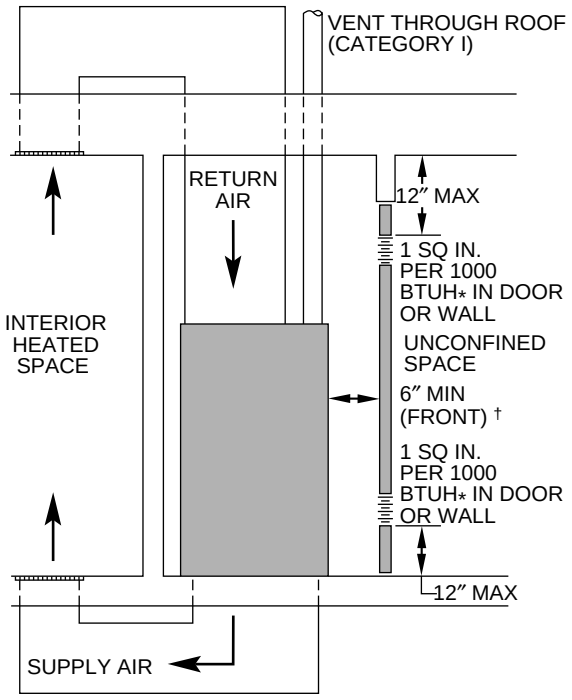
UNCONFINED SPACE — An unconfined space must have at least 50 cu ft for each 1000 Btuh of input for all the appliances (such as furnaces, clothes dryer, water heaters, etc.) in the space.

For Example:

58RAV FURNACE INPUT BTUH	MINIMUM SQ FT WITH 7-1/2 FT CEILING
46,000	307
69,000	460
92,000	613
115,000	767
135,000	920

If the unconfined space is constructed unusually tight, air for combustion and ventilation MUST come from either the outdoors or spaces freely communicating with the outdoors. Combustion and ventilation openings must be sized the same as for a confined space. A minimum opening with a total of at least 1 sq in. per 5000 Btuh of total input rating for all equipment must be provided. Return air must not be taken from the room unless an equal or greater amount of air is supplied to the room.

CONFINED SPACE — A confined space has volume less than 50 cu ft per 1000 Btuh of the total input ratings of all appliances installed in that space. A confined space MUST have 2 permanent openings, 1 within 12 in. of the ceiling, and the other within 12 in. of the floor. (See Fig. 2.)



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

† Minimum of 3-In. when type B-1 vent is used.

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

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

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

1. All air from inside the structure:
   a. Each opening MUST have at least 1 sq in. of free area per 1000 Btuh of the total input for all equipment within the confined space, but not less than 100 sq in. per opening. (See Fig. 2.)

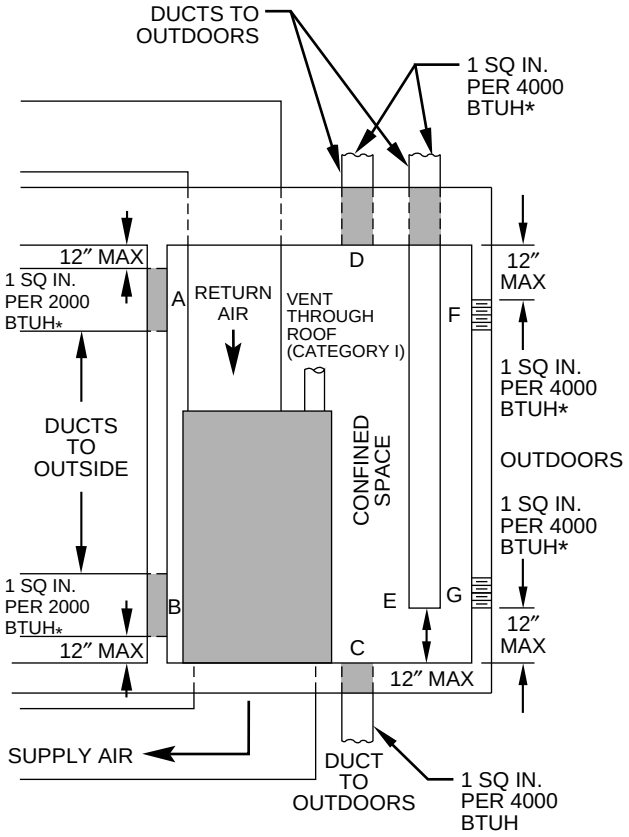
For Example:

58RAV FURNACE INPUT BTUH	FREE AREA PER OPENING (SQ IN.)
46,000	100
69,000	100
92,000	100
115,000	115
135,000	138

   b. If the building is constructed unusually tight, in addition to the 2 permanent openings that freely communicate with an unconfined space, a permanent opening directly communicating with the outdoors should be provided. This opening

should have a minimum free area of 1 sq in. per 5000 Btuh of total input rating for all equipment in the enclosure.

c. If the furnace is installed on a raised platform to provide a return-air plenum, and return air is taken directly from the hallway or space adjacent to the furnace, all air for combustion must come from outdoors. (See Fig. 3.)



*Minimum dimensions of 3-In.

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

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

2. All air from outside the structure:

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

For Example:

58RAV FURNACE INPUT BTUH	FREE AREA PER OPENING (SQ IN.)	ROUND PIPE (IN. DIA)
46,000	11.5	4
69,000	17.3	5
92,000	23.0	6
115,000	28.8	7
135,000	34.5	7

   b. If combustion air is taken from the outdoors through horizontal ducts, the openings and ducts MUST have at least 1 sq in. of free area per 2000 Btuh of the total input for all equipment within the confined space.

For Example:

58RAV FURNACE INPUT BTUH	FREE AREA PER OPENING (SQ IN.)	ROUND PIPE (IN. DIA)
46,000	23.0	6
69,000	34.3	7
92,000	46.0	8
115,000	57.6	9
135,000	69.0	10

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

→ Step 3—Supply-Air Plenum Installation (Downflow)

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. 4.
3. Construct plenum to dimensions specified in Table 3.
4. If downflow subbase (KGASB) is used, install as shown in Fig. 5.

   If coil assembly CD5, CK5, or Coil Box KCAKC is used, install as shown in Fig. 6.

INSTALLATION ON A COMBUSTIBLE FLOOR

1. Cut and frame hole in floor per dimensions in Installation Instructions packaged with downflow subbase.
2. When completed, coil assembly, coil box, plenum, and furnace should be installed as shown in Fig. 6.

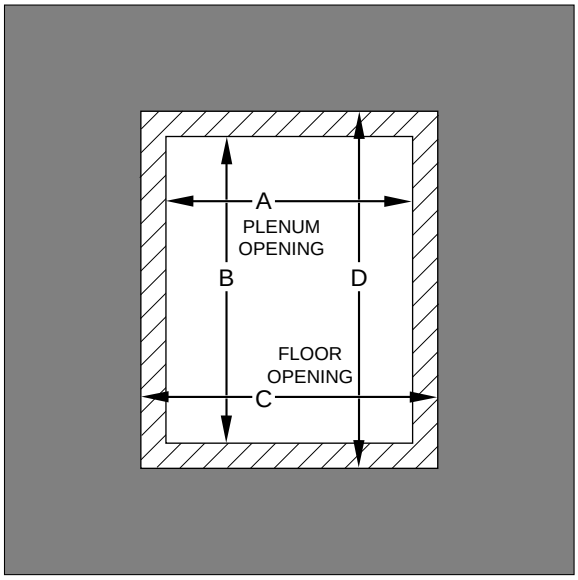

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Fig. 4—Floor and Plenum Opening Dimensions

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

Step 4—Horizontal Attic Installation

⚠ WARNING

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

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

CONSTRUCT A WORKING PLATFORM

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

INSTALL FURNACE

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

→ Step 5—Horizontal Crawlspace Installation

The furnace can be installed horizontally with either the LH or RH side up. In a crawlspace, the furnace can either be hung from the 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 crawlspace installation is very similar to the attic installation, refer to Step 4. The installation of a sheet metal shield in front of the louvered control panel is covered in Step 4. For a crawlspace installation, this same sheet metal shield must be installed above the louvered control panel. Extend the sheet metal shield over the furnace top far enough to cover the gas pipe entry hole.

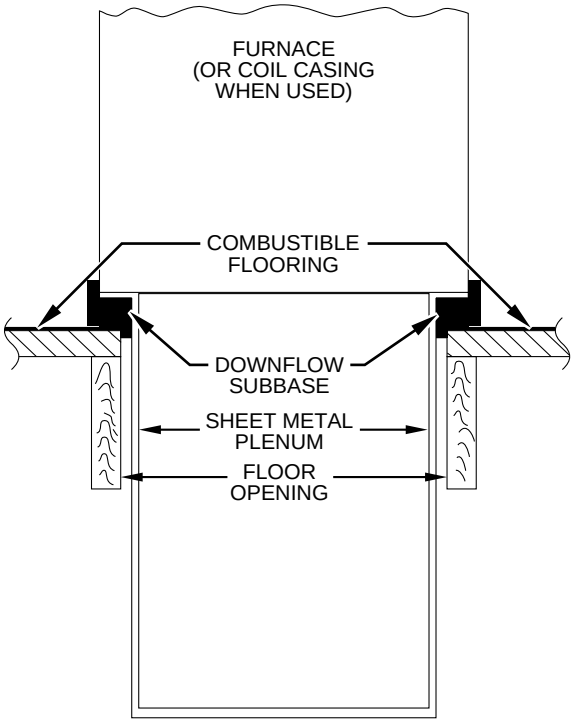

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Fig. 5—Furnace, Plenum, and Subbase Installed on a Combustible Floor

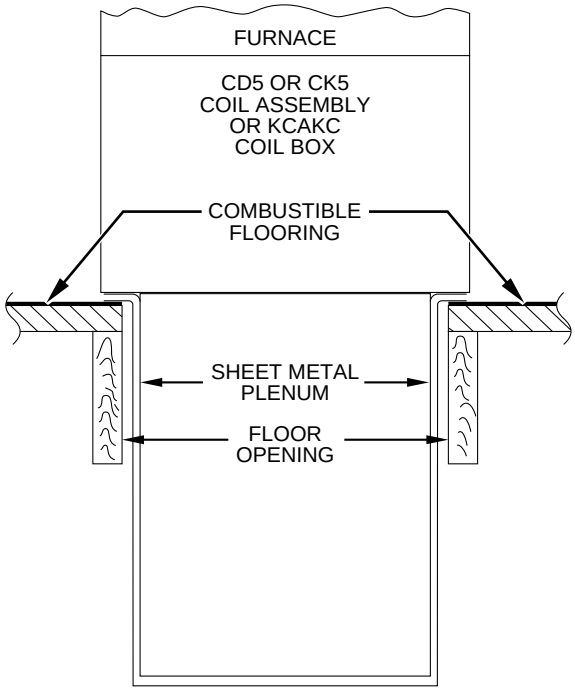

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Fig. 6—Furnace, Plenum, and Coil Assembly or Coil Box Installed on a Combustible Floor

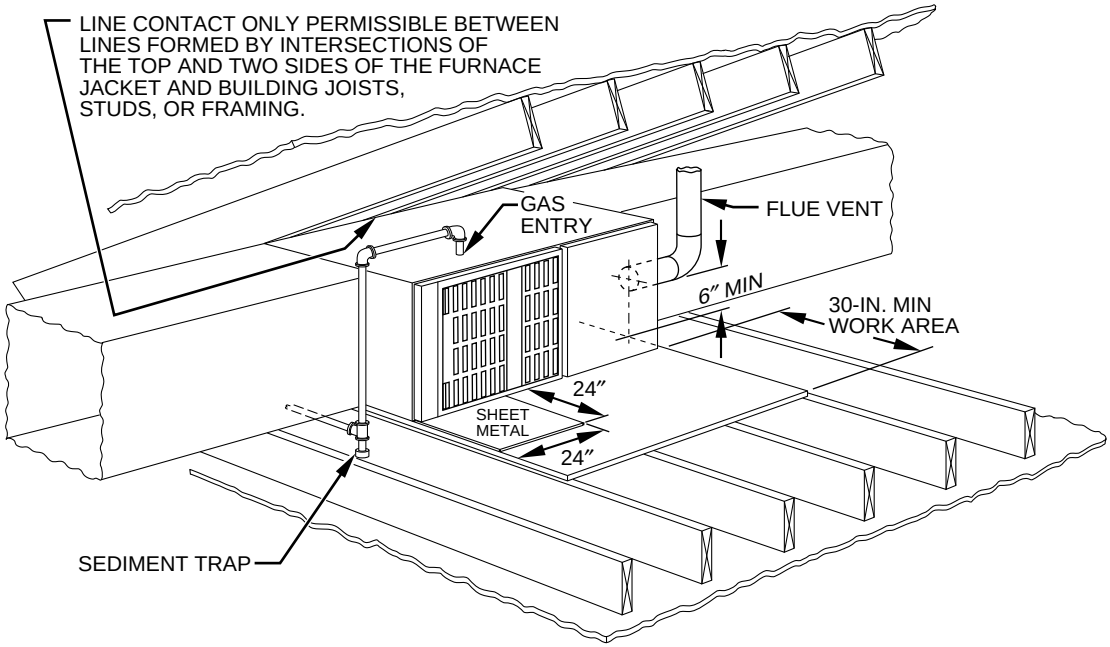

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Fig. 7—Typical Attic Installation

Step 6—Filter Arrangement

⚠ WARNING

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

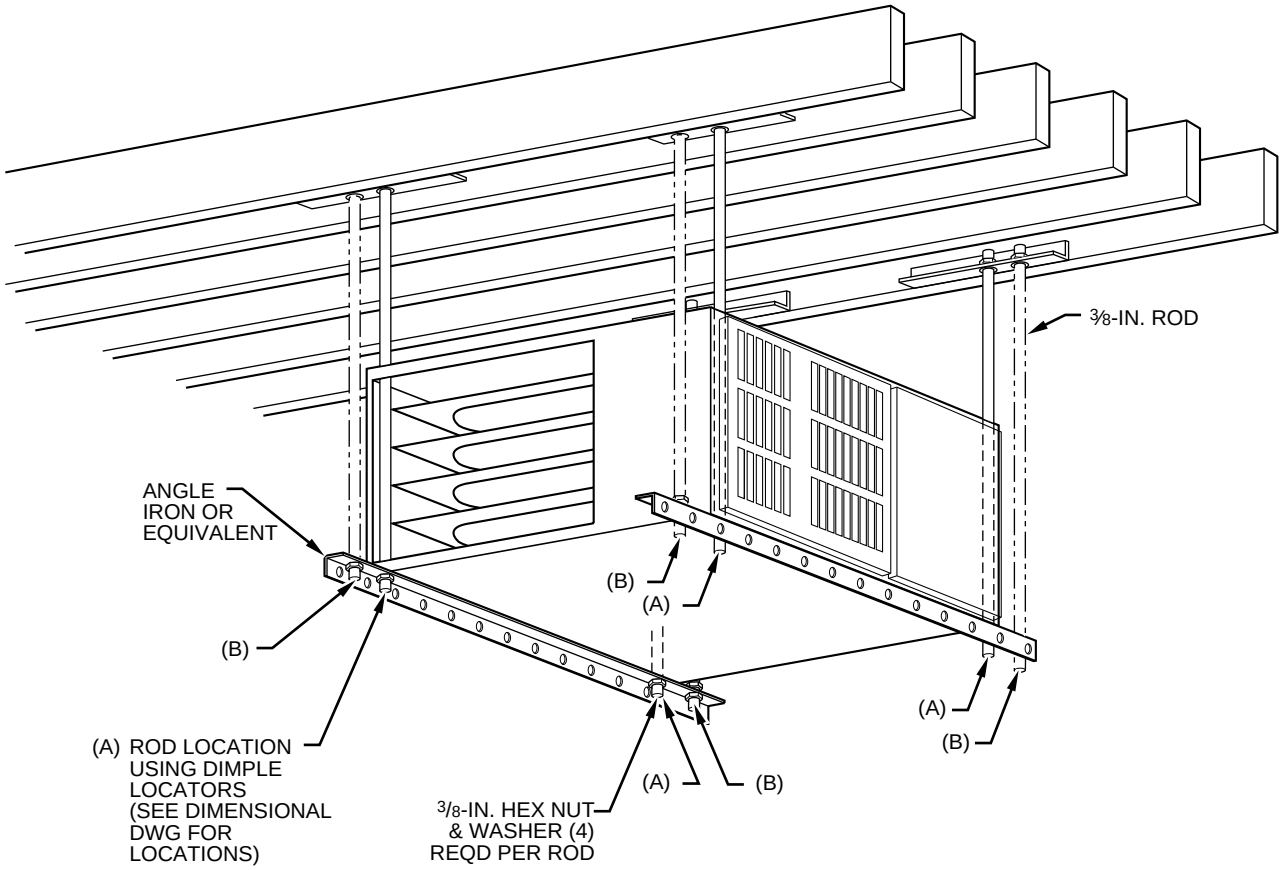
The 2 factory-supplied filters are shipped in the blower compartment. After the return-air duct has been connected to the furnace, install the filters in a V-formation inside the return-air plenum. See Fig. 10 and Table 4 for horizontal applications. Horizontal filter retainers must be field supplied. See Fig. 11 for downflow applications.

Step 7—Gas Piping

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

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

Refer to Table 5 for recommended gas pipe sizing. Risers should be used to connect to the furnace and to the meter.



(A) PREFERRED ROD LOCATION

(B) ALTERNATE ROD LOCATION

NOTES: 1. A 1 In. clearance minimum between top of furnace and combustible material.

2. The entire length of furnace must be supported when furnace is used in horizontal position.

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Fig. 9—Horizontal Crawlspace Installation on Hanger Rods

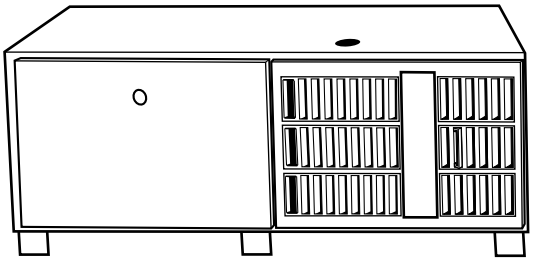

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Fig. 8—Horizontal Installation on Blocks

⚠ CAUTION

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

⚠ WARNING

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

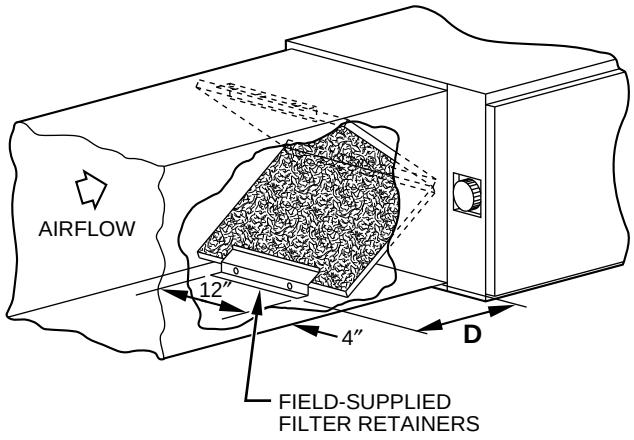

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Fig. 10—Horizontal Filter Arrangement

Table 4—Filter Retainer (In.)

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

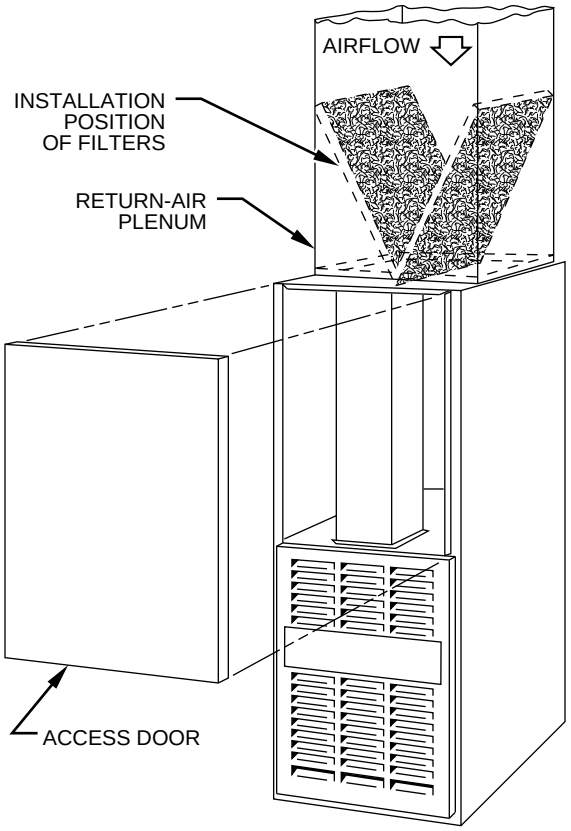

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Fig. 11—Downflow Filter Arrangement

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 pressure drop of 0.5-in. wc (based on a 0.60 specific gravity gas). Ref: Table 10-2 NFPA 54/ANSI Z223.1-1996.

⚠ CAUTION

Connect the gas pipe to the furnace using a backup wrench to avoid damaging gas controls.

⚠ 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. Failure to follow this warning could result in fire, explosion, personal injury, or death.

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

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

Install a sediment trap in the riser leading to the furnace. The trap can be installed by connecting a tee to the riser leading from the furnace. Connect a capped nipple into the lower end of the tee. The capped nipple should extend below the level of the gas controls. (See Fig. 12.)

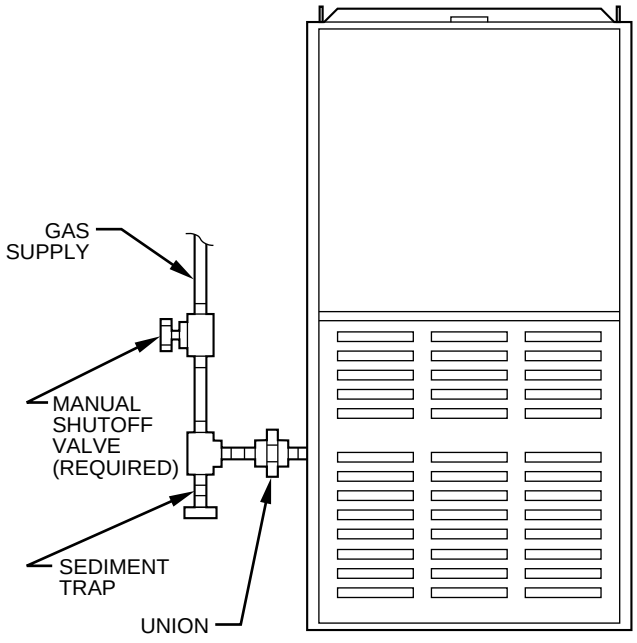

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Fig. 12—Typical Gas Pipe Arrangement

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

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

Step 8—Electrical Connections

115-V WIRING

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

⚠ CAUTION

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

Make all electrical connections in accordance with the current edition of the National Electrical Code (NEC) ANSI/NFPA 70-1996, and any local codes or ordinances that might apply. For Canadian installations, all electrical connections must be made in accordance with Canadian Electrical Code CSA C22.1, or authorities having jurisdiction.

NOTE: Proper polarity must be maintained for 115-v wiring. If polarity is incorrect, control center fault code indicator light will flash rapidly and furnace will not operate.

Table 6—Electrical Data

UNIT SIZE	VOLTS—HERTZ—PHASE	OPERATING VOLTAGE RANGE		MAXIMUM UNIT AMPS	MINIMUM WIRE GAGE	MAXIMUM WIRE LENGTH FT‡	MAXIMUM FUSE OR HACR-TYPE CKT BKR AMPS†
		Maximum*	Minimum*				
050-08	115—60—1	127	104	6.6	14	42	15
050-12	115—60—1	127	104	8.1	14	34	15
070-08	115—60—1	127	104	6.7	14	42	15
070-12	115—60—1	127	104	8.4	14	33	15
096-12	115—60—1	127	104	9.2	14	30	15
096-16	115—60—1	127	104	10.2	14	28	15
115-16	115—60—1	127	104	10.1	14	28	15
115-20	115—60—1	127	104	13.3	12	33	20
135-20	115—60—1	127	104	14.3	12	31	20

* Permissible limits of the voltage range at which the unit will operate satisfactorily.
† Time-delay fuse is recommended.
‡ Length shown is as measured 1 way along wire path between unit and service panel for maximum 2 percent voltage drop.

⚠ WARNING

The cabinet MUST have an uninterrupted or unbroken ground according to NEC ANSI/NFPA 70-1996 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.

24-V WIRING — Make field 24-v connections at the 24-v terminal strip. (See Fig. 13.) Connect terminal Y as shown in Fig. 14 for proper operation in cooling mode. Use AWG No. 18 color-coded wire only.

The 24-v circuit contains an automotive-type, 3-amp fuse located on the main control board. Any direct shorts during installation, service, or maintenance could cause this fuse to blow. If fuse replacement is required, use ONLY a 3-amp fuse of identical size.

ACCESSORIES

1. Electronic air cleaner (EAC)

   Two quick-connect terminals, marked EAC-1 and EAC-2, are provided for EAC connection. (See Fig. 13.) These terminals are energized with 115v (1.5-amp maximum) during blower motor operation.

2. Humidifier (HUM)

   Quick-connect terminal (HUM) and screw terminal (COM) are provided for 24-v humidifier connection. The terminals are energized with 24v (0.5-amp maximum) after inducer motor prepurge period.

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

Step 9—Venting

Refer to the National or Local Installation Code such as; National Fuel Gas Code NFPA No. 54-1996/Z223.1-1996, or the Canadian Installation Code, CAN B149.1- and .2-M95, for proper vent sizing and installation requirements. Use the enclosed Venting Tables for Category I Fan-Assisted Furnaces for a quick, easy reference. 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.

Step 10—Start-up, Adjustment, and Safety Check

GENERAL

NOTE: Proper polarity must be maintained for 115-v wiring. If polarity is incorrect, control center fault indicator light will flash rapidly and furnace will not operate.

The furnace must have a 115-v power supply properly connected and grounded. Proper polarity must be maintained for correct operation. Thermostat wire connections at R, W, C, and Y must be made at the 24-v terminal block on the control board. The gas service pressure must not exceed 0.5 psig (14-in. wc), but must be no less than 0.16 psig (4.5-in. wc).

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

The blower compartment door must be in place to complete the 115-v circuit to the furnace.

⚠ CAUTION

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

SEQUENCE OF OPERATION

⚠ CAUTION

Furnace control must be grounded for proper operation or control will lockout. Control is grounded through green wire routed to gas valve and burner bracket screw.

Using the schematic diagram shown in Fig. 15, follow the sequence of operation through the different modes. Read and follow the wiring diagram very carefully.

NOTE: If there is a power interruption and any thermostat call, the control will initiate a 90-sec blower only on period before starting another cycle.

1. Heating mode

   When the thermostat "calls for heat," R-W circuit closes. The furnace control performs a self-check, verifies the pressure switch contacts are open, and starts the inducer motor.

   a. Prepurge period—As the inducer motor comes up to speed, the pressure switch contacts close to begin a 15-sec prepurge period.

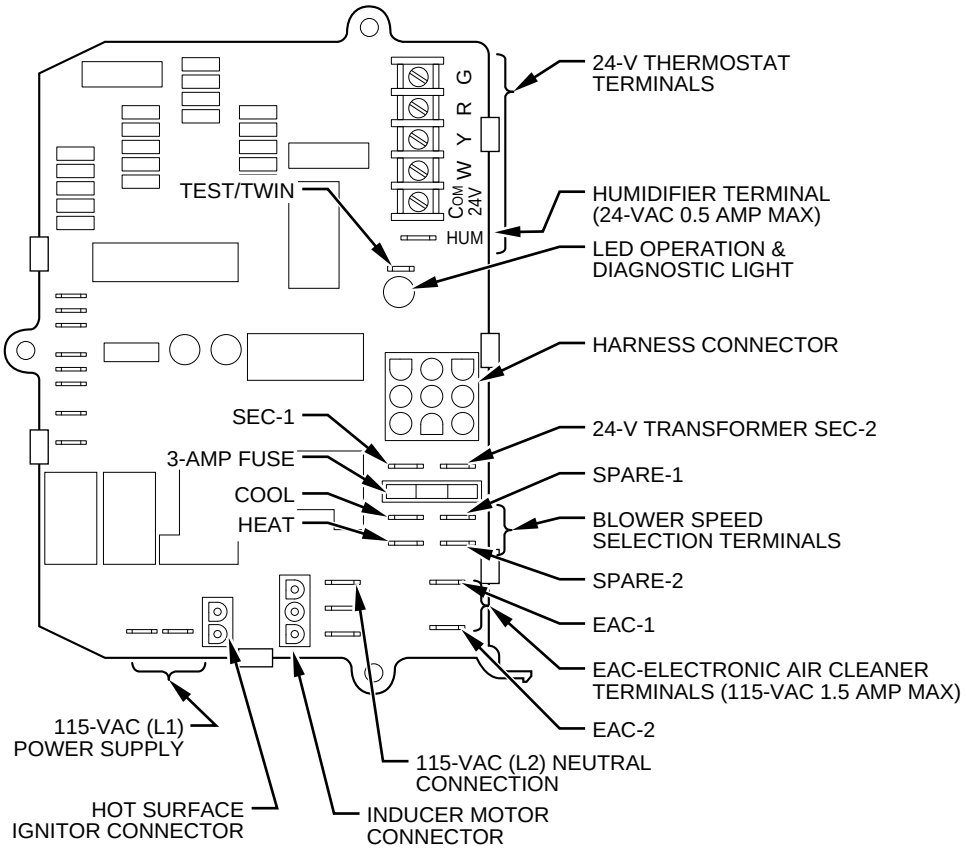

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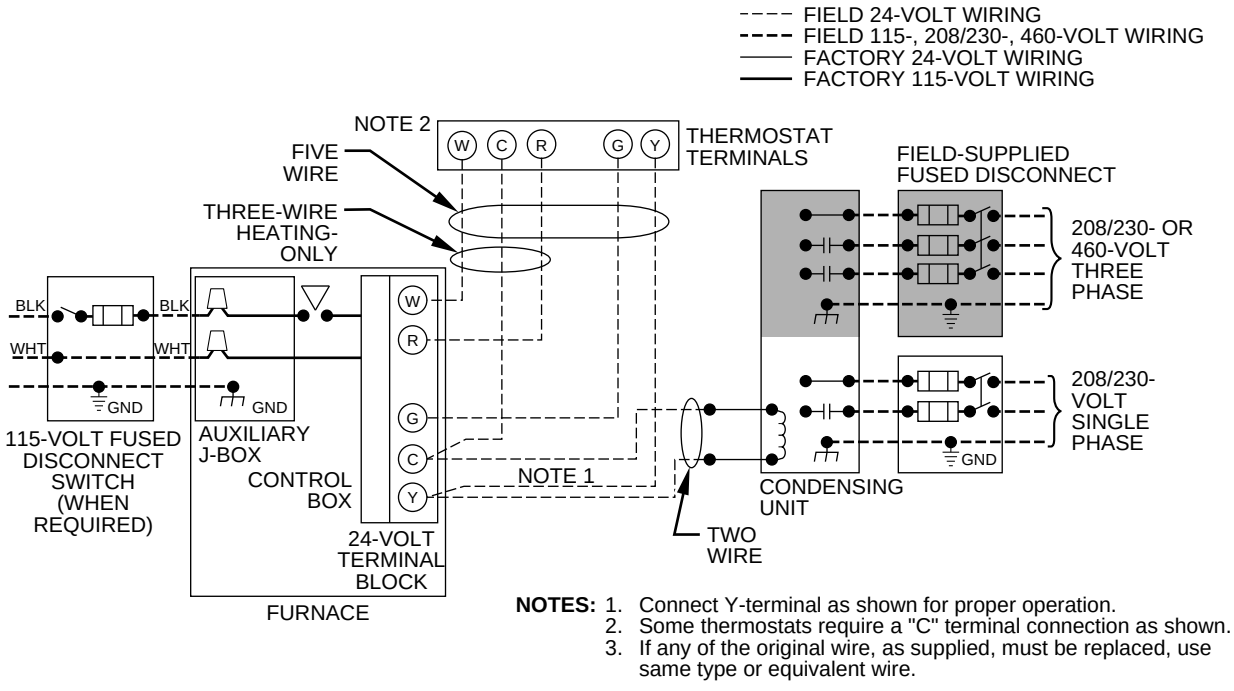
Fig. 13—Control Board



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.

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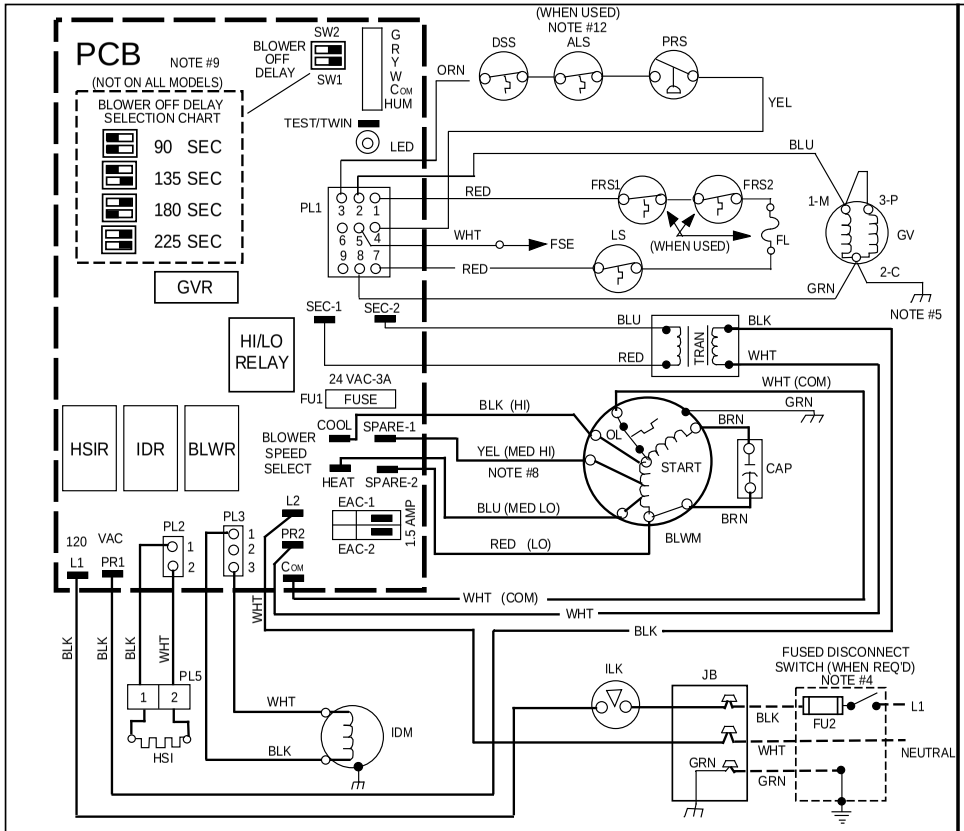
→ **Fig. 14—Heating and Cooling Application Wiring Diagram**

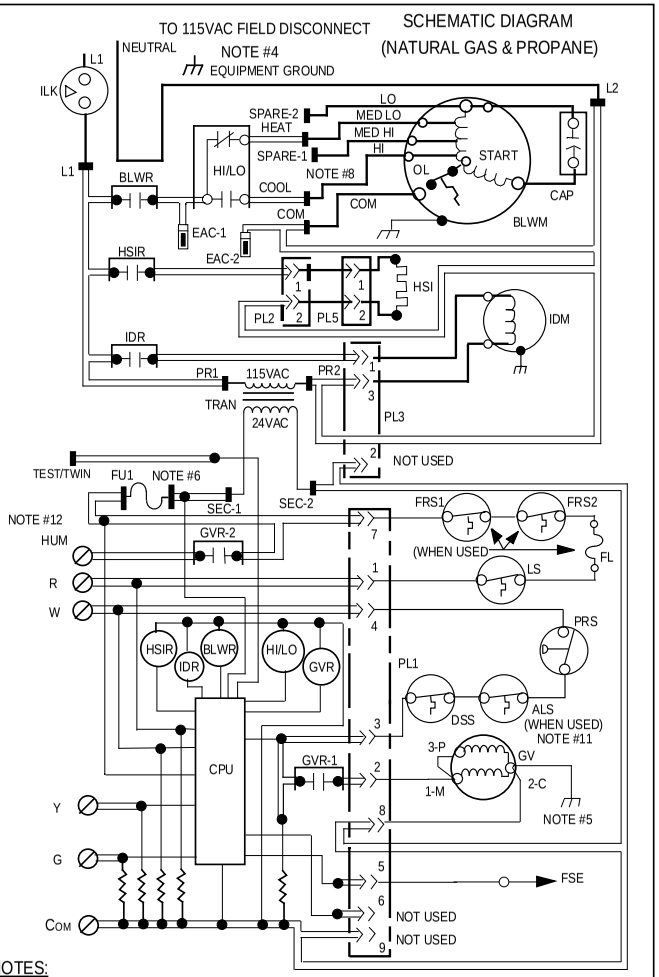
b. Ignitor warm-up—At the end of the prepurge period, the ignitor is energized for a 17-sec ignitor warm-up period.

c. Ignition sequence—When the ignitor warm-up period is completed, the gas valve opens, permitting gas flow to the burners where it is ignited. After 5 sec, the ignitor is de-energized and a 2-sec flame-sensing period begins.

d. HUM terminal is energized with the gas valve. See Accessories in Electrical Connections section.

e. Flame-sensing—When burner flame is sensed, the control begins the blower on delay period and continues holding the gas valve open. If burner flame is not sensed, the control closes the gas valve and repeats the ignition cycle.





LEGEND

ALS	AUXILIARY LIMIT SWITCH, OVERTEMP. -MANUAL RESET, SPST-(N.C.)
BLWR	BLOWER MOTOR RELAY, SPST-(N.O.)
BLWM	BLOWER MOTOR
CAP	CAPACITOR
CPU	MICROPROCESSOR AND CIRCUITRY
DSS	DRAFT SAFEGUARD SWITCH
EAC-1	ELECTRONIC AIR CLEANER CONNECTION (115 VAC 1.5 AMP MAX.)
EAC-2	ELECTRONIC AIR CLEANER CONNECTION (COMMON)
FL	FUSIBLE LINK
FRS	FLAME ROLLOUT SW. -MANUAL RESET, SPST-(N.C.)
FSE	FLAME PROVING ELECTRODE
FU1	FUSE, 3 AMP, AUTOMOTIVE BLADE TYPE, FACTORY INSTALLED
FU2	FUSE OR CIRCUIT BREAKER CURRENT INTERRUPT DEVICE (FIELD INSTALLED & SUPPLIED)
GV	GAS VALVE-REDUNDANT OPERATORS
GVR	GAS VALVE RELAY, DPST-(N.O.)
HI/LO	BLOWER MOTOR SPEED CHANGE RELAY, SPDT
HSI	HOT SURFACE IGNITOR (115 VAC)
HSIR	HOT SURFACE IGNITOR RELAY, SPST-(N.O.)
HUM	24VAC HUMIDIFIER CONNECTION (.5 AMP. MAX.)
IDM	INDUCED DRAFT MOTOR
IDR	INDUCED DRAFT RELAY, SPST-(N.O.)
ILK	BLOWER ACCESS PANEL INTERLOCK SWITCH, SPST-(N.O.)
JB	JUNCTION BOX
LED	LIGHT-EMITTING DIODE FOR STATUS CODES
LGPS	LOW GAS PRESSURE SWITCH, SPST-(N.O.)
LS	LIMIT SWITCH, AUTO RESET, SPST(N.C.)
OL	AUTO-RESET INTERNAL MOTOR OVERLOAD TEMP. SW.
PCB	PRINTED CIRCUIT BOARD
PL1	9-CIRCUIT CONNECTOR
PL2	2-CIRCUIT PCB CONNECTOR
PL3	3-CIRCUIT IDM CONNECTOR
PL5	2-CIRCUIT HSI/PCB CONNECTOR
PRS	PRESSURE SWITCH, SPST-(N.O.)
TEST/TWIN	COMPONENT TEST & TWIN TERMINAL
TRAN	TRANSFORMER-115VAC/24VAC
	JUNCTION
	UNMARKED TERMINAL
	PCB TERMINAL
	FACTORY WIRING (115VAC)
	FACTORY WIRING (24VAC)
	FIELD WIRING (115VAC)
	FIELD WIRING (24VAC)
	CONDUCTOR ON PCB
	FIELD WIRING TERMINAL
	FIELD GROUND
	EQUIPMENT GROUND
	FIELD SPLICE
	PLUG RECEPTACLE

NOTES:

1. If any of the original equipment wire is replaced use wire rated for 105°C.
2. Inducer (IDM) and blower (BLWM) motors contain internal auto-reset thermal overload switches (OL).
3. Blower motor speed selections are for average conditions, see installation instructions for details on optimum speed selection.
4. Use only copper wire between the disconnect switch and the furnace junction box (JB).
5. This wire must be connected to furnace sheetmetal for control to detect flame.
6. Replace only with a 3 amp fuse.
7. Yellow lead not on all motors.
8. Blower-on delay, gas heating 45 seconds, cooling or heat pump 2 seconds.
9. Blower-off delay, gas heating 90, 135, 180 or 225 seconds, cooling or heat pump 90 seconds. (135 seconds only on some models)
10. Ignition-lockout will occur after four consecutive unsuccessful trials-for-ignition. Control will auto-reset after three hours.
11. When used auxiliary limit switch (ALS) is on downflow models only. When used FL is on upflow models only.
12. Some models may have spade quick connect terminals.

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Fig. 15—Unit Wiring Diagram

NOTE: Ignition sequence will repeat 3 additional times before a lockout occurs. Lockout automatically resets after 3 hrs, or can be manually reset by turning 115v off (not at thermostat) for 3 sec minimum, then on again.

f. Blower on delay—Forty sec after burner flame is proven, the blower motor is energized on heating speed. Simultaneously, the humidifier and electronic air cleaner terminals (HUM and COM for humidifier, EAC-1 and EAC-2 for electronic air cleaner) are energized.

g. Blower off delay—When the thermostat is satisfied, the circuit between R and W is broken, de-energizing the gas valve and stopping gas flow to the burners. The blower motor, and EAC remain energized for 135 sec.

h. Post-purge—The inducer motor remains energized 5 sec after the burners are extinguished.

2. Cooling mode

When the thermostat "calls for cooling," R-G and R-Y circuits close. The R-Y circuit starts the outdoor condensing unit and combined R-Y and R-G circuits start the furnace blower motor on cooling speed. The EAC-1 terminal is energized with 115v whenever the blower is operating on cooling speed.

When the thermostat is satisfied, R-G and R-Y circuits are broken. Furnace blower and EAC continue operating on cooling speed for an additional 90 sec.

3. Continuous blower mode

NOTE: EAC-1 terminal is energized with 115v whenever blower is operating.

When the R-G circuit is made, the blower motor operates on heating speed. During a call for heat, the blower stops, allowing the furnace heat exchangers to heat up more quickly, then restarts at the end of the 40-sec blower on delay period.

The blower reverts to continuous operation after the heating cycle is completed.

When the thermostat "calls for cooling," the blower operates on cooling speed. When the thermostat is satisfied, the blower operates an additional 90 sec before reverting back to continuous operation on heating speed.

4. Heat pump mode

When installed with a heat pump, the furnace control automatically changes the timing sequence to avoid long blower off time during demand defrost cycles. When the W-Y or W-Y-G thermostat inputs are received at the same time, the control changes the blower to heating speed or starts the blower if it was off, and begins a heating cycle. The blower remains on until the end of the prepurge period, then shuts off until the end of the ignition warm up and trial for ignition periods (a total of 24 sec). The blower then comes back on at heating speed.

When the W input signal disappears, the control begins the normal inducer post-purge period and the blower changes to cooling speed after a 1-sec delay. If the W-Y-G signals disappear at the same time, the blower remains on for the selected heating blower off delay period and the inducer goes through its normal post-purge period. If the W-Y inputs should disappear, leaving the G signal input, the control goes into continuous blower and the inducer remains on for the normal post-purge period.

Anytime the control senses false flame, the control locks out of the heating mode. This occurs because the control cannot sense the W input due to the false flame signal and, as a result, sees only the Y input and goes into cooling mode blower off delay. All other control functions remain in standard format.

NOTE: EAC-1 terminal is energized whenever blower operates. HUM terminal is only energized when gas valve is energized.

START-UP PROCEDURES

1. Purge gas lines—After all connections have been made, purge the lines and check for leaks.

⚠ WARNING

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

2. Component test—The furnace control allows all components, except gas valve, to be run for a short period of time.

This feature helps diagnose a system problem in case of a component failure. To initiate component test procedure, short (jumper) the TEST 1/4-in. quick connect terminal on control board (adjacent to diagnostic light) and the COM terminal on thermostat connection block for approximately 2 sec. (See Fig. 13.)

NOTE: Component test feature will not operate if any thermostat signal is present at control center.

Component test sequence is as follows.

a. Momentarily jumper TEST and COM terminals until LED goes off.

b. LED will display previous fault 4 times.

c. Inducer motor starts and continues to run for entire component test.

d. Hot surface ignitor is energized for 15 sec, then de-energized.

e. Blower motor operates on cooling speed for 10 sec, then stops.

f. Blower motor operates on heating speed for 10 sec, then stops.

g. Inducer motor stops.

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.

ADJUSTMENTS

1. Set gas input rate

Furnace gas input rate on rating plate is for installations at altitudes up to 2000 ft. 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 average yearly heat value (at installed altitude) from local gas supplier.

(2.) Obtain average yearly specific gravity from local gas supplier.

(3.) Verify furnace model. Table 8 can only be used for model 58RAV Furnaces.

(4.) Find installation altitude in Table 8.

NOTE: For Canada altitudes of 2000 to 4500 ft, use U.S.A. altitudes of 2001 to 3000 ft in Table 8.

(5.) Find closest natural gas heat value and specific gravity in Table 8.

(6.) Follow heat value and specific gravity lines to point of intersection to find orifice size and manifold pressure settings for proper operation .

EXAMPLE: (0—2000 ft altitude)
Heating value = 1050 Btu/cu ft
Specific gravity = 0.62
Therefore: Orifice No. 43*
Manifold pressure 3.6-in. wc
* Furnace is shipped with No. 43 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 regulator adjustment seal cap. (See Fig. 16.)

(2.) Turn adjusting screw, counterclockwise (out) to decrease manifold pressure or clockwise (in) to increase manifold pressure.

NOTE: This furnace has been approved for a manifold pressure of 3.2-in. wc to 3.8-in. wc when installed at altitudes up to 2000 ft. For altitudes above 2000 ft, the manifold pressure can be adjusted from 2.0-in. wc to 3.8-in. wc.

⚠ 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.

(3.) After correct manifold pressure is obtained, replace gas valve regulator adjustment screw cap and verify adjusted gas input rate using method outlined in item c.

(4.) Burner flame should be clear blue, almost transparent. (See Fig. 17.)

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

NOTE: High-Altitude Adjustment

United States

At installation altitudes above 2000 ft, this furnace has been approved for a 4% derate for each 1000 ft above sea level. See Table 7 for derate multiplier factor.

Table 7—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	28—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:
92,000 Btuh input furnace installed at 4300 ft.

Furnace Input Rate at Sea Level	X	Derate Multiplier Factor	=	Furnace Input Rate at Installation Altitude
92,000		0.82		75,440

Canada

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

a. Turn off all other gas appliances and pilots.

b. Start furnace and let operate for 3 minutes.

c. Measure time (in sec) for gas meter test dial to complete 1 revolution.

d. Refer to Table 9 for cu ft of gas per hr.

e. Multiply gas rate (cu ft/hr) X heating value (Btu/cu ft) using natural gas heating value from local gas utility/supplier.

EXAMPLE: (0—2000 ft altitude)
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 = 82 sec
Gas rate = 88 cu ft/hr (from Table 9)
Btu heating input = 88 X 1050 = 92,400 Btuh
In this example, the orifice size and manifold pressure adjustment is within ±2 percent of the furnace input rate.

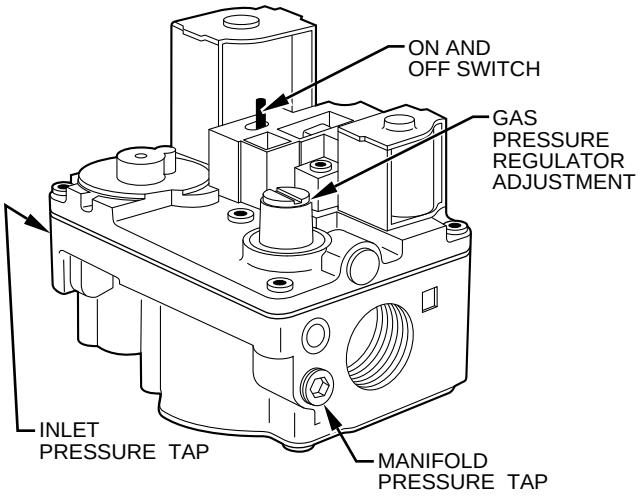

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Fig. 16—Redundant Automatic Gas Control Valve

2. Set temperature rise.

Furnace must operate within range of temperature rise specified on the unit rating plate. Determine the air temperature rise as follows.

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 does not affect thermometer readings. This is particularly important with straight-run ducts.

Table 8—Model 58RAV Orifice Size and Manifold Pressure for Correct Input (Tabulated Data Based on 23,000 BTUH Per Burner, Derated 4% per 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	Orifice No.	Manifold Pressure	Orifice No.	Manifold Pressure	Orifice No.	Manifold Pressure	Orifice No.	Manifold Pressure
U.S.A. and Canada		850	41	3.6	41	3.7	41	3.8	40	3.6	40	3.8
		875	42	3.8	41	3.5	41	3.6	41	3.7	41	3.8
		900	42	3.5	42	3.7	42	3.8	41	3.5	41	3.6
	0	925	42	3.4	42	3.5	42	3.6	42	3.7	42	3.8
		950	42	3.2	42	3.3	42	3.4	42	3.5	42	3.6
	to	975	**43**	**3.7**	**43**	**3.8**	42	3.2	42	3.3	42	3.4
		1000	**43**	**3.5**	**43**	**3.6**	**43**	**3.7**	42	3.2	42	3.3
	2000	1025	**43**	**3.3**	**43**	**3.4**	**43**	**3.6**	**43**	**3.7**	**43**	**3.8**
		1050	**43**	**3.2**	**43**	**3.3**	**43**	**3.4**	**43**	**3.5**	**43**	**3.6**
		1075	44	3.5	44	3.6	**43**	**3.2**	**43**	**3.3**	**43**	**3.4**
		1100	44	3.3	44	3.4	44	3.5	**43**	**3.2**	**43**	**3.3**

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	Orifice No.	Manifold Pressure	Orifice No.	Manifold Pressure	Orifice No.	Manifold Pressure	Orifice No.	Manifold Pressure
U.S.A. and Canada	U.S.A	775	42	3.7	42	3.8	41	3.5	41	3.6	41	3.8
	Altitudes	800	42	3.4	42	3.6	42	3.7	42	3.8	41	3.5
	2001	825	42	3.2	42	3.3	42	3.5	42	3.6	42	3.7
	to	850	**43**	**3.7**	**43**	**3.8**	42	3.3	42	3.4	42	3.5
	3000	875	**43**	**3.5**	**43**	**3.6**	**43**	**3.7**	42	3.2	42	3.3
	or	900	**43**	**3.3**	**43**	**3.4**	**43**	**3.5**	**43**	**3.7**	**43**	**3.8**
	Canada	925	**43**	**3.1**	**43**	**3.2**	**43**	**3.4**	**43**	**3.5**	**43**	**3.6**
	Altitudes	950	**43**	**3.0**	**43**	**3.1**	**43**	**3.2**	**43**	**3.3**	**43**	**3.4**
	2000	975	**43**	**2.8**	**43**	**2.9**	**43**	**3.0**	**43**	**3.1**	**43**	**3.2**
	to	1000	**43**	**2.7**	**43**	**2.8**	**43**	**2.9**	**43**	**3.0**	**43**	**3.1**
	4500	1025	**43**	**2.6**	**43**	**2.6**	**43**	**2.7**	**43**	**2.8**	**43**	**2.9**

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	Orifice No.	Manifold Pressure	Orifice No.	Manifold Pressure	Orifice No.	Manifold Pressure	Orifice No.	Manifold Pressure
U.S.A. Only		750	42	3.4	42	3.6	42	3.7	42	3.8	41	3.5
		775	42	3.2	42	3.3	42	3.5	42	3.6	42	3.7
		800	**43**	**3.7**	**43**	**3.8**	42	3.2	42	3.3	42	3.4
	3001	825	**43**	**3.5**	**43**	**3.6**	**43**	**3.7**	**43**	**3.8**	42	3.2
		850	**43**	**3.3**	**43**	**3.4**	**43**	**3.5**	**43**	**3.6**	**43**	**3.7**
	to	875	**43**	**3.1**	**43**	**3.2**	**43**	**3.3**	**43**	**3.4**	**43**	**3.5**
		900	**43**	**2.9**	**43**	**3.0**	**43**	**3.1**	**43**	**3.2**	**43**	**3.3**
	4000	925	**43**	**2.8**	**43**	**2.9**	**43**	**3.0**	**43**	**3.0**	**43**	**3.1**
		950	**43**	**2.6**	**43**	**2.7**	**43**	**2.8**	**43**	**2.9**	**43**	**3.0**
		975	**43**	**2.5**	**43**	**2.6**	**43**	**2.7**	**43**	**2.7**	**43**	**2.8**
		1000	**43**	**2.4**	**43**	**2.4**	**43**	**2.5**	**43**	**2.6**	**43**	**2.7**

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	Orifice No.	Manifold Pressure	Orifice No.	Manifold Pressure	Orifice No.	Manifold Pressure	Orifice No.	Manifold Pressure
U.S.A. Only		725	42	3.2	42	3.3	42	3.5	42	3.6	42	3.7
		750	**43**	**3.7**	**43**	**3.8**	42	3.2	42	3.3	42	3.4
		775	**43**	**3.4**	**43**	**3.6**	**43**	**3.7**	**43**	**3.8**	42	3.2
	4001	800	**43**	**3.2**	**43**	**3.3**	**43**	**3.5**	**43**	**3.6**	**43**	**3.7**
		825	**43**	**3.0**	**43**	**3.1**	**43**	**3.2**	**43**	**3.4**	**43**	**3.5**
	to	850	**43**	**2.9**	**43**	**3.0**	**43**	**3.1**	**43**	**3.2**	**43**	**3.3**
		875	**43**	**2.7**	**43**	**2.8**	**43**	**2.9**	**43**	**3.0**	**43**	**3.1**
	5000	900	**43**	**2.6**	**43**	**2.6**	**43**	**2.7**	**43**	**2.8**	**43**	**2.9**
		925	**43**	**2.4**	**43**	**2.5**	**43**	**2.6**	**43**	**2.7**	**43**	**2.8**
		950	**43**	**2.3**	**43**	**2.4**	**43**	**2.5**	**43**	**2.5**	**43**	**2.6**

* For size 135-20 only, input is 22,500 Btuh. Deduct 0.1-in. wc from manifold pressure shown in table. Change orifice size if manifold pressure falls below 3.2-in. wc on altitudes up to 2000 ft, otherwise change orifice size if manifold pressure falls below 2.0-in. wc.

Table 8—Model 58RAV Orifice Size and Manifold Pressure for Correct Input Continued (Tabulated Data Based on 23,000 BTUH Per Burner, Derated 4% per 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	Orifice No.	Manifold Pressure	Orifice No.	Manifold Pressure	Orifice No.	Manifold Pressure	Orifice No.	Manifold Pressure
U.S.A. Only	700	**43**	**3.7**	**43**	**3.8**	42	3.2	42	3.3	42	3.4
	725	**43**	**3.4**	**43**	**3.6**	**43**	**3.7**	**43**	**3.8**	42	3.2
	750	**43**	**3.2**	**43**	**3.3**	**43**	**3.4**	**43**	**3.5**	**43**	**3.6**
	775	**43**	**3.0**	**43**	**3.1**	**43**	**3.2**	**43**	**3.3**	**43**	**3.4**
5001	800	**43**	**2.8**	**43**	**2.9**	**43**	**3.0**	**43**	**3.1**	**43**	**3.2**
	825	**43**	**2.7**	**43**	**2.7**	**43**	**2.8**	**43**	**2.9**	**43**	**3.0**
to	850	**43**	**2.5**	**43**	**2.6**	**43**	**2.7**	**43**	**2.8**	**43**	**2.8**
	875	**43**	**2.4**	**43**	**2.4**	**43**	**2.5**	**43**	**2.6**	**43**	**2.7**
6000	900	**43**	**2.2**	**43**	**2.3**	**43**	**2.4**	**43**	**2.5**	**43**	**2.5**
	925	**43**	**2.1**	**43**	**2.2**	**43**	**2.3**	**43**	**2.3**	**43**	**2.4**
	950	48	3.8	**43**	**2.1**	**43**	**2.1**	**43**	**2.2**	**43**	**2.3**
	975	48	3.6	48	3.7	**43**	**2.0**	**43**	**2.1**	**43**	**2.2**
	1000	48	3.4	48	3.5	48	3.6	48	3.7	**43**	**2.1**

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	Orifice No.	Manifold Pressure	Orifice No.	Manifold Pressure	Orifice No.	Manifold Pressure	Orifice No.	Manifold Pressure
U.S.A. Only	650	**43**	**3.7**	**43**	**3.8**	42	3.2	42	3.3	42	3.5
	675	**43**	**3.4**	**43**	**3.5**	**43**	**3.7**	**43**	**3.8**	42	3.2
	700	**43**	**3.2**	**43**	**3.3**	**43**	**3.4**	**43**	**3.5**	**43**	**3.6**
6001	725	**43**	**3.0**	**43**	**3.1**	**43**	**3.2**	**43**	**3.3**	**43**	**3.4**
	750	**43**	**2.8**	**43**	**2.9**	**43**	**3.0**	**43**	**3.1**	**43**	**3.2**
to	775	**43**	**2.6**	**43**	**2.7**	**43**	**2.8**	**43**	**2.9**	**43**	**3.0**
	800	**43**	**2.4**	**43**	**2.5**	**43**	**2.6**	**43**	**2.7**	**43**	**2.8**
7000	825	**43**	**2.3**	**43**	**2.4**	**43**	**2.5**	**43**	**2.5**	**43**	**2.6**
	850	**43**	**2.2**	**43**	**2.2**	**43**	**2.3**	**43**	**2.4**	**43**	**2.5**
	875	**43**	**2.0**	**43**	**2.1**	**43**	**2.2**	**43**	**2.3**	**43**	**2.3**

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	Orifice No.	Manifold Pressure	Orifice No.	Manifold Pressure	Orifice No.	Manifold Pressure	Orifice No.	Manifold Pressure
U.S.A. Only	625	**43**	**3.4**	**43**	**3.6**	**43**	**3.7**	**43**	**3.8**	42	3.2
	650	**43**	**3.2**	**43**	**3.3**	**43**	**3.4**	**43**	**3.5**	**43**	**3.6**
	675	**43**	**3.0**	**43**	**3.1**	**43**	**3.2**	**43**	**3.3**	**43**	**3.4**
7001	700	**43**	**2.7**	**43**	**2.8**	**43**	**2.9**	**43**	**3.0**	**43**	**3.1**
	725	**43**	**2.6**	**43**	**2.6**	**43**	**2.7**	**43**	**2.8**	**43**	**2.9**
to	750	**43**	**2.4**	**43**	**2.5**	**43**	**2.6**	**43**	**2.6**	**43**	**2.7**
	775	**43**	**2.2**	**43**	**2.3**	**43**	**2.4**	**43**	**2.5**	**43**	**2.5**
8000	800	**43**	**2.1**	**43**	**2.2**	**43**	**2.2**	**43**	**2.3**	**43**	**2.4**
	825	48	3.7	**43**	**2.0**	**43**	**2.1**	**43**	**2.2**	**43**	**2.2**
	850	48	3.5	48	3.6	48	3.7	**43**	**2.1**	**43**	**2.1**

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	Orifice No.	Manifold Pressure	Orifice No.	Manifold Pressure	Orifice No.	Manifold Pressure	Orifice No.	Manifold Pressure
U.S.A. Only	600	**43**	**3.2**	**43**	**3.3**	**43**	**3.4**	**43**	**3.5**	**43**	**3.6**
	625	**43**	**3.0**	**43**	**3.1**	**43**	**3.2**	**43**	**3.3**	**43**	**3.4**
8001	650	**43**	**2.7**	**43**	**2.8**	**43**	**2.9**	**43**	**3.0**	**43**	**3.1**
	675	**43**	**2.5**	**43**	**2.6**	**43**	**2.7**	**43**	**2.8**	**43**	**2.9**
to	700	**43**	**2.4**	**43**	**2.4**	**43**	**2.5**	**43**	**2.6**	**43**	**2.7**
	725	**43**	**2.2**	**43**	**2.3**	**43**	**2.3**	**43**	**2.4**	**43**	**2.5**
9000	750	**43**	**2.0**	**43**	**2.1**	**43**	**2.2**	**43**	**2.3**	**43**	**2.3**
	775	48	3.6	48	3.7	**43**	**2.1**	**43**	**2.1**	**43**	**2.2**
	800	48	3.4	48	3.5	48	3.6	48	3.7	**43**	**2.0**

* For size 135-20 only, input is 22,500 Btuh. Deduct 0.1-in. wc from manifold pressure shown in table. Change orifice size if manifold pressure falls below 3.2-in. wc on altitudes up to 2000 ft, otherwise change orifice size if manifold pressure falls below 2.0-in. wc.

Table 8—Model 58RAV Orifice Size and Manifold Pressure for Correct Input Continued (Tabulated Data Based on 23,000 BTUH Per Burner, Derated 4% per 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	Orifice No.	Manifold Pressure	Orifice No.	Manifold Pressure	Orifice No.	Manifold Pressure	Orifice No.	Manifold Pressure
U.S.A. Only		**575**	**43**	**3.0**	**43**	**3.1**	**43**	**3.2**	**43**	**3.3**	**43**	**3.4**
		600	**43**	**2.7**	**43**	**2.8**	**43**	**2.9**	**43**	**3.0**	**43**	**3.1**
	9001	**625**	**43**	**2.5**	**43**	**2.6**	**43**	**2.7**	**43**	**2.8**	**43**	**2.8**
		650	**43**	**2.3**	**43**	**2.4**	**43**	**2.5**	**43**	**2.6**	**43**	**2.6**
	to	**675**	**43**	**2.1**	**43**	**2.2**	**43**	**2.3**	**43**	**2.4**	**43**	**2.4**
		700	48	3.8	**43**	**2.1**	**43**	**2.1**	**43**	**2.2**	**43**	**2.3**
	10000	**725**	48	3.5	48	3.6	48	3.7	**43**	**2.1**	**43**	**2.1**
		750	49	3.8	48	3.4	48	3.5	48	3.6	48	3.7
		775	49	3.6	49	3.7	49	3.8	48	3.4	48	3.5

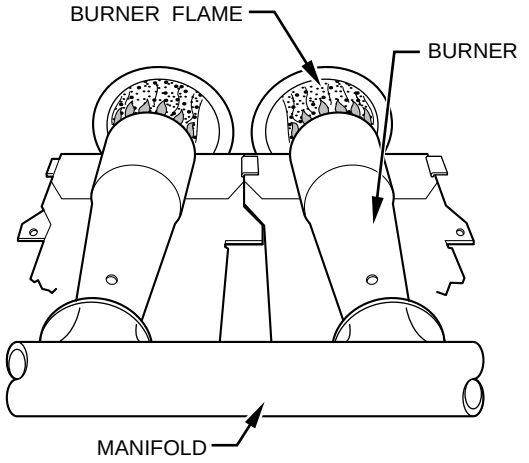
* For size 135-20 only, input is 22,500 Btuh. Deduct 0.1-in. wc from manifold pressure shown in table. Change orifice size if manifold pressure falls below 3.2-in. wc on altitudes up to 2000 ft, otherwise change orifice size if manifold pressure falls below 2.0-in. wc.

Table 9—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				

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

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



A89020

Fig. 17—Burner Flame

⚠ WARNING

Disconnect the electrical power before changing the speed tap. Failure to follow this warning could result in personal injury.

d. To change blower motor speed selections for heating mode, remove blower motor lead from control board HEAT terminal. (See Fig. 13.) Select desired blower motor speed lead from 1 of the other terminals and relocate it to HEAT terminal. See Table 10 for lead color identification. Reconnect original lead on SPARE terminal.

Follow this same procedure for proper selection of COOL speed selection.

Table 10—Speed Selector

COLOR	SPEED	FACTORY-ATTACHED TO
Black	High	COOL
Yellow (When present)	Medium-High	SPARE
Blue	Medium-Low	HEAT
Red	Low	SPARE
White	Common	COM

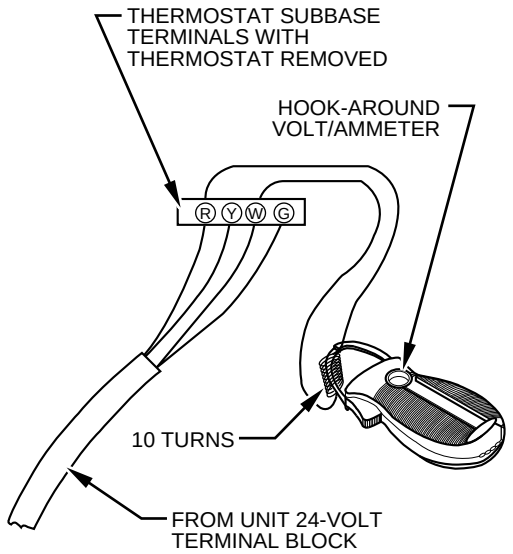
⚠ CAUTION

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

3. Set thermostat heat anticipator.

   The thermostat heat anticipator must be set to match the amp draw of the electrical components in the R-W circuit. Accurate amp draw readings can be obtained at thermostat subbase terminals R and W. Fig. 18 illustrates an easy method of obtaining the actual amp draw. The amp reading should be taken after the blower motor has started. See the thermostat manufacturer's instructions for adjusting the heat anticipator and for varying the heating cycle length.

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



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

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Fig. 18—Amp Draw Check With Ammeter

CHECK SAFETY CONTROLS

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

1. Check primary limit control.

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

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

2. Check draft safeguard switch.

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

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

   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 pipe to furnace outlet collar.

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

3. Check pressure switch.

   This control proves operation of draft inducer blower.

   a. Turn off 115-v power to furnace.

   b. Remove control door and disconnect inducer motor lead wires from wire harness.

   c. Turn on 115-v power to furnace.

   d. Set thermostat to "call for heat" and wait 1 minute. When pressure switch is functioning properly, hot surface ignitor should NOT glow and control center diagnostic light flashes a 31 fault. If hot surface ignitor 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 control door, and turn on 115-v power to furnace.

4. Check auxiliary limits (when used).

   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 re-connection.

   d. Replace blower access door.

   e. Turn on 115-v power to furnace. Be sure room thermostat is calling for 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.

CHECKLIST

1. Put away tools, instruments, and clean up debris.
2. Verify manual reset switches have continuity.
3. Ensure blower and control access doors are properly installed.
4. Cycle test furnace with room thermostat.
5. Check operation of accessories per manufacturer's instructions.
6. Review User's Manual with owner.
7. Leave literature packet near furnace.

SERVICE TRAINING

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

- Unit Familiarization
- Maintenance
- Installation Overview
- Operating Sequence

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