

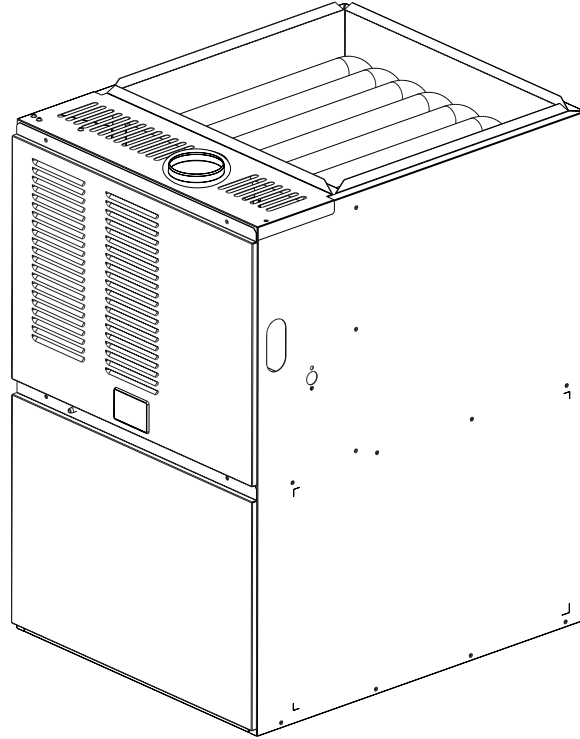
Residential Gas Furnaces

Installation Instructions

***RA 80+ Series**

High Efficiency Compact Upflow/Horizontal

These instructions are primarily intended to assist qualified individuals experienced in the proper installation of this type appliance. Some local codes require licensed installation/service personnel for this type of equipment. Read all instructions carefully before starting the installation.



WARNING:

Improper installation, adjustment, alteration, service, or maintenance can cause injury or property damage. Refer to this manual for assistance. For additional information consult a qualified installer, service agency, or the gas supplier.

WARNING:

If the information in these instructions is not followed exactly, a fire or explosion may result, causing property damage, personal injury or death.

FOR YOUR SAFETY

Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.

WHAT TO DO IF YOU SMELL GAS:

- Do not try to light any appliance.
- Do not touch any electrical switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.
- Extinguish any open flame.

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FURNACE SPECIFICATIONS - Upflow/Horizontal Models

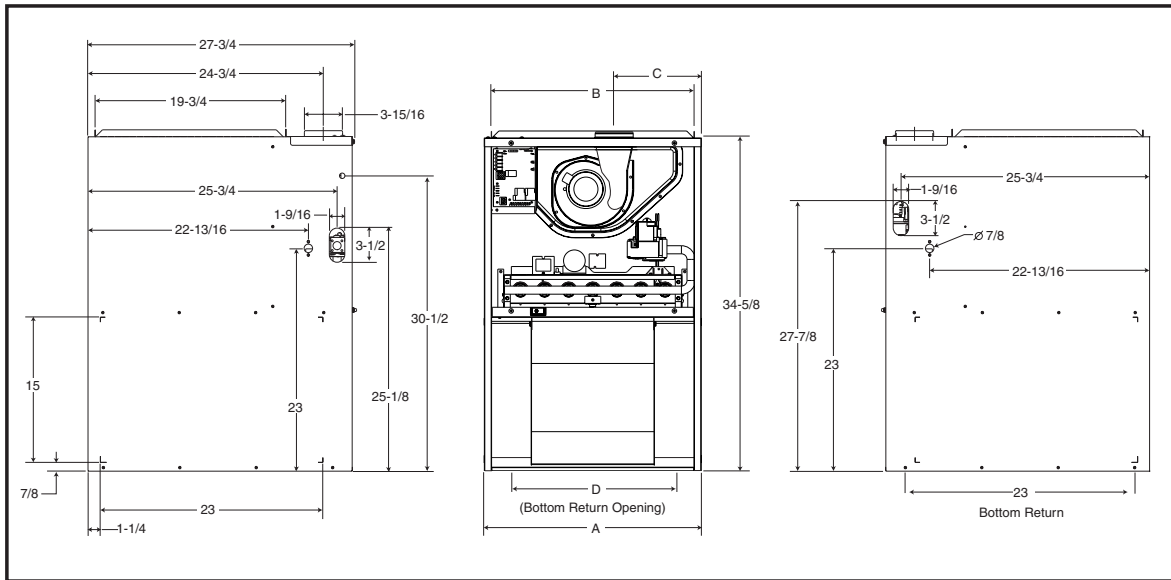


Figure 1. Unit Dimensions in Inches

FURNACE DIMENSIONS AND SHIPPING WEIGHTS							
Model Number *RA-	Furnace Input (Btuh)	Dimensions					Shipping Weight (lbs)
		A (in.)	B (in.)	C (in.)	D (in.)	Flue Outlet (in.)	
045(†)-08A	45,000	14 1/4	12 3/4	4	11 3/4	4	88
054(†)-12A	54,000	14 1/4	12 3/4	4	11 3/4	4	94
072(†)-12A	72,000	14 1/4	12 3/4	4	11 3/4	4	96
072(†)-12B	72,000	19 3/4	18 1/4	7 5/8	17 1/4	4	108
072(†)-16B	72,000	19 3/4	18 1/4	7 5/8	17 1/4	4	115
090(†)-12B	90,000	19 3/4	18 1/4	7 5/8	17 1/4	4	115
090(†)-16B	90,000	19 3/4	18 1/4	7 5/8	17 1/4	4	120
090(†)-20B	90,000	19 3/4	18 1/4	7 5/8	17 1/4	4	130
108(†)-16B	108,000	19 3/4	18 1/4	7 5/8	17 1/4	4	125
108(†)-20B	108,000	19 3/4	18 1/4	7 5/8	17 1/4	4	130
108(†)-20C	108,000	22 1/2	21	9	20	4	135
126(†)-20C	126,000	22 1/2	21	9	20	4	137

Note: †Can be C or N

Table 1. Furnace Dimensions and Shipping Weights

SAFETY INFORMATION

1. Use only with type of gas approved for this furnace. Refer to the furnace rating plate.
2. Install this furnace only in a location and position as specified on Table 3 of these instructions.
3. Provide adequate combustion and ventilation air to the furnace space as specified on Pages 9 through 11.
4. Combustion products must be discharged outdoors. Connect this furnace to an approved vent system only, as specified on Pages 11 through 12.
5. Never test for gas leaks with an open flame. Use a commercially available soap solution made specifically for the detection of leaks to check all connections, as specified on Page 15 of these instructions.
6. Always install furnace to operate within the furnace's intended temperature-rise range with a duct system which has an external static pressure within the allowable range, as specified on Table 2 of these instructions. See furnace rating plate.
7. When a furnace is installed so that supply ducts carry air circulated by the furnace to areas outside the space containing the furnace, the return air shall also be handled

CAPACITIES — Furnace Airflow Data

MODEL NUMBER *RA	HEATING INPUT	MOTOR SPEED	MOTOR HP	EXTERNAL STATIC PRESSURE (INCHES OF WATER COLUMN)																																											
				0.1			0.2			0.3			0.4			0.5			0.6			0.7			0.8																						
				CFM	Rise	CFM	Rise	CFM	Rise	CFM	Rise	CFM	Rise	CFM	Rise	CFM	Rise	CFM	Rise	CFM	Rise	CFM	Rise	CFM	Rise																						
045-08A	45,000	HIGH*	1/5	1000	33	970	34	950	35	920	36	870	38	820	41	770	43	700	47	760	43	740	44	730	45	690	48	670	49	640	52	620	53														
				1300	31	1260	32	1210	33	1160	34	1110	35	1050	38	980	40	910	44	1150	34	1120	35	1090	36	1050	38	1000	40	950	42	890	44	830	48												
054-12A	54,000	MEDIUM LOW**	1/3	790	50	780	50	770	51	750	53	720	55	690	57	650	60	600	66	1380	38	1350	39	1310	40	1260	42	1210	44	1150	46	1080	49	1000	53												
				1220	43	1190	44	1160	45	1120	47	1070	49	1020	52	950	55	880	60	800	64	1380	41	1310	41	1240	44	1200	44	1140	47	1090	49	1030	51	970	55	870	61								
072-12A	72,000	HIGH* MEDIUM LOW**	1/3	1030	52	1030	52	1010	53	980	54	930	57	860	62	780	69	670	79	640	83	1550	34	1500	35	1440	37	1360	40	1280	42	1190	45	1080	49	970	55	870	61								
				1380	41	1310	41	1240	44	1200	44	1130	46	1050	48	970	51	880	57	780	69	670	79	1550	34	1500	35	1440	37	1360	40	1280	42	1190	45	1080	49	970	55	870	61						
072-12B	72,000	MEDIUM** LOW	1/4	1030	52	1030	52	1010	53	980	54	930	57	860	62	780	69	670	79	640	83	1380	41	1310	41	1240	44	1200	44	1130	46	1050	48	970	51	880	57	780	69	670	79						
				1380	41	1310	41	1240	44	1200	44	1130	46	1050	48	970	51	880	57	780	69	670	79	1380	41	1310	41	1240	44	1200	44	1130	46	1050	48	970	51	880	57	780	69	670	79				
072-16B	72,000	HIGH* MED-HIGH* MED-LOW**	1/2	1955	26	1945	27	1920	27	1890	28	1845	29	1785	30	1700	31	1605	33	1635	32	1615	33	1590	33	1550	35	1500	36	1440	37	1370	40	1310	40	1230	44	1150	46	1075	55						
				1370	40	1365	40	1350	40	1340	41	1305	42	1270	43	1230	44	1190	45	1150	46	1100	48	1030	51	975	55	1370	40	1365	40	1350	40	1340	41	1305	42	1270	43	1230	44	1190	45	1150	46	1100	48
090-12B	90,000	HIGH* MEDIUM LOW**	1/4	1550	42	1500	44	1440	46	1360	48	1280	51	1190	55	1080	61	970	68	1380	52	1310	55	1240	58	1200	55	1140	64	1090	64	1030	68	970	76	870	76	780	85	670	99						
				1030	64	1030	64	1010	65	980	67	930	72	860	78	780	85	670	99	1380	52	1310	55	1240	58	1200	55	1140	64	1090	64	1030	68	970	76	870	76	780	85	670	99						
090-16B	90,000	HIGH* MED-HIGH** MED-LOW LOW	1/2	1985	33	1955	34	1905	35	1855	36	1790	37	1705	40	1630	41	1530	44	1635	41	1640	41	1610	42	1575	42	1545	43	1490	45	1430	47	1350	49	1275	57	1175	57	1100	66						
				1410	47	1400	47	1380	48	1355	49	1320	50	1290	52	1240	54	1175	57	1100	66	1410	47	1400	47	1380	48	1355	49	1320	50	1290	52	1240	54	1175	57	1100	66	1060	63	1010	66				
090-20B	90,000	HIGH* MED-HIGH MED-LOW LOW**	3/4	2375	28	2320	29	2280	30	2215	30	2150	31	2085	32	2015	33	1940	34	1975	33	1955	34	1920	35	1895	35	1850	36	1800	37	1740	38	1685	39	1600	48	1400	48	1350	52	1275	55				
				1640	40	1615	41	1595	41	1575	42	1540	43	1500	44	1460	46	1400	48	1350	52	1275	55	1640	40	1615	41	1595	41	1575	42	1540	43	1500	44	1460	46	1400	48	1350	52	1275	55				
108-16B	108,000	HIGH* MED-HIGH** MED-LOW LOW	1/2	1365	49	1345	50	1330	50	1315	51	1280	52	1245	53	1225	54	1210	55	1985	40	1955	41	1905	42	1855	43	1790	45	1705	47	1630	49	1530	52	1430	59	1350	59	1275	68	1175	68	1100	79		
				1410	57	1400	57	1380	58	1355	59	1320	60	1290	62	1240	65	1175	68	1100	79	1410	57	1400	57	1380	58	1355	59	1320	60	1290	62	1240	65	1175	68	1100	79								
108-20B	108,000	HIGH* MED-HIGH MED-LOW LOW**	3/4	2410	32	2370	33	2330	34	2275	35	2230	36	2165	37	2075	38	1990	40	2410	32	2370	33	2330	34	2275	35	2230	36	2165	37	2075	38	1990	40	1790	45	1720	47	1650	54	1485	54	1400	62	1275	62
				2035	39	1995	40	1965	41	1915	42	1895	42	1815	44	1720	47	1650	54	1485	54	1400	62	2035	39	1995	40	1965	41	1915	42	1895	42	1815	44	1720	47	1650	54	1485	54	1400	62				
108-20C	108,000	HIGH* MED-HIGH** MED-LOW LOW	3/4	1680	47	1660	48	1650	49	1645	49	1640	50	1565	51	1550	52	1455	55	1420	56	1680	47	1660	48	1650	49	1645	49	1640	50	1565	51	1550	52	1455	55	1420	56	1330	59	1300	60	1275	62		
				1435	55	1430	55	1425	56	1415	56	1415	56	1400	57	1350	59	1330	60	1275	62	1435	55	1430	55	1425	56	1415	56	1415	56	1400	57	1350	59	1330	60	1275	62								
126-20C	126,000	HIGH* MED-HIGH** MED-LOW LOW	3/4	2270	35	2210	36	2190	36	2165	37	2130	38	2100	39	2030	40	1975	41	2270	35	2210	36	2190	36	2165	37	2130	38	2100	39	2030	40	1975	41	1755	46	1720	47	1650	54	1455	55	1420	56	1220	66
				1880	42	1865	43	1835	43	1815	44	1790	45	1770	45	1755	46	1720	47	1650	54	1455	55	1420	56	1220	66	1880	42	1865	43	1835	43	1815	44	1790	45	1770	45	1755	46	1720	47	1650	54	1455	55
126-20C	126,000	HIGH* MED-HIGH** MED-LOW LOW	3/4	1565	50	1550	51	1535	52	1520	52	1510	53	1495	54	1455	55	1420	56	1565	50	1550	51	1535	52	1520	52	1510	53	1495	54	1455	55	1420	56	1325	60	1320	70	1285	72	1275	73	1250	75	1220	76
				1325	60	1320	61	1310	61	1310	61	1285	62	1275	63	1250	64	1220	66	1325	60	1320	61	1310	61	1310	61	1285	62	1275	63	1250	64	1220	66												

- Notes:
- Airflow rates of 1800 CFM or more require two return air connections. Data is for operation with filter(s).
 - Temperature rises in the table are approximate. Actual temperature rises may vary.
 - Temperature rises displayed in italics are for reference only.
 - Temperature rises displayed in **BOLD** are rated temperature rises.

* Factory Set Cooling Speed
 ** Factory Set Heating Speed

Table 2. Furnace Airflow Data

- by duct(s) sealed to the furnace casing and terminating outside the space containing the furnace.
8. A gas-fired furnace for installation in a residential garage must be installed as specified on Page 9 of these instructions.
 9. The furnace is not to be used for temporary heating of buildings or structures under construction.

INSTALLATION REQUIREMENTS

Requirements and Codes

This furnace must be installed in accordance with these instructions, all applicable local building codes, current revision of the National Fuel Gas Code (ANSI-Z223.1), and in Canada with the CAN/CGA - B149 installation code. The current revision of the National Fuel Gas Code is available from:

**American National Standards Institute,
Inc.**
1430 Broadway
New York, New York 10018

Additional helpful publications are:

NFPA-90A - Installation of
Air Conditioning and Ventilating Systems

NFPA-90B - Warm Air Heating
and Air Conditioning Systems

These publications are available from:

National Fire Protection Association, Inc.
Batterymarch Park
Quincy, Massachusetts 02269

WARNING:

This furnace is not approved for installation in mobile homes. Installation in a mobile home could cause fire, property damage, and/or personal injury.

IMPORTANT NOTE

The Commonwealth of Massachusetts requires compliance with regulation 248 CMR 4.00 and 5.00 for installation of through – the – wall vented gas appliances as follows:

- (a) For direct-vent appliances, mechanical-vent heating appliances or domestic hot water equipment, where the bottom of the vent terminal and the air intake is installed below four feet above grade the following requirements must be satisfied:

1. If there is not one already present, on each floor level where there are bedroom(s), a carbon monoxide detector and alarm shall be placed in the living area outside the bedroom(s). The carbon monoxide detector shall comply with NFPA 720 (2005 Edition).

2. A carbon monoxide detector shall be located in the room that houses the appliance or equipment and shall:

- a. Be powered by the same electrical circuit as the appliance or equipment such that only one service switch services both the appliance and the carbon monoxide detector;
- b. Have battery back-up power;
- c. Meet ANSI/UL 2034 Standards and comply with NFPA 720 (2005 Edition); and
- d. Have been approved and listed by a Nationally Recognized Testing Laboratory as recognized under 527 CMR.

3. A Product-approved vent terminal must be used, and if applicable, a Product-approved air intake must be used. Installation shall be in strict compliance with the manufacturer's instructions. A copy of the installation instructions shall remain with the appliance or equipment at the completion of the installation.

4. A metal or plastic identification plate shall be mounted at the exterior of the building, four feet directly above the location of vent terminal. The plate shall be of sufficient size to be easily read from a distance of eight feet away, and read "Gas Vent Directly Below".

- (b) For direct-vent appliances, mechanical-vent heating appliances or domestic hot water equipment where the bottom of the vent terminal and the air intake is installed above four feet above grade the following requirements must be satisfied:

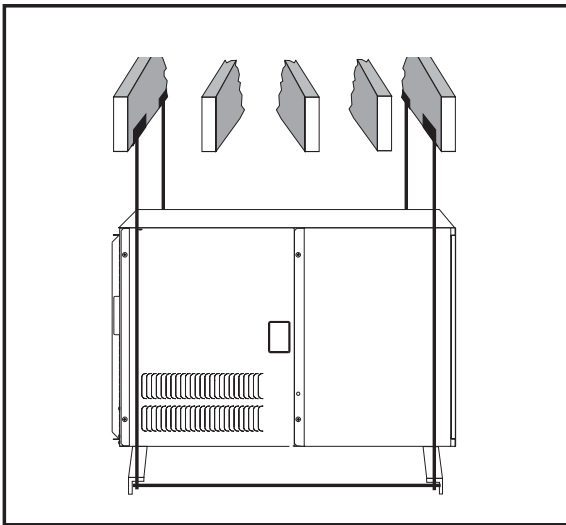


Figure 2. Horizontal Installation Suspended in Attic or Crawl Space

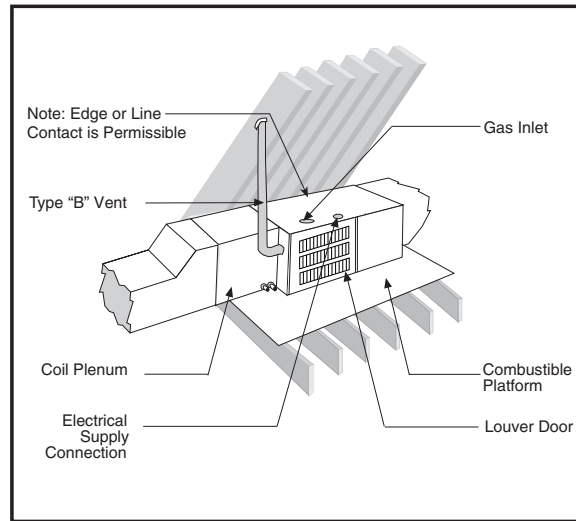


Figure 3. Horizontal Installation on a Platform

UPFLOW APPLICATION

HORIZONTAL APPLICATION

INSTALLATION CLEARANCES

Vent Connector Type	Standard Single Wall Metal Vent	Type B-1 Double Wall Metal Vent
LEFT SIDE	0"	0"
RIGHT SIDE	0"	0"
VENT	6"	1"
BACK	0"	0"
BOTTOM	0"	0"
TOP	1"	1"
FRONT	4" [†]	4" [†]

[†]Allow 24" minimum clearance for servicing. The recommended clearance is 36".

Table 3. Minimum Clearances to Combustible Material

1. If there is not one already present, on each floor level where there are bedroom(s), a carbon monoxide detector and alarm shall be placed in the living area outside the bedroom(s). The carbon monoxide detector shall comply with NFPA 720 (2005 Edition).
2. A carbon monoxide detector shall:
 - a. Be located in the room that houses the appliance or equipment;
 - b. Be either hard-wired or battery powered or both; and
 - c. Shall comply with NFPA 720 (2005 Edition).
3. A Product-approved vent terminal must be used, and if applicable, a Product-approved air intake must be used. Installation shall be in strict compliance with the manufacturer's instructions. A copy of the installation instructions shall remain with the appliance or equipment at the completion of the installation.

Location

These gas furnaces are shipped ready for installation in the upflow, horizontal right or left positions. The furnace must be installed on a level surface, located close to the vent (or chimney) and as close to the center of the air distribution system as possible. See Table 1 for overall dimensions to determine the required clearances in hallways, doorways, stairs, etc. to allow the furnace to be moved to the installation point. The furnace must be installed so that all electrical components are protected from water. The furnace must be installed upstream from a refrigeration system. This furnace is not to be used for temporary heating of buildings or structures under construction.

Horizontal Furnace Installation

The furnace can be installed horizontally in an attic, basement, crawl space or alcove. It can be suspended from a ceiling in a basement or utility room in either a right to left airflow or left to right airflow. (See Figures 2 and 3.)

If the furnace is to be suspended from the ceiling, it will be necessary to use steel straps around each end of the furnace. These straps should be attached to the furnace with sheet metal screws and to the rafters with bolts. The furnace could also be suspended by an angle iron frame bolted to the rafters. (See Figure 2.)

Access for positioning and servicing must be considered when locating the unit. Refer to Table 3, Minimum Clearances to Combustible Material, for clearance specifications.

Keep all insulating materials away from the louvered door. Insulating materials may be combustible.

These furnaces may be installed directly on combustible wood flooring or supports, if type "B-1" vent pipe is used (See Figure 3). It is recommended for further reduction of fire hazard that cement board or sheet metal be placed between the furnace and the combustible floor and extend 12 inches beyond the front of the louvered door.

WARNING:

Furnaces installed with combustion air drawn from a heated space which includes exhaust fans, fireplaces, or other devices that may produce a negative pressure should be considered confined space installations.

See the "venting requirements" section for venting guidelines and specifications.

Clearances to Combustibles

This furnace is Design Certified by CSA International for the minimum clearances to combustible material listed in Table 3. Refer to the furnace rating plate, located inside of the furnace cabinet, for the specific model number and clearance information.

Access for positioning and servicing the unit must be considered when locating unit. Twenty four inches is the minimum required clearance from the front of the unit for servicing it. Thirty inches is the minimum required clearance from the front of the unit for positioning it. **Thirty six inches is the recommended clearance from the front of the unit.** Please note that a panel or door can be located such that the minimum clearance on the rating plate is satisfied, but that panel or door must be removable and allow the appropriate clearance for your installation.

This furnace is certified for use on wood flooring. This furnace must not be installed directly on carpeting, tile, or any combustible material other than wood flooring.

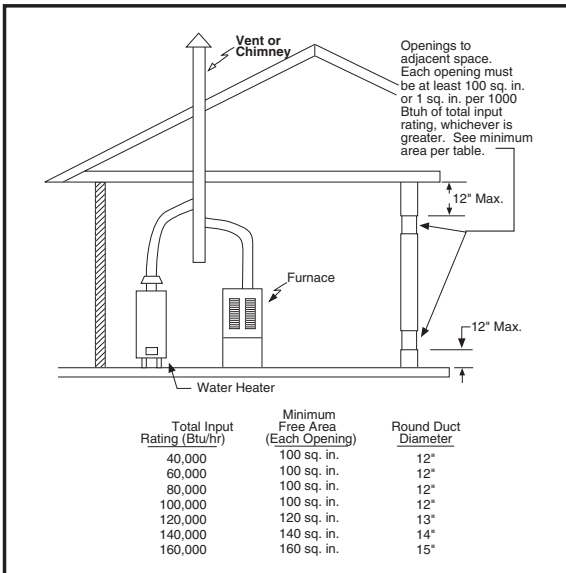


Figure 4. Equipment in a Confined Space with all Combustion Air Drawn from the Inside

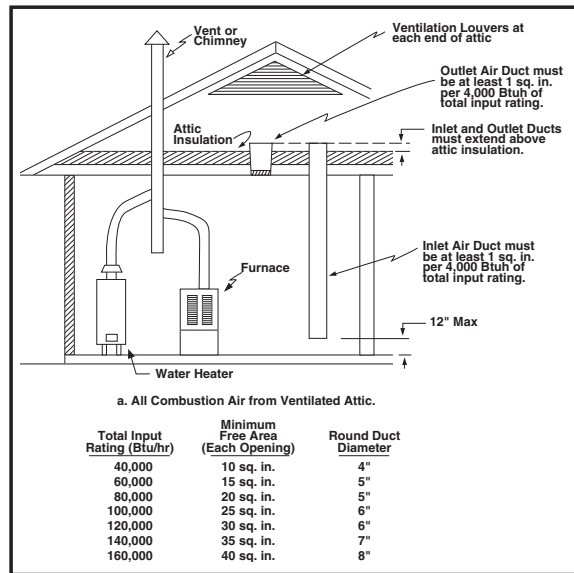


Figure 5. Equipment in a Confined Space with all Combustion Air Drawn from the Outside through Vertical Ducts

A gas-fired furnace installed in a residential garage must be installed so the burners and the igniter are located not less than 18 inches (457 mm) above the floor, and the furnace must be located or protected to avoid physical damage by vehicles.

! WARNING:

Do not place combustible material on or against the furnace cabinet or within 6 inches of the vent pipe (for B-vent use the recommended clearance). Do not place combustible materials, including gasoline and any other flammable vapors and liquids, in the vicinity of the furnace.

VENTING AND COMBUSTION AIR REQUIREMENTS

General

Provisions must be made in the installation of this furnace to provide an adequate supply of air for combustion. Detailed instructions for determining the adequacy of an installation can be found in the current revision of the National Fuel Gas Code (ANSI Z223.1 / NFPA54) or in applicable local building codes. **Consult local codes for special requirements.** For Canadian installations consult Canadian Installations Codes and (CAN/CGA B149.1 or .2).

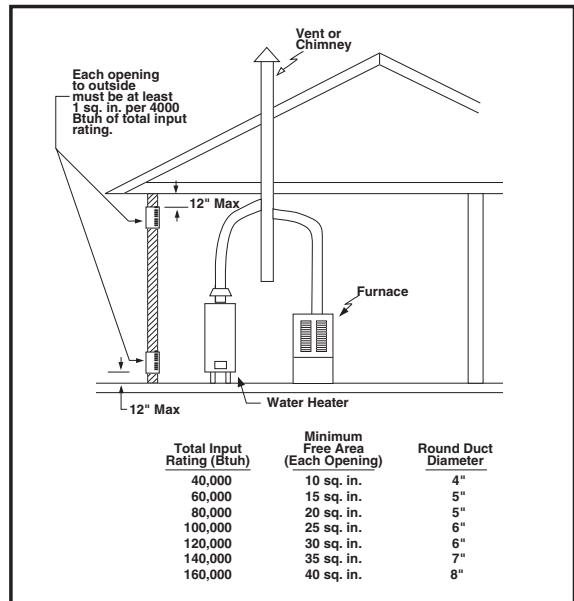


Figure 6. Equipment in a Confined Space with all Combustion Air Drawn from the Outside through Exterior Wall

If the furnace is operated with inadequate air for combustion one of the flame roll-out switches located in the burner compartment or the vent switch will open, turning off the gas supply to the burners. These safety devices are manually reset switches. **DO NOT** install jumper wires across these switches to defeat their function. **DO NOT** reset a switch without identifying and correcting the fault condition. If a switch must be replaced, use only the correct part specified in the Replacement Parts List.

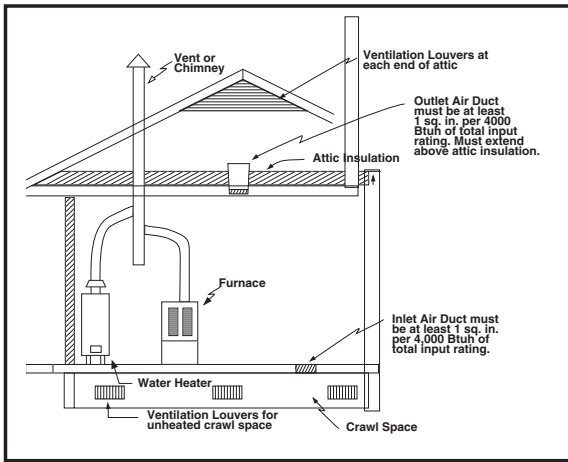


Figure 7. Equipment in a Confined Space with All Combustion Air Drawn from a Crawl Space and Ventilated Attic

Air openings in the furnace door, supply air registers, and return air grilles must not be restricted.

! CAUTION:

Combustion air must not be drawn from a corrosive atmosphere.

To maximize heat exchanger life, the combustion air must be free of chemicals which form corrosive acidic compounds in the combustion gases. Some examples of these chemicals are chlorine, fluorine, and sulphur. Some common sources of these chemicals are detergents, bleaches, aerosol sprays, cleaning solvents, and a wide variety of commercial and household products.

When installing a furnace in a commercial building or in a laundry room or workshop of a residence, it may be necessary to provide outside air to the furnace for combustion.

! WARNING:

Furnace installation using methods other than those described in the following sections must comply with the National Fuel Gas Code and all applicable local codes to provide sufficient combustion air for the furnace.

Installation In An Unconfined Space

An unconfined space is an area including all rooms not separated by doors with a volume greater than 50 cubic feet per 1,000 Btuh of the combined input rates of all appliances which draw combustion air from that space. For example, a space including a water heater rated at 45,000 Btuh input and a furnace rated at 72,000 Btuh requires a volume of 5,850 cubic feet [$50 \times (45 + 72) = 5,850$] to be considered unconfined. If the space has an 8 foot ceiling, the floor area of the space must be 731 square feet ($5,850 / 8 = 731$). In general, a furnace installed in an unconfined space will not require outside air for combustion. However, in "tight" buildings (with weather stripping and caulk to reduce infiltration), it may be necessary to provide outside air to ensure adequate combustion and venting, even though the furnace is located in an unconfined space.

Installation In A Confined Space

A confined space is an area with volume less than 50 cubic feet per 1,000 Btuh of the combined input rates of all appliances drawing combustion air from that space. Furnace closets, small equipment rooms and garages are confined spaces. Furnaces installed in a confined space which supply heated air to areas outside the space must draw return air from outside the space and must have the return air ducts tightly

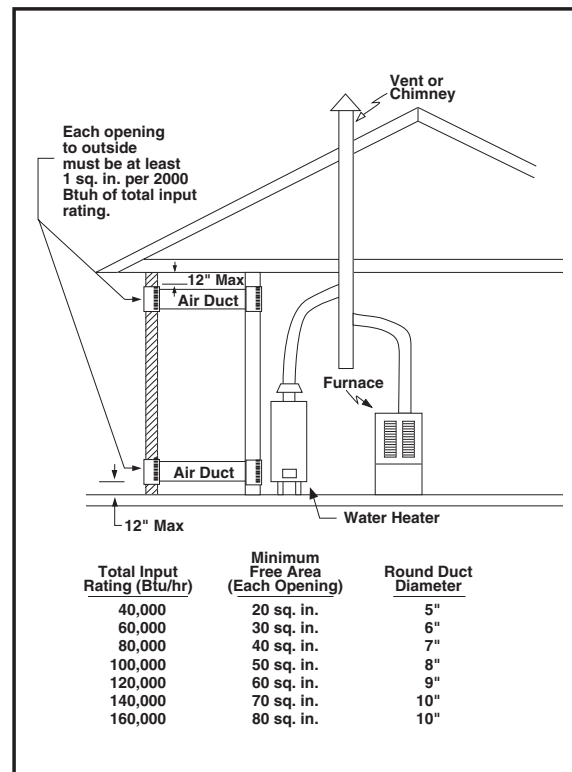


Figure 8. Equipment in a Confined Space with all Combustion Air Drawn from the Outside through Horizontal Ducts

sealed to the furnace. **A confined space must have two openings into the space for combustion air. One opening must be within 12 inches of the ceiling, and the other must be within 12 inches of the floor.** The required sizing of these openings is determined by whether inside or outside air is used to support combustion, the method by which the air is brought to the space, and by the total input rate of all appliances in the space.

Air From Inside (See Figure 4)

If combustion air is taken from the heated space, the two openings must *each* have a free area of at least one square inch per 1,000 Btuh of total input of all appliances in the confined space, but **not less than 100 square inches of free area.** For example, if the combined input rate of all appliances is less than or equal to 100,000 Btuh, each opening must have a free area of at least 100 square inches. If the combined input rate of all appliances is 126,000 Btuh, each opening must have a free area of at least 126 square inches.

Outdoor Air Using Vertical Ducts (See Figure 5)

If combustion air is taken from outdoors through vertical ducts, the openings and ducts must have a minimum free area of one square inch per 4,000 Btuh of total appliance input. In installations drawing combustion air from a ventilated attic, both air ducts must extend above the attic insulation.

If the unit is installed in an area with an exhaust fan, provide sufficient ventilation to prevent negative pressures from occurring in the room.

The combustion air openings must not be restricted in any manner.

CAUTION:

Do not supply combustion air from an attic space that is equipped with power ventilation or any other device that may produce a negative pressure.

Air Directly Through An Exterior Wall (See Figure 6)

If combustion air is provided directly through an exterior wall, the two openings must each have free area of at least one square inch per 4000 Btuh of total appliance input.

Outdoor Air Using a Crawl Space and Ventilated Attic (See Figure 7)

When directly communicating with the outdoors, each opening shall have a minimum free area of 1 square inch per 4,000 Btuh of total appliance input. The openings shall communicate directly, or by ducts, with the outdoor spaces (crawl or attic) that freely communicate with the outdoors.

Outdoor Air Using Horizontal Ducts (See Figure 8)

If combustion air is taken from outdoors through horizontal ducts, the openings and ducts must have a minimum free area of one square inch per 2,000 Btuh of total appliance input.

If the unit is installed in an area with an exhaust fan, provide sufficient ventilation to prevent negative pressures from occurring in the room.

The combustion air openings must not be restricted in any manner.

VENTING REQUIREMENTS

General

This furnace must be vented in compliance with, the current revision of the National Fuel Gas Code (ANSI-Z223.1/NFPA54), with the instructions provided below. This furnace is approved for Category I venting only.

In Canada, venting shall conform to the requirements of the current (CAN/CGA B149.1 or .2) installation codes. **Consult local codes for special requirements.**

This furnace must never be vented to a chimney flue servicing a fireplace or other appliance designed to burn solid fuel. If the furnace vent is to be connected to a chimney serving a fireplace, the fireplace must be sealed off from the chimney.

Single wall metal vents shall not be used for Category I venting. Category I furnaces must be vented vertically or near vertically.

For Category I furnace installations, the furnace shall be connected to a factory built chimney or vent complying with a recognized standard, or a masonry or concrete chimney lined with a lining material acceptable to the authority having jurisdiction. **Venting into an unlined masonry chimney or concrete chimney is prohibited.**

The furnace vent, if metal, may be insulated if local codes allow. Any part of the vent system, metal vent only, not exposed to weather, but

which are exposed to ambient temperatures below 35° F must be insulated to prevent condensation. All vent insulation shall be foil backed fiberglass of one inch minimum thickness.

Three sheet metal fasteners (field supplied) should be used to secure the vent pipe to the furnace flue. These fasteners should be evenly spaced around the flue diameter, if possible.

Combustion Air Quality

The recommended source of combustion air is to use the outdoor air supply. However, the use of indoor air in most applications is acceptable except as follows:

1. If the furnace is installed in a confined space it is recommended that the necessary combustion air come from the outdoors by way of attic, crawl space, air duct, or direct opening.
2. If outdoor combustion air is used, there must be no exposure to the installations or substances listed in Item 3 below.
3. The following types of installation may require **Outdoor Air** for combustion, due to chemical exposures:
 - Commercial buildings
 - Buildings with indoor pools
 - Furnaces installed in laundry rooms
 - Furnaces installed in hobby or craft rooms
 - Furnaces installed near chemical storage areas

Exposure to the following substances in the combustion air supply may also require

Outdoor Air for combustion:

- Permanent wave solutions
- Chlorinated waxes and cleaners
- Chlorine based swimming pool chemicals
- Water softening chemicals
- De-icing salts or chemicals
- Carbon tetrachloride
- Halogen type refrigerants
- Cleaning solvents (such as perchloroethylene)
- Printing inks, paint removers, varnishes, etc.
- Hydrochloric acid
- Cements and glues
- Antistatic fabric softeners for clothes dryers
- Masonry acid washing materials

Category I - Common Venting

When an existing furnace is removed from a venting system serving other appliances, the venting system is likely to be too large to properly vent the remaining appliances. An improperly sized venting system can result in the formation of condensate, leakage, spillage, etc.

The venting system should be designed to have the minimum number of elbows or turns. All horizontal runs shall be sloped upwards from the furnace at 1/4 inch per running foot of vent. Supports for the vent pipe must be installed a minimum of every five feet along the vent run to ensure no displacement after installation.

Under no circumstances shall any portion of the vent system extend into or pass through any return air duct, supply air duct, or plenum.

If the furnace is operated with blocked or restricted venting, the burner roll-out limit switch will open, turning off the gas supply to the burners. The roll-out limit switch is a manually reset device. DO NOT install a jumper wire across this switch to defeat its function. DO NOT reset the switch without identifying and correcting the fault condition which caused the switch to trip. If this switch must be replaced, use only factory-approved replacement parts.

WARNING:

Upon completion of the furnace installation, carefully inspect the entire flue system both inside and outside the furnace to assure it is properly sealed. Leaks in the flue system can result in serious personal injury or death due to exposure of flue products, including carbon monoxide.

WARNING:

CARBON MONOXIDE POISONING HAZARD

Failure to follow the steps outlined below for each appliance connected to the venting system being placed into operation could result in carbon monoxide poisoning or death.

The following steps shall be followed for each appliance connected to the venting system being placed into operation, while all other appliances connected to the venting system are not in operation:

1. Seal any unused openings in the venting system.
2. Inspect the venting system for proper size and horizontal pitch, as required in the *National Fuel Gas Code, ANSI Z223.1/NFPA 54* or the *CSA B149.1, Natural Gas and Propane Installation Codes* and these instructions. Determine that there is no blockage or restriction, leakage, corrosion and other deficiencies which could cause an unsafe condition.
3. As far as practical, close all building doors and windows and all doors between the space in which the appliance(s) connected to the venting system are located and other spaces of the building.
4. Close fireplace dampers.
5. Turn on clothes dryers and any appliance not connected to the venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they are operating at maximum speed. Do not operate a summer exhaust fan.
6. Follow the lighting instructions. Place the appliance being inspected into operation. Adjust the thermostat so appliance is operating continuously.
7. Test for spillage from draft hood equipped appliances at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle.
8. If improper venting is observed during any of the above tests, the venting system must be corrected in accordance with the *National Fuel Gas Code, ANSI Z223.1/NFPA 54* and/or *CSA B149.1, Natural Gas and Propane Installation Codes*.
9. After it has been determined that each appliance connected to the venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas-fired burning appliance to their previous conditions of use.

CIRCULATING AIR SUPPLY

General

Plenums and air ducts must be installed in accordance with the Standard for the Installation of Air Conditioning and Ventilating Systems (NFPA No. 90A) or the Standard for the Installation of Warm Air Heating and Air Conditioning Systems (NFPA No. 90B).

It is recommended that the outlet duct be provided with a removable access panel. This opening should be accessible when the furnace is installed in service and shall be of a size that smoke or reflected light may be observed inside the casing to indicate the presence of leaks in the heat exchanger. The cover for the opening shall be attached in such a manner as to prevent leaks.

If outside air is used as return air to the furnace for ventilation or to improve indoor air quality, the system must be designed so that the return air is not less than 50° F (10° C) during operation. If a combination of indoor and outdoor air is used, the ducts and damper system must be designed so that the return air supply to the furnace is equal to the return air supply under normal, indoor return air applications.

When a cooling system is installed which uses the furnace blower to provide airflow over the indoor coil, the coil must be installed downstream (on the outlet side) of the furnace or in parallel with the furnace.

If a cooling system is installed in parallel with the furnace, a damper must be installed to prevent chilled air from entering the furnace and condensing on the heat exchanger. If a manually operated damper is installed, it must be designed so that operation of the furnace is prevented when the damper is in the cooling position and operation of the cooling system is prevented when the damper is in the heating position.

Return Air

In applications where the supply ducts carry heated air to areas outside the space in which the furnace is installed, the return air must be delivered to the furnace by duct(s) sealed to the furnace casing, running full size and without interruption.

WARNING:

The solid base of these furnaces must be in place when the furnace is installed with side return air ducts. Removal of all or part of the base could cause products of combustion to be circulated into the living space and create potentially hazardous conditions, including carbon monoxide poisoning that could result in personal injury or death.

The return air ductwork may be connected to the left side return, right side, or bottom. **NOTE: Do not use the back of the furnace for return air.** Table 2, in the front pages of these instructions, contains the airflow data for each

furnace model. Where maximum airflow is 1800 CFM or more, two openings must be used for return air.

WARNING:

Products of combustion must not be allowed to enter the return air ductwork or the circulating air supply. Failure to prevent products of combustion from being circulated into the living space can create potentially hazardous conditions including carbon monoxide poisoning that could result in personal injury or death.

All return ductwork must be secured to the furnace with sheet metal screws. For installations in confined spaces, all return ductwork must be adequately sealed and joints must be taped. When return air is provided through the bottom of the furnace, the joint between the furnace and the return air plenum must be air tight.

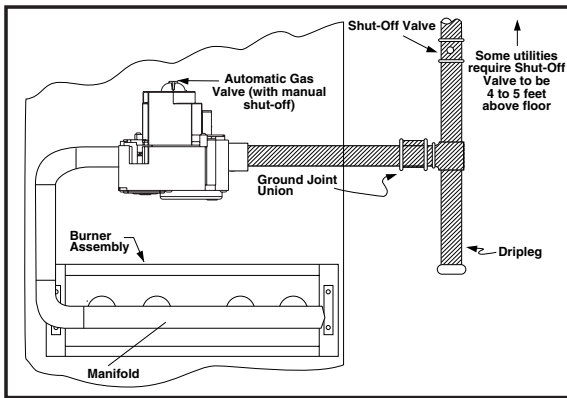
The floor or platform on which the furnace is mounted must provide sound physical support of the furnace with no gaps, cracks, or sagging between the furnace and the floor or platform.

Return air and circulating air ductwork must not be connected to any other heat producing device such as a fireplace insert, stove, etc. Doing so may result in fire, explosion, carbon monoxide poisoning, personal injury, or property damage.

GAS SUPPLY AND PIPING

CAUTION:

Do not re-drill the burner orifices. If the orifice size must be changed, use only new orifices.



**Figure 9. Typical Gas Service Connection
Typical Right Side Entry**

CAPACITY OF BLACK IRON GAS PIPE (CU. FT. PER HOUR) FOR NATURAL GAS (SPECIFIC GRAVITY - 0.60)								
NOMINAL BLACK IRON PIPE DIAMETER (in.)	LENGTH OF PIPE RUN (feet)							
	10	20	30	40	50	60	70	80
1/2	130	90	75	65	55	50	45	40
3/4	280	190	150	130	115	105	95	90
1	520	350	285	245	215	195	180	170
1 1/4	1050	730	590	500	440	400	370	350
1 1/2	1600	1100	890	760	670	610	560	530

The cubic feet per hour listed in the table above must be greater than the cubic feet per hour of gas flow required by the furnace.

To determine the cubic feet per hour of gas flow required by the furnace, divide the input rate of the furnace by the heating value of the gas:

$$\text{Cubic Feet Per Hour Required} = \frac{\text{Input To Furnace (Btu/hr)}}{\text{Heating Value of Gas (Btu/Cu. Ft.)}}$$

**Table 4. Capacity of Black Iron Gas Pipe
(cu. ft. per hour) for Natural Gas
(specific gravity = .60)**

General

This furnace may be installed for either left or right side gas entry. A typical gas service hookup is shown in Figure 9. When making the gas connection provide clearance between the gas supply line and the entry hole in the furnace casing to avoid unwanted noise and/or damage to the furnace.

All gas piping must be installed in compliance with local codes and utility regulations. Some local regulations require the installation of a manual main shut-off valve and ground joint union external to the furnace. The shut-off valve should be readily accessible for service and/or emergency use. Consult the local utility or gas supplier for additional requirements regarding placement of the manual

main gas shut-off. In the absence of local codes the gas line installation must comply with the latest edition of the National Fuel Gas Code (ANSI Z223.1) or (CAN/CGA B149.1 or .2) Installation Codes.

An 1/8 inch NPT tap must be installed in the gas line to the unit for use when measuring the gas supply pressure. The tap should be readily accessible for service use. A drip leg should be installed in the vertical pipe run to the unit. Table 4 lists gas flow capacities for standard pipe sizes as a function of length in typical applications based on nominal pressure drop in the line.

IMPORTANT NOTES:

1. Gas piping must not be run in or through air ducts, chimneys, gas vents, elevator shafts, etc.
2. Compounds used on threaded joints of gas piping must be resistant to the actions of liquefied petroleum gases.
3. The main manual gas valve and main power disconnect to the furnace must be properly labeled by the installer in case emergency shutdown is required.

Leak Check

After the gas piping to the furnace is complete, all connections must be tested for gas leaks. To check for leaks in gas piping systems, use only a soap and water solution or other approved method.

! CAUTION:

Do not use matches, lighters, candles, or other sources of open flame to check for gas leaks.

IMPORTANT NOTE:

When pressure testing the gas supply lines at pressures greater than 1/2 psig (14 inch W.C.), the furnace must be disconnected from the gas supply piping system to prevent damage to the gas control valve. If the test pressure is less than or equal to 1/2 psig (14 inch W.C.), the furnace must be isolated from the gas supply line by closing the manual shut-off valve.

For a Natural Gas Sea Level Heating Value of 800 to 899 Btu/cu.ft.					
	Elevation (feet above sea level)				
	zero to 1999	2000 to 4999	5000 to 5999	6000 to 7999	8000 to 10000
Manifold Pressure Setting (in WC)	3.5	3.5	3.5	3.5	3.0

For a Natural Gas Sea Level Heating Value of 900 to 999 Btu/cu.ft.					
	Elevation (feet above sea level)				
	zero to 1999	2000 to 4999	5000 to 5999	6000 to 7999	8000 to 10000
Manifold Pressure Setting (in WC)	3.5	3.5	3.5	3.2	2.8

For a Natural Gas Sea Level Heating Value of 1,000 to 1,100 Btu/cu.ft.					
	Elevation (feet above sea level)				
	zero to 1999	2000 to 4999	5000 to 5999	6000 to 7999	8000 to 10000
Manifold Pressure Setting (in WC)	3.5	3.5	3.0	2.8	2.5

Table 5. Manifold Pressure (in WC) for Natural Gas at Various Altitudes

	Elevation (feet above sea level)				
	0 to 1,999	2,000 to 4,999	5,000 to 5,999	6,000 to 7,999	8,000 to 10,000
Manifold Pressure in (WC) for an LP Gas Heating Value of 2,500 Btu/hr.	10.0	8.5	10.0	9.0	8.5

Table 6. Manifold Pressure (in WC) for LP/Propane Gas at Various Altitudes

Furnace Rating Plate Input (Btu/h)	Orifice Drill Size	
	#	#
	Nat	LP
45,000	50	57
54,000	47	56
72,000	47	56
90,000	47	56
108,000	47	56
126,000	47	56

Table 7. Natural and LP Gas Orifice Sizes for Elevations between zero and 4999 ft. Above Sea Level

Furnace Rating Plate Input (Btu/h)	Orifice Drill Size	
	#	#
	Nat	LP
45,000	50	61
54,000	47	61
72,000	47	61
90,000	47	61
108,000	47	61
126,000	47	61

Table 8. Natural and LP gas Orifice Sizes for Elevations between 5000 and 10,000 ft. Above Sea Level

 **WARNING:**

FIRE OR EXPLOSION HAZARD

Failure to follow the safety warnings exactly could result in serious injury, death or property damage.

Never test for gas leaks with an open flame. Use a commercially available soap solution made specifically for the detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury or loss of life.

Conversion

Conversion of this furnace to use LP/propane gas must be made by qualified service personnel, using **only** approved parts.

 **WARNING:**

This furnace was equipped at the factory for use with natural gas only. A special kit, supplied by the manufacturer, is required to convert the furnace to operate on LP/propane gas. Failure to use the proper conversion kit can cause fire, explosion, property damage, carbon monoxide poisoning, personal injury, or death.

HIGH ALTITUDE CONVERSION**High Altitude Application**

Conversion of this furnace to replace the pressure switch or to utilize LP/propane gas must be made by qualified service personnel, using factory authorized or approved parts. High altitude application with this furnace can be field performed by a simple adjustment of manifold pressure, and if necessary changing the orifices and the pressure switch. The changes required depend on the installation altitude and the heating value of the gas. The gas heating value based on sea level can be obtained from your local gas utility. The heating value of gas at high altitude is always lower than the sea level heating value. The heating values used in Tables 5 & 6 are based on sea level values.

Pressure Switch Conversion for High Altitude Applications

The pressure switch is factory equipped to

operate between zero and 5000 feet above sea level. For higher altitude applications, you may need to replace the pressure switch. The approved high altitude pressure switch kit is 903853. The directions to convert the furnace are given below:

1. READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE CONVERSION.
2. Disconnect all electrical power to the furnace.
3. Remove the access door(s) from the front of the unit.
4. Turn the gas valve knob to the OFF position.
5. Shut off the gas to the unit.
6. Disconnect the electrical leads to the pressure switch (see Figure 14). It is not necessary to mark the leads as polarity does not matter across the switch.
7. Remove the hose from the pressure switch and remove the fasteners that secure the pressure switch to the burner box.
8. Discard the old pressure switch.
9. From the kit, install the new high altitude pressure switch using the same fasteners that were removed above.
10. Reattach the hose to the pressure switch port in the same manner as it was removed.
11. Reattach the electrical leads to the pressure switch.
12. Turn on the electrical power to the furnace.
13. Turn the gas valve knob to the ON position.
14. Follow the start-up procedure outlined later in these installation instructions. Verify that the furnace is operating properly after the conversion.

Natural Gas High Altitude Conversion

All factory shipped furnaces are ready to operate up to 4999 ft. above sea level. For higher altitudes (between 5000 and 10,000 ft. above sea level), conversion can be achieved simply by adjusting the furnace manifold pressure as shown in Table 5.

LP/Propane Gas Sea Level and High Altitude Conversion**IMPORTANT NOTE:**

When converting a low NO_x Furnace from Natural gas to LP/Propane gas, it is necessary to remove the NO_x Baffles.

Conversion to LP/propane gas can be accomplished by first replacing the natural gas orifices with the appropriate LP/propane orifices shown in Table 7 or 8. Note: for installations between zero and 5000 ft., refer to Table 7. For installations above 5000 ft. above sea level,

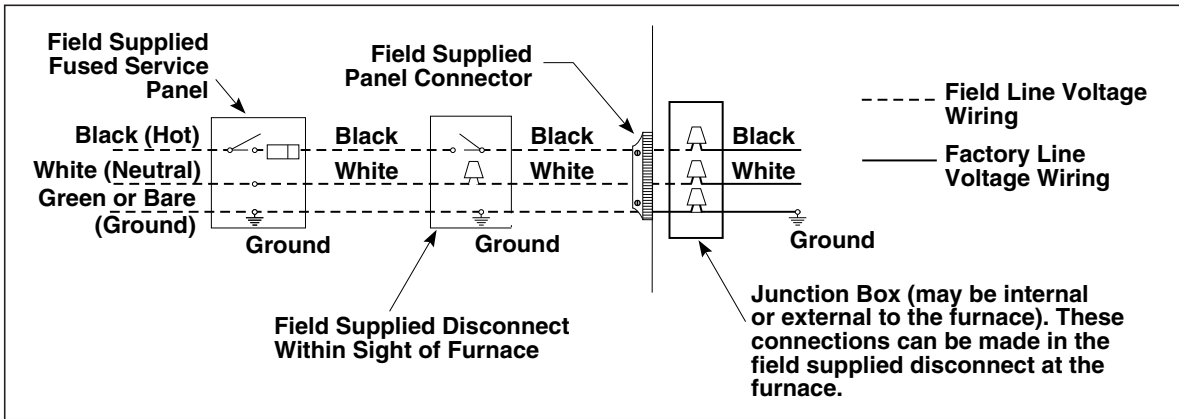


Figure 10. Line Voltage Field Wiring

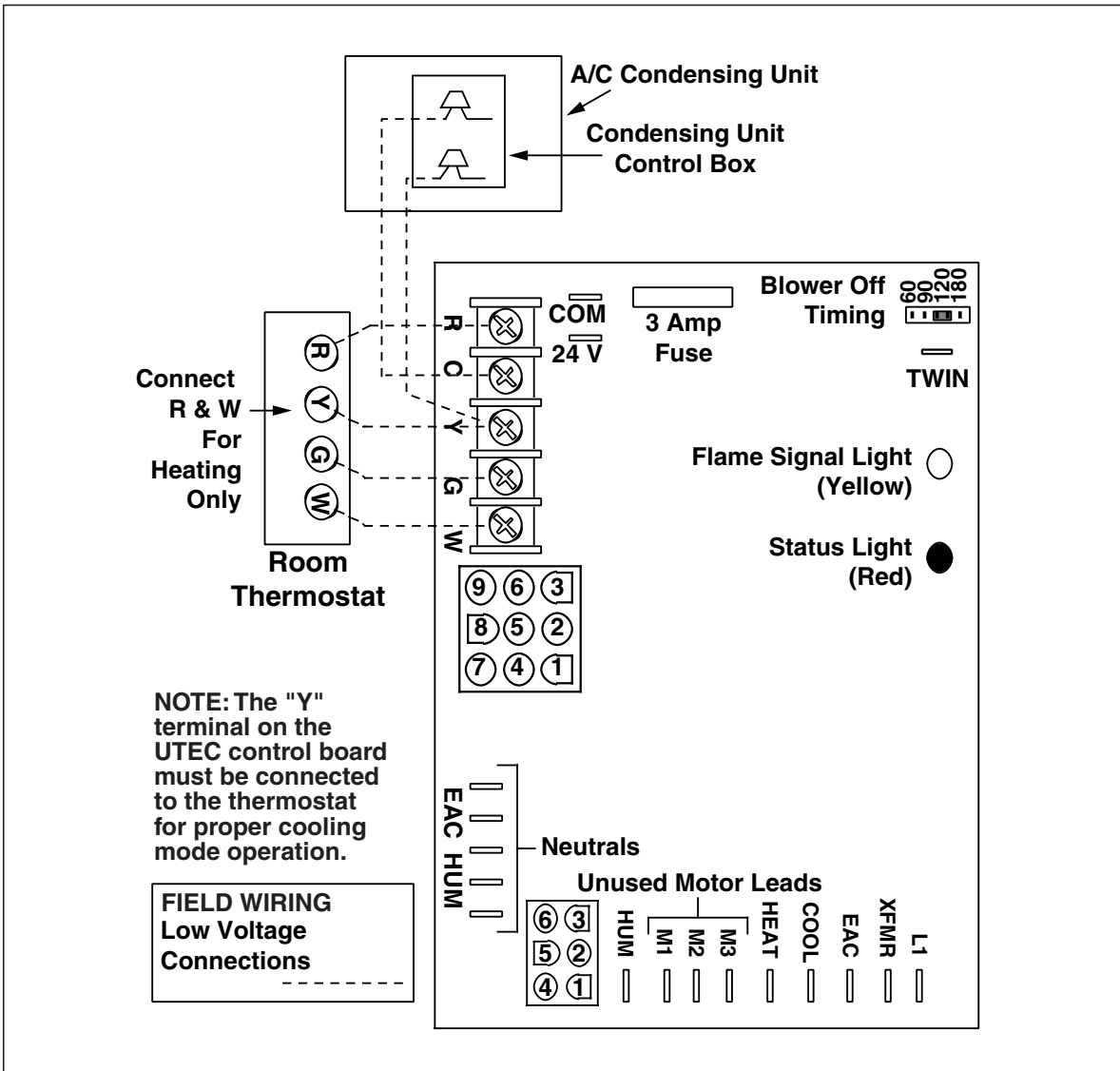


Figure 11. Line Voltage Field, Four-wire Heating/Cooling Applications

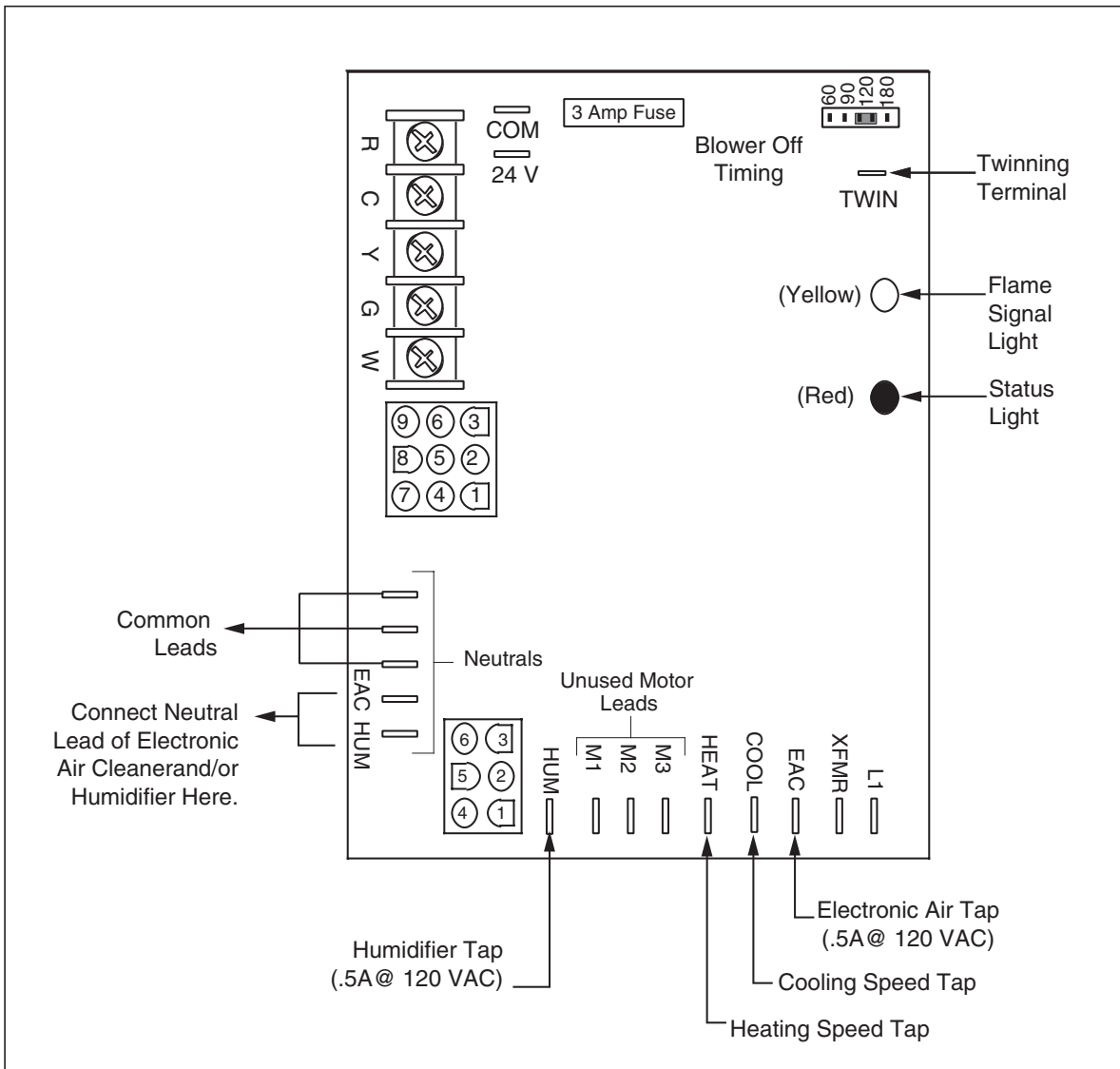


Figure 12. Integrated Control

Furnace Model Number *RA	Maximum Furnace Amperes	Minimum Wire Gauge	Maximum Fuse or Circuit Breaker Amps**
045-08A	6.8	14	15
054-12A	9.3	14	15
072-12A	9.3	14	15
072-12B	9.3	14	15
072-16B	11.6	14	15
090-12B	9.3	14	15
090-16B	11.6	14	15
090-20B	15.6	12	20
108-16B	11.6	14	15
108-20B	15.6	12	20
108-20C	15.6	12	20
126-20C	15.6	12	20

** Time-delay fuses or HACR-type circuit breakers are required.

Thermostat Wire Gauge	Recommended Thermostat Wire Length	
	2-wire (heating)	4 or 5-wire (cooling)
24	55 ft.	25 ft.
22	90 ft.	45 ft.
20	140 ft.	70 ft.
18	225 ft.	110 ft.

Table 9. Electrical Data

refer to Table 8. After changing the orifices, use Table 6 to determine the appropriate manifold pressure for your installation.

Conversion to LP/propane, sea level, and high altitude is detailed in the installation instructions provided with the conversion kit. Approved conversion kits are listed below.

United States LP/Propane Gas Sea Level and High Altitude Conversion Kit - P/N 904090A

This kit is for LP/propane conversion in the United States at altitudes between zero and 10,000 ft. above sea level. Follow the installation instructions supplied with the kit for proper installation.

Canadian LP/Propane Gas Sea Level and High Altitude Conversion Kit - P/N 904091A

This kit is for LP/propane conversions in Canada at altitudes between zero and 4500 ft. above sea level. Follow the installation instructions supplied with the kit for proper installation.

GAS FLOW RATE (CUBIC FEET PER HOUR)							
TIME FOR ONE REVOLUTION (SECONDS)	CUBIC FEET PER REVOLUTION OF METER			TIME FOR ONE REVOLUTION (SECONDS)	CUBIC FEET PER REVOLUTION OF METER		
	1	5	10		1	5	10
10	360	1800	3600	66	55	273	545
12	300	1500	3000	68	53	265	529
14	257	1286	2571	70	51	257	514
16	225	1125	2250	72	50	250	500
18	200	1000	2000	74	49	243	486
20	180	900	1800	76	47	237	474
22	164	818	1636	78	46	231	462
24	150	750	1500	80	45	225	450
26	138	692	1385	82	44	220	439
28	129	643	1286	84	43	214	429
30	120	600	1200	86	42	209	419
32	113	563	1125	88	41	205	409
34	106	529	1059	90	40	200	400
36	100	500	1000	92	39	196	391
38	95	474	947	94	38	191	383
40	90	450	900	96	38	188	375
42	86	429	857	98	37	184	367
44	82	409	818	100	36	180	360
46	78	391	783	102	35	176	353
48	75	375	750	104	35	173	346
50	72	360	720	106	34	170	340
52	69	346	692	108	33	167	333
54	67	333	667	110	33	164	327
56	64	321	643	112	32	161	321
58	62	310	621	114	32	158	316
60	60	300	600	116	31	155	310
62	58	290	581	118	31	153	305
64	56	281	563	120	30	150	300

Table 10. Gas Flow Rate

**CAUTION:**

To avoid electric shock, personal injury, or death, turn off the electric power at the disconnect or the main service panel before making any electrical connections.

ELECTRICAL WIRING

General

Electrical connections must be made in accordance with all applicable local codes and ordinances, and with the current revision of the National Electric Code (ANSI/NFPA 70).

For Canadian installations the electrical connections and grounding shall be done in accordance with the current Canadian Electrical Code (CSA C22.1, Part 1 and/or local codes). If any of the original wire as supplied with the furnace must be replaced, it must be replaced with wire having a temperature rating of at least 105°C. Refer to the furnace nameplate and Table 9 for electrical requirements.

Line Voltage Wiring

The line voltage (115 volt) to the furnace must be supplied from a dedicated branch circuit containing the correct fuse or circuit breaker for the furnace. (See Table 9.) An electrical disconnect must be installed to be readily accessible from and located within sight of the furnace. (See the Wiring Diagram label in the furnace and Figure 10.)

**CAUTION:**

Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation.

Verify proper operation after servicing.

The furnace cabinet must have an uninterrupted, unbroken ground to minimize injury should an electrical fault condition occur. **The controls used in this furnace require an earth ground to operate properly.** Acceptable methods for grounding are electrical wire or conduit approved for electrical ground service. Do not use gas piping as an electrical ground.

IMPORTANT NOTE:

Proper line voltage polarity must be maintained in order for the control system to operate correctly. Verify that the incoming neutral line is connected to the white wire and the incoming “hot” line is connected to the black wire. These furnaces will not operate unless the polarity and ground are properly connected. See Figure 10.

Low Voltage Wiring

Install the thermostat per the manufacturer's instructions. The low voltage (24 volt) connections from the thermostat are made at the terminal strip on the integrated control in the furnace. See Figure 11 for the proper connections for heating only (two-wire) and heating/cooling (four-wire) applications. The recommended minimum wire gauge for thermostat wiring is shown in Table 9.

The thermostat must not be installed on an outside wall or any other location where its operation may be adversely affected. Adverse affects include radiant loading from fireplaces, sunlight, or lighting fixtures, and convective loading from warm air registers or electrical appliances. To determine the heat anticipator setting either:

1. Add the current draw of the system components; or
2. Measure the current flow on the thermostat R-W circuit after the circulating blower motor has started.

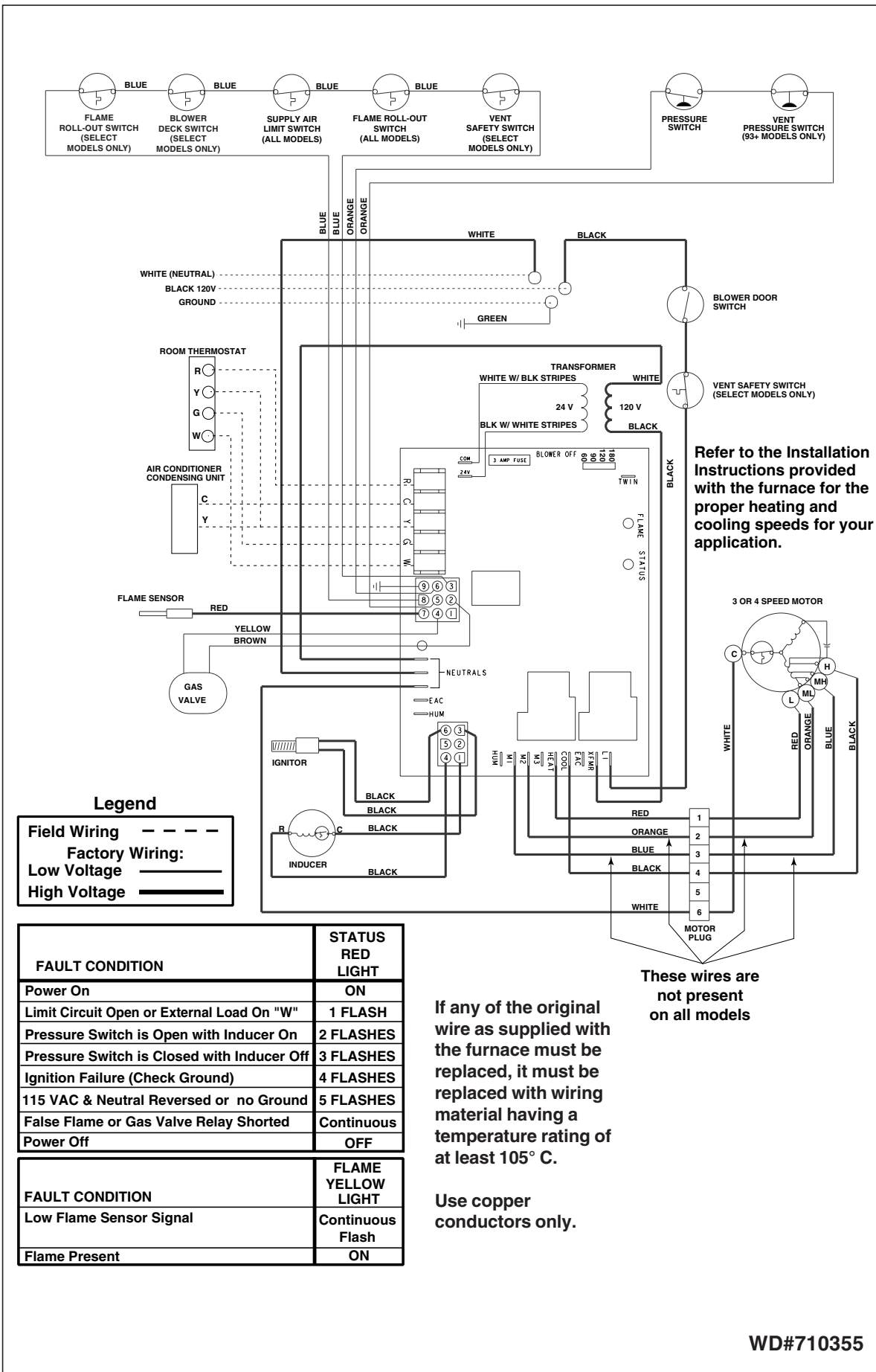
Set the heat anticipator according to the thermostat manufacturer's instructions for heat anticipator settings.

START-UP AND ADJUSTMENTS

General

Prior to start-up, verify that:

1. The line voltage power leads are securely connected, that the polarity of the connections is correct, and that the furnace is properly grounded.
2. The thermostat wires (R, W, Y, and G) are securely connected to the correct leads on the terminal strip of the circuit board.
3. The gas line service pressure does not exceed 10.0 in. water column (0.36 psig), and is not less than 4.5 in. water column (0.16 psig) for natural gas. For LP gas the line service pressure must not exceed 14



Legend

Field Wiring	---
Factory Wiring:	—
Low Voltage	—
High Voltage	—

FAULT CONDITION	STATUS RED LIGHT
Power On	ON
Limit Circuit Open or External Load On "W"	1 FLASH
Pressure Switch is Open with Inducer On	2 FLASHES
Pressure Switch is Closed with Inducer Off	3 FLASHES
Ignition Failure (Check Ground)	4 FLASHES
115 VAC & Neutral Reversed or no Ground	5 FLASHES
False Flame or Gas Valve Relay Shorted	Continuous
Power Off	OFF

FAULT CONDITION	FLAME YELLOW LIGHT
Low Flame Sensor Signal	Continuous Flash
Flame Present	ON

Figure 13. Wiring Diagram

in. water column (0.51 psig), and must not be less than 11.0 in. w.c. (0.40 psig).

4. The roll-out manual reset switch is closed. If necessary, press the red button to reset a switch. DO NOT install a jumper wire across a switch to defeat its function. If a switch reopens on start-up, DO NOT reset the switch without identifying and correcting the fault condition which caused the switch to trip.
5. The blower door is in place, closing the door switch in the line voltage circuit.
6. The gas line has been purged and all connections are leak tight.

Start-up Procedures

After all of the above checks have been made:

1. Set the thermostat to the lowest setting.
2. Close the disconnect(s) to provide line voltage to the furnace.
3. Follow the procedures given on the operating instruction label attached to the furnace.
4. Set the thermostat above room temperature and verify the operating sequence. (See the **Sequence of Operation**).
5. After the furnace has run for approximately five minutes, set the thermostat below room temperature and verify steps (9) through (11) of the **Sequence of Operation**.

Verifying and Adjusting Firing Rate

The firing rate must be verified for each installation to prevent over-firing the furnace.

Follow the procedure below to determine the firing rate.

1. Shut off all other gas fired appliances.
2. Start the furnace and allow it to run for at least three minutes.
3. Measure the time (in seconds) required for the gas meter to complete one revolution.
4. Convert the time per revolution to cubic feet of gas per hour using Table 10.

5. Multiply the gas flow rate in cubic feet per hour by the heating value of the gas in Btu per cubic foot to obtain the firing rate in Btu per hour. Example:

- Time for 1 revolution of a gas meter with a 1 cubic foot dial = 40 seconds.
- From Table 10 read 90 cubic feet per hour of gas.
- Heating value of the gas (obtained from gas supplier) = 1040 Btu per cubic foot.
- Firing rate = $1040 \times 90 = 93,600$ Btuh.

6. Adjustments to the firing rate can be made by adjusting the gas manifold pressure. See the High Altitude Application section for additional information of firing rate at elevations above 2000 ft.

The manifold pressure must be set to the appropriate value for your installation. Refer to either Table 5 for natural gas or Table 6 for LP/propane gas to verify the manifold pressure setting required for your particular installation. To adjust the manifold pressure, remove the regulator cap and turn the adjusting screw clockwise to increase pressure or counter-clockwise to reduce pressure. Replace the regulator cap after adjustments are complete.

Verifying and Adjusting Temperature Rise

Verify the temperature rise through the furnace is within the range specified on the furnace rating plate. Temperature rises outside the specified range could result in premature heat exchanger failure and/or cycling on limit switch.

Place thermometers in the return and supply air stream as close to the furnace as possible. The thermometer on the supply air side must be shielded from direct radiation from the heat exchanger to avoid false readings. Adjust all registers and duct dampers to the desired position and run the furnace for ten to fifteen minutes before taking any temperature readings. The temperature rise is the difference between the supply and return air temperatures.

For typical duct systems, the temperature rise will fall within the range specified on the rating plate with the blower speed at the factory recommended setting. If the temperature rise measured is outside the range specified, it may be necessary to change the blower speed.

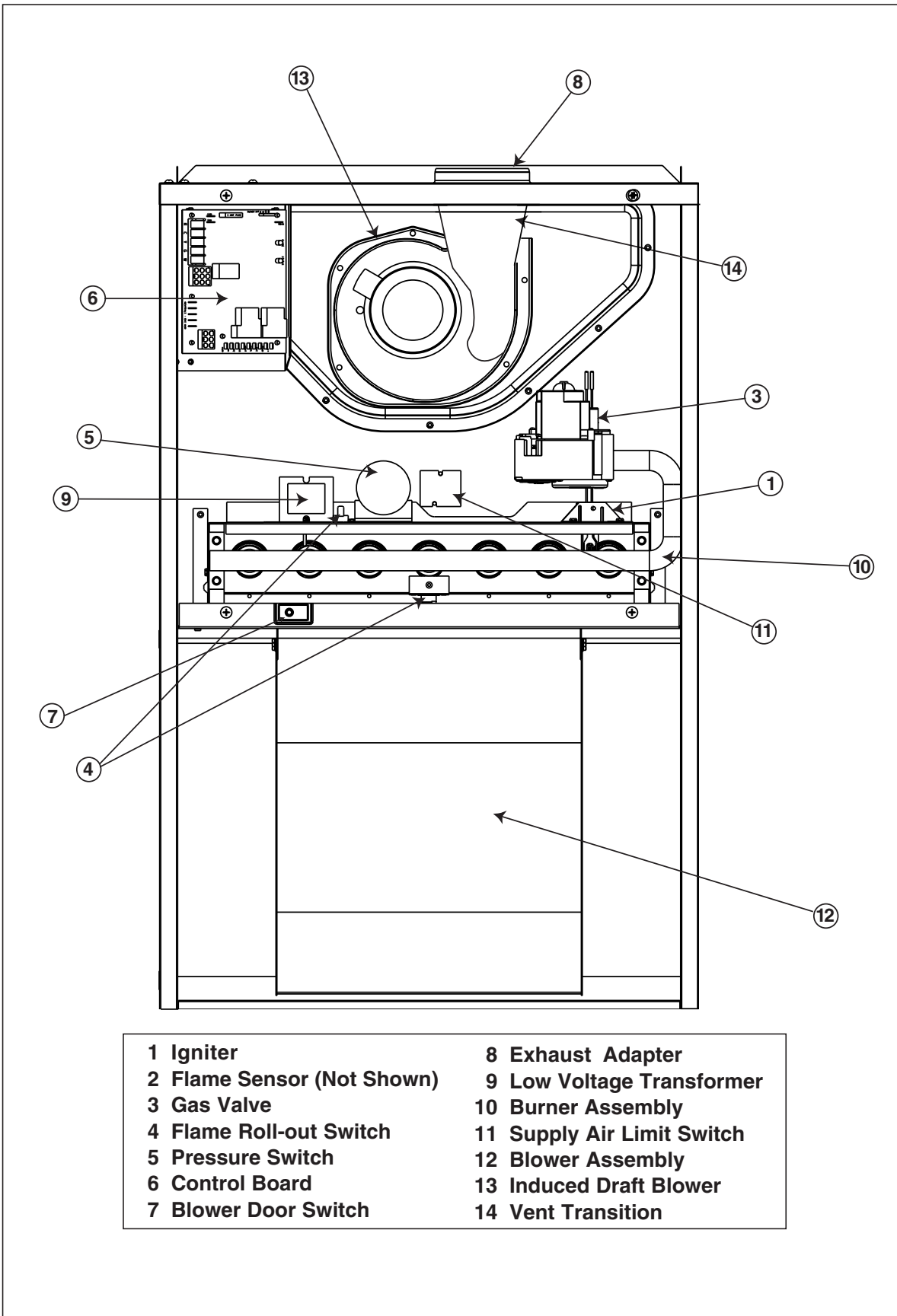


Figure 14. Location of Major Components

Lower blower speeds will increase the temperature rise and higher blower speeds will decrease the temperature rise.

The furnace is equipped with a multi-speed motor. Heating and cooling speed selection is made by moving the leads on the integrated control located in the furnace. The wiring diagram on the furnace and Figures 12, 13 and 14 show the speed taps for adjusting motor speed.

If it is desired that the blower operate at the same unused speed for heating and cooling, move blower leads to M1, M2, and/or M3 and install the jumper wire found in the plastic instruction bag. Remove the desired blower tap, and install the jumper wire piggyback to the heating speed tap, and straight quick connect to the cooling speed tap. Reconnect the desired blower tap to piggyback quick connect.

The integrated control is factory set to start the circulating air blower 30 seconds after the gas valve is opened. The integrated control is factory wired to turn the blower motor off 120 seconds after the gas valve is closed. If necessary for comfort, the "off" time may be changed by adjusting the Blower Off jumper on the integrated control. See Figure 12 or 13 for blower on and off time adjustments.

 **WARNING:**

To avoid electric shock, personal injury, or death, disconnect the electric power before performing any maintenance.

Verifying Burner Operation

To verify operation of the burners, make sure that the furnace door is in place and that there is power to the furnace. Set the thermostat to a temperature above room temperature and observe the ignition sequence. The burner flame should carry over immediately between all burners. The flames should be blue, without yellow tips. Flames should extend from each burner without lifting off, curling, or floating. After verifying satisfactory flame characteristics, set the thermostat to a temperature below room temperature and verify that the burner flame extinguishes completely.

Verifying Operation of the Supply Air Limit Switch

To verify operation of the supply air limit switch, make sure that the blower door is in place and that there is power to the furnace. Block the return airflow to the furnace by installing a close-off plate in place of or upstream of the filter(s). Set the thermostat to a temperature above room temperature and verify that the Sequence of Operation is as described in these instructions. The limit switch should function to turn off the gas valve within approximately four minutes (the exact time depending on the efficiency of the close-off in blocking the return air to the furnace). The circulating air and combustion blowers should continue to run when the limit switch opens. Remove the close-off immediately after the limit switch opens. If the furnace operates for more than four minutes with no return air, set the thermostat to a temperature below room temperature, shut off the power to the furnace, and replace the limit switch.

DESCRIPTION OF COMPONENTS

Figure 14 shows the location of each of the functional components described below. Also, refer to the Sequence of Operation Section of this manual. If any component of the furnace must be replaced, use only factory authorized replacement parts. See the Replacement Parts List for the factory authorized replacement for each component.

Supply Air Limit Switch

The supply air limit switch prevents the air temperature leaving the furnace from exceeding the maximum allowable outlet air temperature.

Flame Sensor

The flame sensor acts to prove that flame has carried over from the igniter to the opposite end burner. If no flame is sensed, the furnace will shut down within 7 seconds.

Flame Roll-Out Switch

The flame roll-out switch verifies that the burner flames are drawn into the heat exchanger tubes. If the burner flames are not properly drawn into the heat exchanger, the flame roll-out switch will open. The circulating air blower and combustion blower will continue to operate if the flame roll-out switch opens.

Gas Valve

The gas valve controls the flow of gas to the burners. When the gas valve is energized it automatically opens and regulates the gas pressure in the manifold.

Pressure Switch

The pressure switch verifies that the inducer is drawing the combustion gases through the heat exchanger.

MAINTENANCE

It is recommended that the furnace be checked yearly. At a minimum, this check should include the following items.

WARNING:

To avoid electrical shock, personal injury, or death, turn off the electric power at the disconnect or the main service panel before making any electrical connections.

WARNING:

Products of combustion must not be allowed to enter the living space. Failure to prevent products of combustion from being circulated into the living space can create potentially hazardous conditions including carbon monoxide poisoning that could result in personal injury or death.

Vent System

Check the vent pipe to ensure that it is not corroded or blocked by debris. Any corroded section of vent pipe must be replaced, and any obstruction or blockage must be removed prior to operating the furnace.

Air Filter(s)

WARNING:

Never operate the furnace without a filter in place. Dust and lint in the return air can build up on internal components, resulting in loss of efficiency, equipment damage, and possible fire.

Air filter(s) are not supplied with the furnace as shipped from the factory.

The installer must provide a high velocity filter and rack for a filter in the return air duct adjacent to the furnace, or in a return air grill to the furnace. Filters should be changed or cleaned monthly during the heating season. New or newly renovated homes may require more frequent changing until the construction dust has been removed.

Filters for side return and bottom return applications are available from your local distributors.

Lubrication

The bearings in the circulating air blower motor and inducer blower used in these furnaces are pre-lubricated and sealed at the factory. No further oiling of the bearings is required for the life of the motor.

Blower Compartment

The blower compartment should be cleaned monthly during the heating and cooling seasons to remove any dirt and lint that may have accumulated in the compartment or on the blower and motor. Dirt and lint can create excessive loads on the motor resulting in higher than normal operating temperatures and shortened service life.

Heat Exchanger and Burner Maintenance

The furnace should operate for many years without soot buildup in the flue passageways, however, the flue passageways, the vent system, and the burners should be inspected and cleaned (if required) by a qualified serviceman annually to ensure continued safe operation. Particular attention must be given to identify deterioration from corrosion or other sources.

WARNING:

Holes in the vent pipe or heat exchanger can cause products of combustion to enter the home. Replace the vent pipe or heat exchanger if leaks are found. Failure to prevent products of combustion from being circulated into the living space can create potentially hazardous conditions including carbon monoxide poisoning that could result in personal injury or death.

Cleaning Of Flue Passages

If the flue passages must be cleaned, follow the steps below. See Figure 14 for component location and identification.

1. Shut off the gas supply to the furnace either at the meter or at the manual valve in the gas supply piping.
2. Turn off all power to the furnace and set the thermostat to the lowest temperature setting.
3. Remove the louvered door from the furnace.
4. Turn the gas control lever to the OFF position.
5. Disconnect the wires from the gas valve, igniter, flame sensor, combustion air motor, flame roll-out switch, over-temperature limit switch, pressure switch.



CAUTION:

Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation.

6. Remove the silicone rubber tube from the collector pan.
7. Remove the screws that hold the vent control assembly to the top panel.
8. Remove the nuts that hold the combustion air motor to the collector pan, and remove the complete combustion air blower and combustion tube assembly. **BE CAREFUL NOT TO BREAK THE SEALS AT EACH END OF THE COMBUSTION AIR TUBE.**
9. Remove the screws that hold the collector pan in place, and remove the collector pan from the furnace.
10. Using wrenches, separate the ground-joint union in the gas supply piping at the furnace.
11. Remove the piping between the gas valve and the ground-joint union, if necessary.
12. Remove the screws that hold the burner assembly in place and remove the burner assembly. **BE EXTREMELY CAREFUL NOT TO DAMAGE THE IGNITER WHILE REMOVING THE BURNER ASSEMBLY.**

13. The furnace heat exchanger tubes can now be cleaned by the use of a round wire brush attached to a length of high grade stainless steel cable, such as drain cleanout cable. Attach variable speed reversible drill to the other end of the spring cable. Slowly rotate the cable with the drill and insert it into the top portion of the heat exchanger. While reversing the drill, work the cable in and out several times to obtain sufficient cleaning. Repeat this sequence for each heat exchanger tubes.
14. When all heat exchanger tubes have been cleaned, any debris inside the tubes can be removed with the nozzle of a vacuum cleaner.
15. With a light, check the condition of the upper and lower sections of the heat exchanger tube.
16. Inspect the burners and clean them (if necessary) with a soft wire brush and/or the nozzle of a vacuum cleaner. **BE EXTREMELY CAREFUL NOT TO DAMAGE THE IGNITER WHILE CLEANING THE BURNER.**
17. Replace all the parts in reverse order from which they were removed.
18. Follow the lighting instructions found on the furnace door to return the furnace to operation. Verify proper operation after servicing.

Cleaning of Burners

If the burners must be cleaned, follow the steps below. See Figure 14 for component location and identification.

1. Shut off the gas supply to the furnace either at the meter or at a manual valve in the supply piping.
2. Turn off all power to the furnace and set the thermostat to the lowest temperature setting.
3. Remove the upper louvered door from the furnace.
4. Turn the gas control lever to the OFF position.
5. Disconnect the wires from the gas valve, igniter, and flame sensor.

6. Using wrenches, separate the ground-joint union in the gas supply piping at the furnace.
7. Remove the piping between the gas valve and the ground-joint union, if necessary.
8. Remove the screws that hold the burner assembly in place and remove the burner assembly. **BE EXTREMELY CAREFUL NOT TO DAMAGE THE IGNITER WHILE REMOVING THE BURNER ASSEMBLY.**
9. Inspect the burners and clean them (if necessary) with a soft wire brush and/or the nozzle of a vacuum cleaner. **BE EXTREMELY CAREFUL NOT TO DAMAGE THE IGNITER WHILE CLEANING THE BURNER.**
10. Replace all the parts in reverse order from which they were removed.
11. Follow the lighting instructions found on the furnace door to return the furnace to operation. Verify proper operation after servicing.

SYSTEM OPERATION INFORMATION

General

Proper maintenance is most important to achieve the best performance from a furnace. Follow these instructions for years of safe, trouble free operation.

1. Do not place combustible materials on or against the furnace cabinet or within 6 inches of the vent pipe (or for B-vent use the recommended clearance).
2. Do not store gasoline or any other flammable vapors and liquids in the vicinity of the furnace.
3. Change or replace the air filters monthly during any period when the circulating blower is operating regularly.
4. Always replace the doors on the furnace after servicing or cleaning/changing the filters. Do not operate the furnace without all doors and covers in place.
5. Avoid operating the furnace when windows and doors are open.
6. Be sure that the thermostat is properly installed and is not being affected by drafts or heat from lamps or other appliances.

Sequence of Operation

The operating sequences for the heating, cooling, and fan modes are described below. Refer to the field and furnace wiring diagrams; Figures 10, 11, 12 and 13.

Heating Mode:

1. On a call for heat the thermostat closes, applying 24 VAC to the W terminal on the control board.
2. The control board checks for continuity on the 24 VAC limit control circuit (over-temperature limit switch, flame roll-out switches). If an open limit is detected the control board will energize the inducer and the conditioned air blower. All other system functions will be inoperable until the limit circuit closes. While the limit is open, the red LED will pulse at a rate of 1 blink per unit time.
3. The furnace control checks for continuity across the pressure switch (24 VAC). If the pressure switch is closed the heat mode sequence will not continue. If it remains closed for 10 seconds the red LED will blink 3 times repetitively until the fault condition clears.
4. The inducer is energized.
5. The pressure switch will close. If the pressure switch does not close after 10 seconds the fault LED will blink 2 times repetitively and the inducer will continue to run until the switch is closed.
6. The inducer will pre-purge for 30 seconds and then the igniter will start its warm-up as follows:

Initial Power up: After 30 seconds of igniter warm-up the gas valve (24 VAC) will then open. The igniter circuit will stay energized for 3 seconds after the gas valve opens.

After Initial Power up: The control has a programmed adaptive ignition feature which varies the warm-up period as follows: If ignition is successful the warm-up is reduced by 3-seconds on each subsequent call for heat until ignition failure occurs. Upon ignition failure, the warm-up is increased by 3-seconds on the next try. If successful, the timing remains fixed at this level. In general, whenever ignition failure occurs the warm-up interval is increased

by 3-seconds on the next try. And if successful, it remains there. Minimum and maximum warm-up time limits are set at 6 and 54-seconds, respectively.

7. The furnace control must prove flame via the flame sensor between 3 and 5 seconds after the gas valve opens. If flame is sensed, all burners are on and the igniter cools off. If no flame is sensed, the gas valve closes immediately and the inducer continues to run. A second trial for ignition (step 6) begins if no flame is sensed on the fifth try for ignition, the furnace control is locked and the red LED will blink 4 times repetitively. The thermostat must be opened for at least ten seconds to reset the furnace control after a lock out. Otherwise, the furnace will attempt another ignition sequence in 1 hour.
8. The furnace control energizes the circulating air blower on the heating speed 30 seconds after the gas valve circuit is energized.
9. When the thermostat has been satisfied, gas valve is de-energized.
10. The inducer is de-energized after a 30-second post purge.
11. The furnace control keeps the circulating air blower energized for 120 seconds (factory set) or 60, 90, or 180 seconds (field adjustable). (See Figure 12.)
12. Abnormal conditions: If a limit opens during operation, the inducer and circulating air blower continue to operate. The gas valve is de-energized immediately. The blowers continue to operate until the limit closes. When the limit closes the inducer blower is de-energized immediately. The circulating air blower continues to operate for the specified delay (factory set at 120 seconds).

Cooling Mode:

1. On a call for cooling the thermostat closes, applying 24 VAC to the G and Y terminals on the furnace control. This closes the compressor contactor.
2. The furnace control energizes the circulating blower (115 VAC) on the cooling speed.
3. When the thermostat is satisfied, the G and Y terminals on the control board are de-

energized opening the compressor contactor.

4. The circulating air blower is de-energized after a 90-second delay.

Fan Mode:

1. On a call for fan operation, the thermostat applies 24 VAC to the G terminal on the furnace control board.
2. The circulating air blower is energized immediately on the heating speed.
3. If the furnace is operated in the continuous ON position at the thermostat and is then switched to AUTO, the circulating blower will operate for a specified delay (factory set at 120 seconds).

Furnace Fails to Operate

If the furnace does not operate check the following:

1. Is the thermostat operating properly?
2. Is the blower compartment door in place?
3. Is the furnace disconnect closed?
4. Has the circuit breaker tripped or the control board fuse burned open?
5. Is the gas turned on?
6. Are any manual reset switches open?
7. Is the filter dirty or plugged?
8. Is the flame sensor coated? (Remove and clean with steel wool.)

If the furnace locks out after 5 attempts for ignition, it will try again every hour if a call for heat remains. If the inducer and circulating air blowers are operating, and items 1 through 8 have been checked, press the red reset button on the burner roll-out switches (See Figure 14). If the furnace operates after depressing either reset button, contact a qualified serviceman to identify and repair the problem.

If the furnace continues to not operate, depress the red reset buttons on the flame roll-out switches. (See Figure 14.) If the furnace operates after depressing the reset buttons, contact a qualified servicemen to identify and repair the problem.

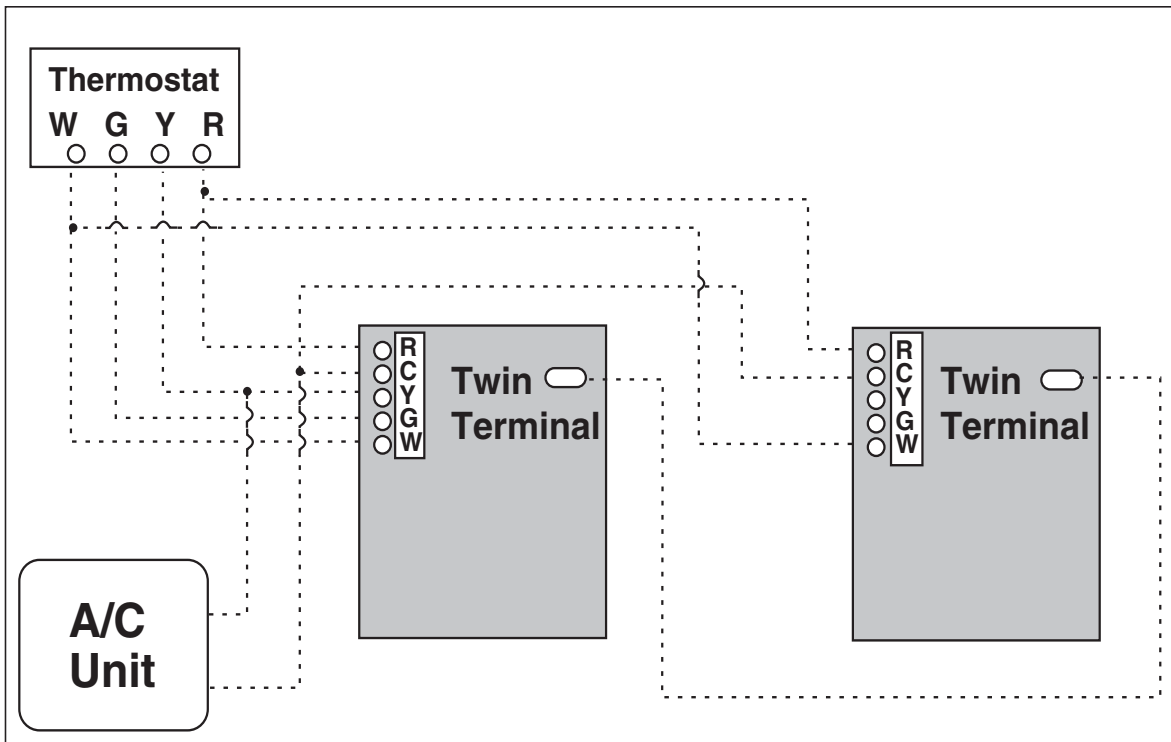


Figure 15. Twinning

Twinning

The control board on these furnaces is capable of being twinned to another furnace of the same series or a G series furnace with a UTEC control board. If using UTEC control boards, leave the fuses installed on each board. The thermostat wires and the 3/16 inch quick-connect terminals marked "TWIN" on the furnace controls must be wired for twinning. (See Figure 15.)

INSTALLATION/PERFORMANCE CHECK LIST

LOCATION _____ CITY _____ STATE _____

INSTALLER _____ CITY _____ STATE _____

UNIT MODEL NUMBER _____

UNIT SERIAL NUMBER _____

Minimum Clearances per Table 3? _____

Electrical Connections tight? _____

Line Voltage Polarity correct? _____

Supply Voltage: _____ Volts

Blower Motor HP: _____

FUEL TYPE:

Natural Gas _____

LP/Propane _____

Gas Piping Connections
leak-tested? _____

Gas Line Pressure: _____
(in. water column, with furnace operating)

Manifold Pressure: _____
(in. water column, with furnace operating)

Is there adequate fresh air supply for
combustion and ventilation? _____

Furnace Input: _____ (Btuh)

Supply Air Temperature: _____ (° F)

Return Air Temperature: _____ (° F)

Temperature Rise: _____ (° F)

Are Flue Connections tight? _____

Is there Proper Draft? _____

Is Vent free from restrictions? _____

Is the Filter(s) secured in place? _____

Is the Filter(s) clean? _____

Has the Thermostat been calibrated? _____

Is the Thermostat level? _____

Is the Heat Anticipator Setting correct? _____

Has the Owner's Information been reviewed
with the homeowner? _____

Has the Literature Package been left near the
furnace? _____



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