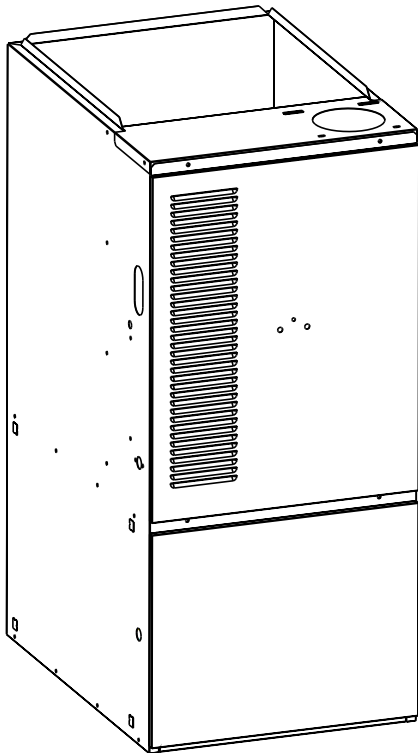


Gas Furnaces

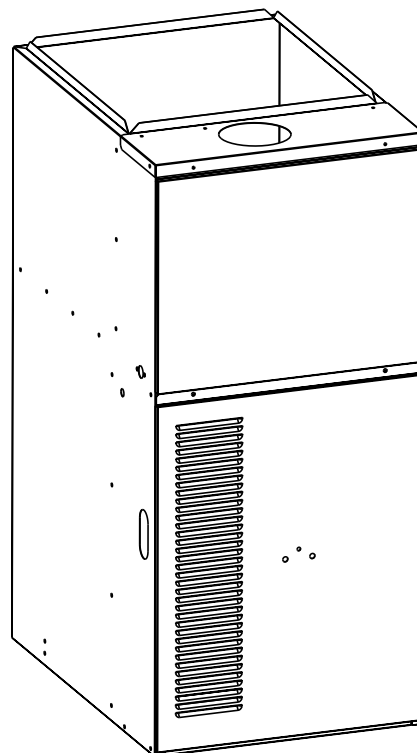
Installation Instructions

*RA Full Size Series 80+ High Efficiency Upflow/Horizontal

*RK Full Size Series 80+ High Efficiency Downflow



*RA 80+ Upflow/Horizontal



*RK 80+ Downflow

WARNING:

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

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.
-

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

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FURNACE SPECIFICATIONS - Upflow/Horizontal Models

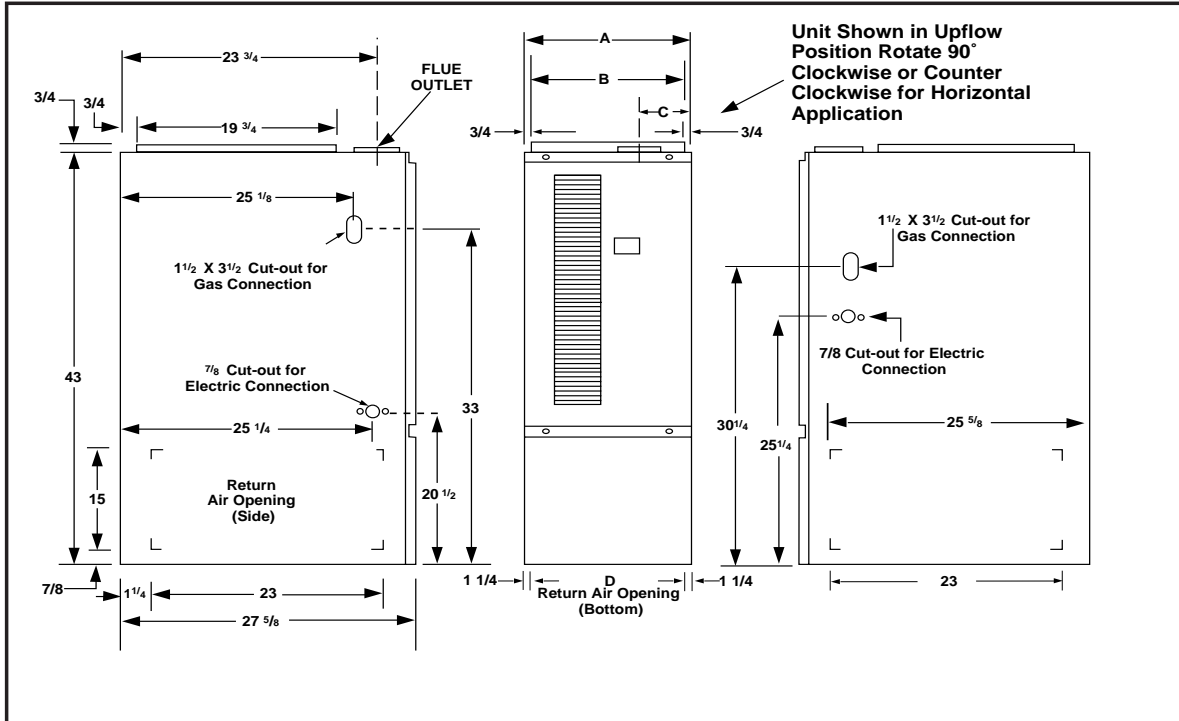


Figure 1A. Upflow Unit Dimensions

FURNACE DIMENSIONS AND SHIPPING WEIGHTS							
Model *RA	Furnace Input (Btuh)	Dimensions				Shipping Weight (lbs)	D (IN.)
		A (in.)	B (in.)	C (in.)	Flue Outlet (in.)		
045(*)-08	45,000	14 1/4	12 3/4	3 1/4	3	123	11 3/4
060(*)-12	60,000	14 1/4	12 3/4	3 3/4	4	134	11 3/4
072(*)-12	72,000	14 1/4	12 3/4	3 3/4	4	135	11 3/4
072(*)-16	72,000	19 3/4	18 1/4	3 3/4	4	152	17 1/4
072(*)-17	72,000	14 1/4	12 3/4	3 3/4	4	135	11 3/4
096(*)-12	96,000	19 3/4	18 1/4	3 3/4	4	163	17 1/4
096(*)-16	96,000	19 3/4	18 1/4	3 3/4	4	163	17 1/4
096(*)-20	96,000	22 1/2	21	3 3/4	4	174	20
120(*)-16	120,000	19 3/4	18 1/4	3 3/4	4	174	17 1/4
120(*)-20	120,000	22 1/2	21	3 3/4	4	182	20
144(*)-20	144,000	22 1/2	21	4 1/4	5	194	20

Note: (*) Can be C or N

Table 1A. Upflow Furnace Dimensions and Shipping Weights

FURNACE SPECIFICATIONS - Downflow Models

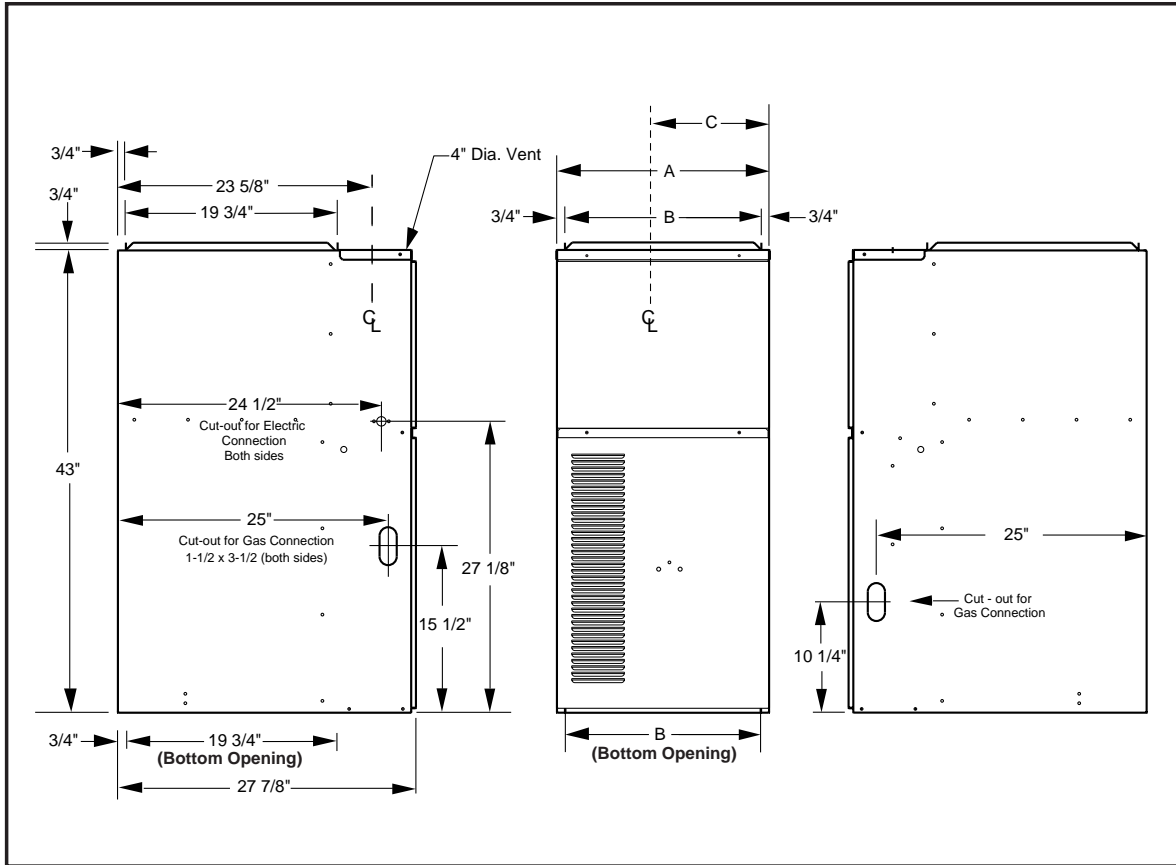


Figure 1B. Downflow Unit Dimensions

DOWNFLOW FURNACE MODELS FURNACE DIMENSIONS AND SHIPPING WEIGHTS					
Model Number *RK	Furnace Input (Btuh)	Dimensions			Shipping Weights (lbs)
		A inches	B inches	C inches	
060(*)-12	60,000	14 1/4	12 3/4	5 1/2	134
072(*)-12	72,000	14 1/4	12 3/4	5 1/2	135
072(*)-16	72,000	19 3/4	18 1/4	11	147
096(*)-12	96,000	19 3/4	18 1/4	11	154
096(*)-16	96,000	19 3/4	18 1/4	11	156
120(*)-20	120,000	19 3/4	18 1/4	11	182
135(*)-20	135,000	19 3/4	18 1/4	11	182

Note: (*) Can be C or N

Table 1B. Downflow Furnace Dimensions and Shipping Weights

CAPACITIES—Furnace Airflow Data

80+ UPFLOW/HORIZONTAL FURNACE MODELS

Model Number *RA-	Heating Input (Btuh)	Motor Speed	Motor HP	External Static Pressure (Inches 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
045(ft)-08A	45000	High*	1000	33	970	34	950	35	920	36	870	38	820	41	770	43	700	48	
		Medium**	760	44	740	46	730	46	720	46	690	48	640	50	620	52	620	54	
		Low	630	53	620	54	610	55	600	56	570	58	540	62	510	65	470	71	
060(ft)-12A	60000	High*	1380	32	1350	33	1310	34	1260	35	1210	37	1150	39	1080	41	1000	44	
		Medium**	1220	36	1190	37	1160	38	1120	40	1070	42	1020	44	950	47	880	51	
		Low	820	54	800	56	780	57	760	58	730	61	700	63	670	66	640	69	
072(ft)-12A	72000	High*	1380	39	1350	40	1310	41	1260	42	1210	44	1150	46	1080	49	1000	53	
		Medium**	1220	44	1190	45	1160	46	1120	48	1070	50	1020	52	950	56	880	61	
		Low	820	65	800	67	780	68	760	70	730	73	700	76	670	80	640	83	
072(ft)-16B	72000	High*	1980	27	1910	28	1830	29	1760	30	1660	32	1570	34	1480	37	1350	40	
		Med-High	1710	31	1660	32	1610	33	1540	35	1470	36	1390	38	1300	41	1200	44	
		Med-Low**	1490	36	1470	36	1420	38	1380	39	1320	40	1250	43	1170	46	1090	49	
072(ft)-17A	72000	High*	1270	42	1250	43	1230	43	1190	45	1140	47	1080	49	1010	53	920	58	
		Med-High	1950	27	1900	28	1810	29	1770	30	1700	31	1630	31	1560	31	1490	32	
		Med-Low**	1500	36	1450	37	1420	38	1380	39	1340	40	1310	41	1280	42	1250	43	
096(ft)-12B	96000	High*	1160	46	1130	47	1090	49	1060	50	1030	52	980	54	940	57	900	59	
		Med-High	910	59	870	61	840	63	810	66	770	69	740	72	710	75	680	78	
		Medium**	1530	46	1450	49	1390	51	1300	55	1220	58	1130	63	1040	68	940	76	
096(ft)-16B	96000	High*	930	76	900	79	870	82	820	87	750	95	670	106	580	123	470	151	
		Med-High	1980	36	1910	37	1840	39	1760	40	1680	42	1590	45	1500	47	1410	50	
		Med-Low	1720	41	1670	43	1610	44	1560	46	1480	48	1410	50	1320	54	1230	58	
096(ft)-20B	96000	High*	1470	48	1440	49	1410	50	1370	52	1320	54	1270	56	1200	59	1130	63	
		Med-High	1270	56	1240	57	1220	58	1190	60	1140	62	1090	65	1040	68	970	73	
		Medium**	2435	29	2410	30	2375	30	2335	30	2290	31	2215	32	2135	33	2035	35	
096(ft)-20C	96000	High*	2015	35	2015	35	2005	35	1975	36	1945	37	1905	37	1895	38	1865	38	
		Med-High	1698	42	1695	42	1660	42	1660	43	1645	43	1600	44	1555	46	1495	48	
		Med-Low	1450	49	1440	49	1420	50	1400	51	1375	52	1360	52	1340	53	1315	54	
120(ft)-16B	120000	High*	2340	30	2290	31	2280	31	2180	33	2150	33	2080	34	2000	36	1920	37	
		Med-High	1910	37	1880	38	1860	38	1830	39	1810	39	1790	40	1770	40	1750	41	
		Med-Low	1520	47	1510	47	1490	48	1480	48	1460	49	1440	49	1420	50	1400	51	
120(ft)-20C	120000	High*	1370	52	1350	53	1340	53	1320	54	1300	55	1280	56	1260	56	1230	58	
		Med-High	1900	47	1830	49	1750	51	1630	55	1580	56	1490	60	1400	63	1320	67	
		Med-Low	1720	52	1670	53	1610	55	1560	57	1480	60	1410	63	1320	67	1230	72	
144(ft)-20C	144000	High*	1450	61	1420	63	1380	64	1340	66	1280	69	1220	73	1150	77	1070	83	
		Med-High	2300	39	2250	40	2190	41	2130	42	2090	43	2040	44	2000	44	1950	46	
		Med-Low	1910	47	1880	47	1860	48	1830	49	1800	49	1770	50	1740	51	1700	52	
144(ft)-20C	144000	High*	1540	58	1530	58	1520	58	1500	59	1480	60	1460	60	1450	63	1390	64	
		Med-High	1320	67	1310	68	1300	68	1280	69	1260	71	1230	72	1200	74	1170	76	
		Med-Low	2240	48	2190	49	2130	50	2070	52	2020	53	1960	54	1910	56	1850	58	
144(ft)-20C	144000	High*	1900	56	1860	57	1820	59	1780	60	1740	61	1700	63	1660	64	1620	66	
		Med-High	1520	70	1510	71	1490	72	1480	72	1450	74	1420	75	1390	77	1360	78	
		Med-Low	1330	80	1310	81	1290	83	1280	83	1250	85	1230	87	1210	88			

† Can be C or N.
 ** Factory Set Cooling Speed
 *** Factory Set Heating Speed

NOTES: 1. Airflow rates of 1800 CFM or more require two return air connections. Data is for operation with filter(s).
 2. Temperature rises in the table are approximate. Actual temperature rises may vary.
 3. Temperature rises and airflows for external static pressures greater than 0.5 are for reference only. These conditions are not recommended.

Table 2. Furnace Airflow Data

80+ DOWNFLOW FURNACE MODELS

MODEL NUMBER *RK	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
060(†)-12A	60,000	HIGH* MEDIUM** LOW	1/3	1380	-	1345	-	1330	-	1260	36	1230	37	1190	38	1160	39	1120	40
				1180	38	1145	40	1130	40	1110	41	1080	42	1060	43	1040	44	1010	45
				830	55	810	56	805	56	795	57	780	58	770	59	760	60	750	60
072(†)-08A	72,000	HIGH* MEDIUM** LOW*	1/3	1380	-	1345	-	1330	-	1260	-	1230	-	1190	46	1160	47	1120	49
				1180	46	1145	47	1130	48	1110	49	1080	50	1060	51	1040	52	1010	54
				830	65	810	67	805	67	795	68	780	70	770	71	760	71	750	72
072(†)-12A	72,000	HIGH* MEDIUM** LOW	1/3	1380	-	1345	-	1330	-	1260	-	1230	-	1190	46	1160	47	1120	49
				1180	46	1145	47	1130	48	1110	49	1080	50	1060	51	1040	52	1010	54
				830	65	810	67	805	67	795	68	780	70	770	71	760	71	750	72
072(†)-16B	72,000	HIGH* MED-HIGH MED-LOW** LOW	1/2	1850	-	1790	-	1775	-	1755	-	1735	-	1700	-	1680	-	1650	-
				1460	-	1435	38	1420	38	1400	39	1380	39	1360	40	1340	41	1320	41
				1210	45	1195	45	1180	46	1160	47	1140	48	1120	49	1110	49	1090	50
096(†)-12B	96,000	HIGH* MEDIUM** LOW	1/3	1475	49	1460	50	1445	50	1430	51	1410	51	1400	52	1380	52	1360	53
				1200	60	1195	61	1180	61	1165	62	1145	63	1140	64	1120	65	1110	65
				795	-	785	-	770	-	755	-	735	-	720	-	710	-	690	-
096(†)-16B	96,000	HIGH* MED-HIGH** MED-LOW LOW	1/2	1950	-	1890	-	1865	-	1835	-	1805	40	1770	41	1730	42	1700	43
				1600	45	1580	46	1555	47	1525	48	1495	48	1470	49	1450	50	1420	51
				1375	53	1360	53	1335	54	1305	56	1275	57	1250	58	1230	59	1200	60
120(†)-20B	120,000	HIGH* MED-HIGH** MED-LOW LOW	3/4	2440	-	2395	-	2385	-	2375	-	2360	-	2340	-	2320	-	2300	-
				1920	47	1910	47	1900	48	1890	48	1875	48	1870	48	1860	49	1840	49
				1630	56	1620	56	1610	56	1600	57	1585	57	1580	57	1570	58	1550	58
135(†)-20B	135,000	HIGH* MED-HIGH** MED-LOW LOW	3/4	2440	41	2395	42	2385	42	2375	42	2360	42	2340	43	2320	43	2300	44
				1920	51	1910	52	1900	52	1890	53	1875	53	1870	53	1860	54	1840	55
				1630	61	1620	62	1610	62	1600	63	1585	63	1580	63	1570	64	1550	65
				1430	69	1425	70	1415	70	1405	-	1390	-	1380	-	1370	-		

† Can be C or N.

NOTES: 1. Airflow rates of 1800 CFM or more require two return air connections. Data is for operation with filter(s).

* Factory Set Cooling Speed

** Factory Set Heating Speed

- Not Recommended

2. Temperature rises in the table are approximate. Actual temperature rises may vary.

3. Temperature rises and airflows for external static pressures greater than 0.5 are for reference only. These conditions are not recommended.

Table 2A. Furnace Airflow Data

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 12 through 19.
4. Combustion products must be discharged outdoors. Connect this furnace to an approved vent system only, as specified on Pages 15 through 19.
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 23 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 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 10 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.

Location

Upflow gas furnaces are shipped ready for installation in the upflow or horizontal right or left positions. The *RK gas furnace is for downflow operation only. The furnace must be installed on a level surface, located as 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.

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".

Upflow Furnace Models

UPFLOW APPLICATION

HORIZONTAL APPLICATION

Downflow Furnace Models

DOWNFLOW APPLICATION

UPFLOW, DOWNFLOW & HORIZONTAL INSTALLATION CLEARANCES

Vent Connector Type	Standard Single Wall Metal Vent	Type B-1 Double Wall Metal Vent
LEFT SIDE	0"	0"
RIGHT SIDE	5**	0"
VENT	6"	1"
BACK	0"	0"
BOTTOM	0***	0***
TOP	1"	1"
FRONT	4****	4****

* For Downflow furnace installations **only**, right side minimum clearance is 0".

** For Downflow furnace installations **only**, furnace must be installed on non-combustible flooring.

*** Allow 24" minimum clearance for servicing. The recommended clearance is 36".

Table 3. Minimum Clearances to Combustible Material

(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:

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.

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.

Downflow Warning (*RK Models):

The design of the downflow furnace is certified for natural or propane gas and for installation on non-combustible flooring. A special combustible floor sub-base is required when installing on a combustible floor. Failure to install the sub-base may result in fire, property damage and personal injury. The special downflow sub-bases are factory supplied accessories, part numbers 902974, 902677, 904108 and 904165. Part #904165 is an adjustable sub-base kit and it can be used on all cabinet sizes. When the furnace is installed on a factory or site-built cased air conditioning coil, the sub-base is not necessary. However, the plenum attached to the coil casing must be installed such that its surfaces are at least 1" from combustible construction.



CAUTION:

The downflow sub-base must not be installed directly on carpeting, tile, or any combustible material other than wood flooring.

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. Do not place combustible materials, including gasoline and any other flammable vapors and liquids, in the vicinity of the furnace.

Supply Air Plenum Installation

A. Installation on a concrete slab. - *RK

1. Construct a hole in the floor per the dimensions in Figure 2.
2. Place the plenum and the furnace as shown in Figure 3.

B. Installation on a combustible floor. - *RK

1. Cut and frame the hole in the floor per the dimensions in Figure 4.
2. Place sub-base for combustible floors over the hole with its duct collar extended down-

ward. Attach the supply air plenum to the base in a manner which will assure 1" clearance to the flooring or other combustible construction. Place furnace on the combustible base as shown in Figure 6.

3. When a factory or site built cased coil is provided beneath the furnace the sub-base for combustible floors is not necessary. However, the plenum attached to the cased coil must be installed such that its surfaces are at least 1" from the flooring or other combustible construction.

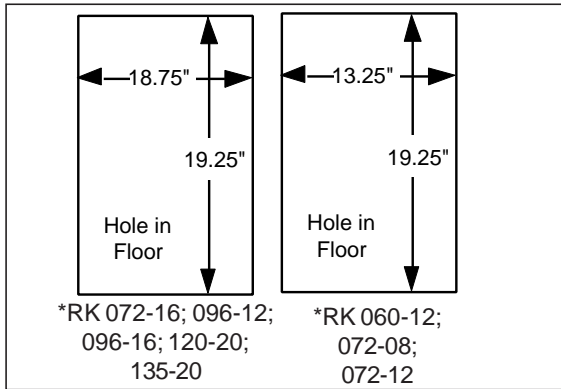


Figure 2. Opening for Concrete Slab

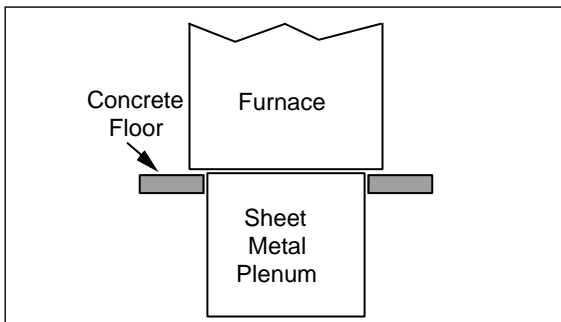


Figure 3. Furnace on a Concrete Slab

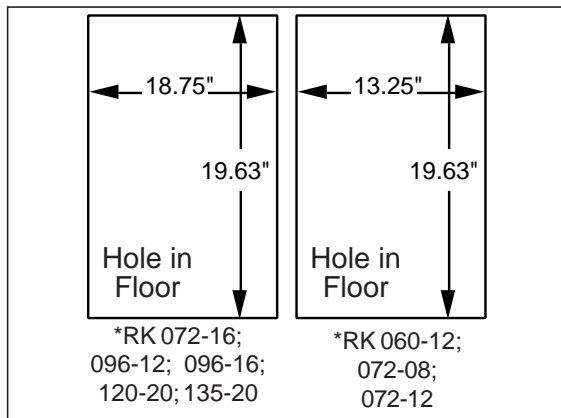


Figure 4. Opening in Wood Floor

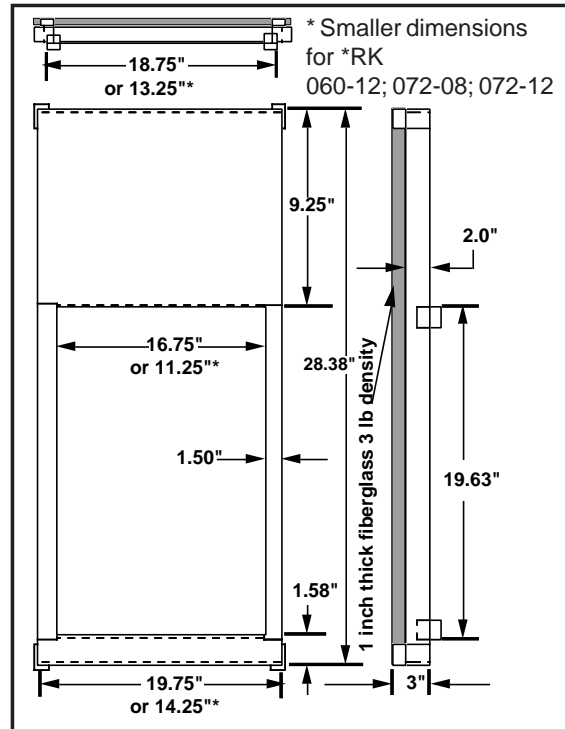


Figure 5. Downflow Sub-Base Dimensions

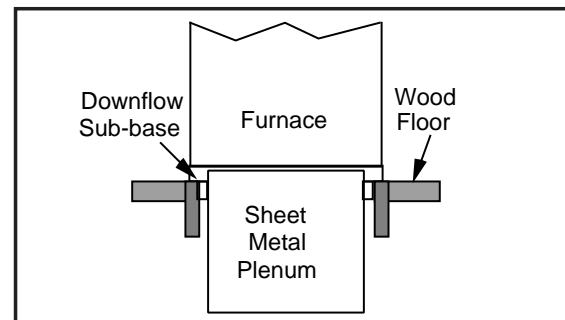


Figure 6. Downflow Sub-Base Dimensions

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).

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.

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

Combustion Air Quality

To maximize heat exchanger life, the combustion air must be free of chemicals which form corrosive acidic compounds in the combustion gases. 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



CAUTION:

Combustion air must not be drawn from a corrosive atmosphere.



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 75,000 Btuh requires a volume of 6,000 cubic feet [$50 \times (45 + 75) = 6,000$] to be considered unconfined. If the space has an 8 foot ceiling, the floor area of the space must be 750 square feet ($6,000 / 8 = 750$). 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 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.

Horizontal Furnace Installation

The *RA series furnaces 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 7 and 8.)

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 7.)

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.

The *RA series furnace may be installed directly on combustible wood flooring or supports, if type "B-1" vent pipe is used (See Figure 8). 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 section for venting guidelines and specifications.

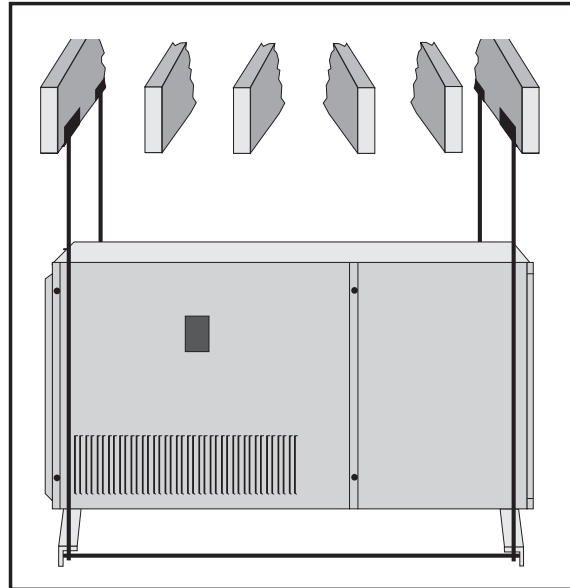


Figure 7. *RA Horizontal Installation Suspended in Attic or Crawl Space

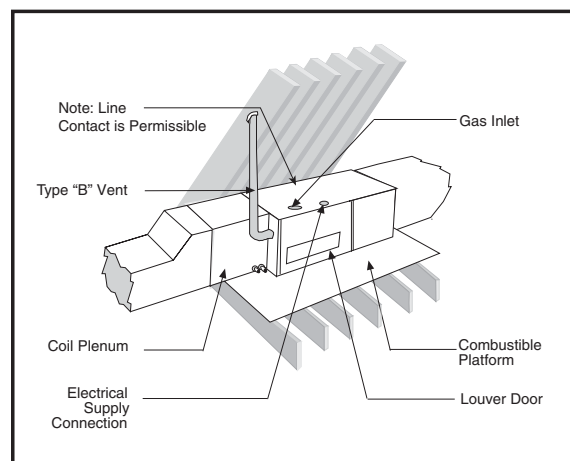


Figure 8. *RA Horizontal installation on a Platform

Air From Inside (See Figure 9)

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 120,000 Btuh, each opening must have a free area of at least 120 square inches.

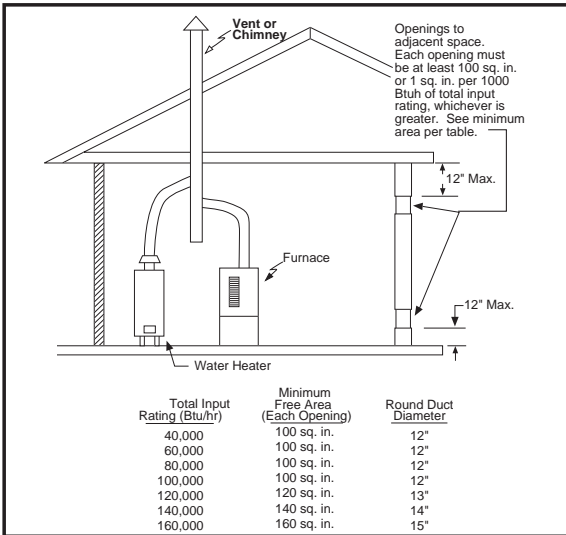


Figure 9. Equipment in a Confined Space with all Combustion Air Drawn from the Inside

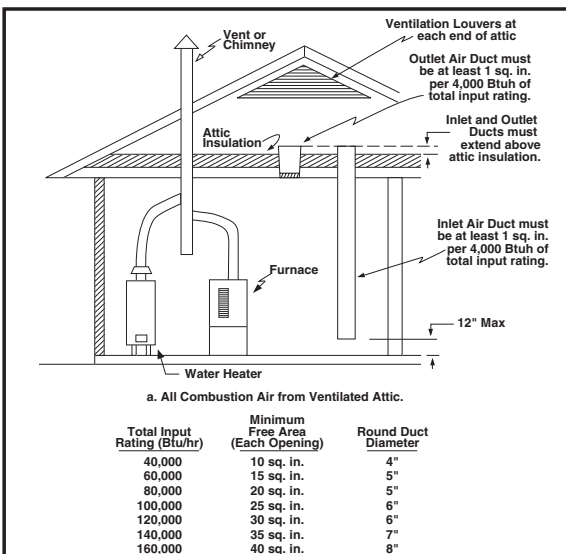


Figure 10. Equipment in a Confined Space with all Combustion Air Drawn from the Outside through Vertical Ducts

Outdoor Air Using Vertical Ducts (See Figure 10)

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 11)

If combustion air is provided directly through an exterior wall, the two openings must each have

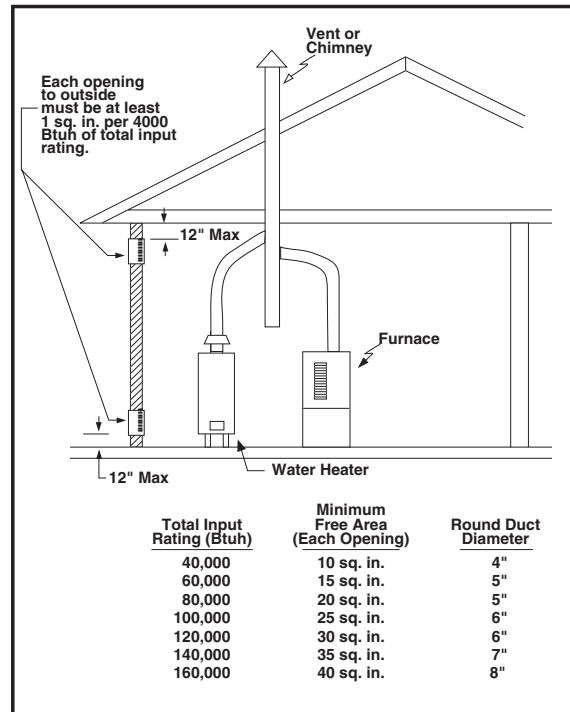


Figure 11. Equipment in a Confined Space with all Combustion Air Drawn from the Outside through Exterior Wall

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 12)

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 13)

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.

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.**

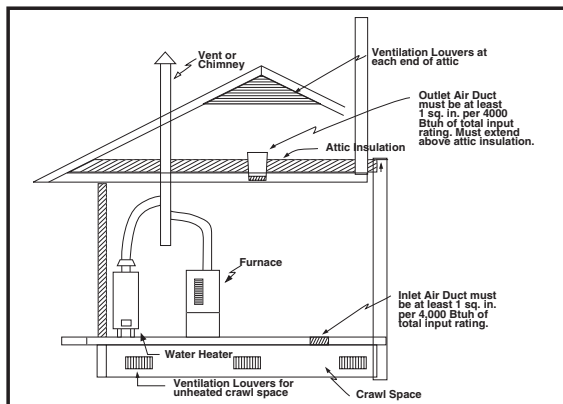


Figure 12. Equipment in a Confined Space with All Combustion Air Drawn from a Crawl Space and Ventilated Attic

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 acceptance to the authority having jurisdiction. **Venting into an unlined masonry chimney or concrete chimney is prohibited.**

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.

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.

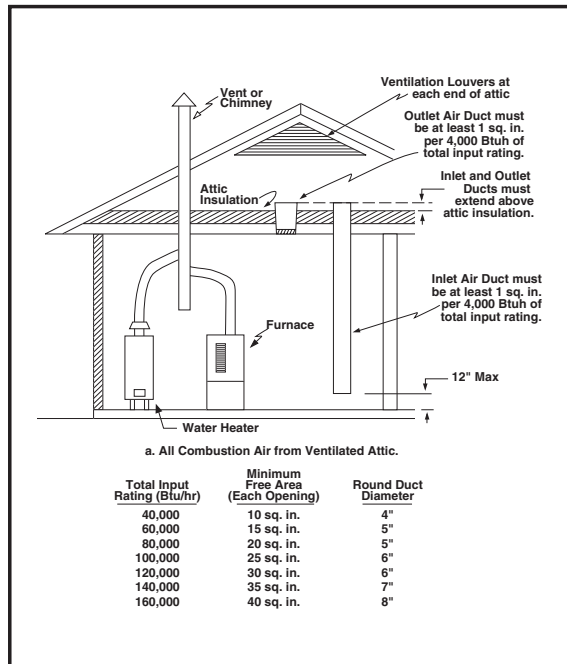


Figure 13. Equipment in a Confined Space with all Combustion Air Drawn from the Outside through Horizontal Ducts

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 steps outlined in the warning below shall be followed with each individual appliance connected to the vent system placed in operation, while all other appliances connected to the vent system are not in operation:



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.

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 blocked vent switch located in the vent plate will open, turning off the gas supply to the burners. The blocked vent 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 the part specified in the Replacement Parts List.

! 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.

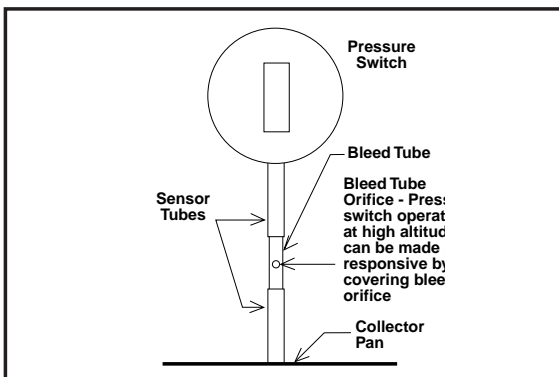


Figure 14. *RA Bleed Tube Installation

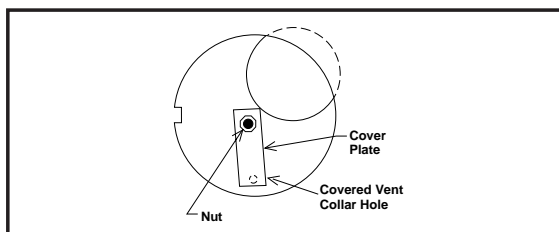


Figure 15. Vent Collar Detail

Category III: Horizontal Venting

NOTE: The reduced NOx models (eighth character N) are not approved as a Category III (Category III) furnace for use with horizontal venting.

The furnaces are approved for use with 3" single wall AL29-4C stainless steel vent pipe in horizontal vent applications. This pipe is available from the following manufacturers:

- Z-FLEX Inc.** - vent brand name (**Z-VENT**)
- Heat-fab Inc.** - vent brand name (**Saf-T Vent**)
- Flex-L International** - vent brand name (**Star-34 Vent**)

This vent pipe must be used for the entire length of the vent run. The installation must be in accordance with all instructions supplied by the vent manufacturer for use on Category III appliances. When venting horizontal, this is defined as a Category III furnace, the vent pressure is positive, and the venting system must be sealed in both horizontal and vertical runs.

For horizontal venting installations in both the United States and Canada the transition assembly must be modified by adding a bleed tube to the pressure switch tube and bypassing the vent switch. All model furnaces will require **Vent Kit #903196** for horizontal venting.

NOTE: No bleed tube is required for the *RA 045(C,N)-08 model.

Horizontal Venting For Upflow Models:

1. Remove the rubber tubing from the pressure switch sensor tube and the collector pan sensor tube. Cut 1/2 inch from one end of the rubber sensor tube, fold in half and cut along the bend line. Discard the 1/2 inch long piece of tubing. Select the correct bleed tube using the table supplied with vent kit #903196 and place the other two pieces of tubing on both ends of the bleed tube. Do not cover the hole in the bleed tube. Place the assembly back on the pressure switch sensor tube and the collector pan sensor tube. (See Figure 14.)
2. Remove the nut and restrictor plate from the vent collar assembly and discard the restrictor plate. Select the appropriate dilution cover plate as noted with vent kit #903196. Fit the clearance hole in the cover plate over the weld stud. The cover plate must cover the hole(s) on the vent collar assembly. Tighten the nut securely while holding the cover plate in position. (See Figure 15.)

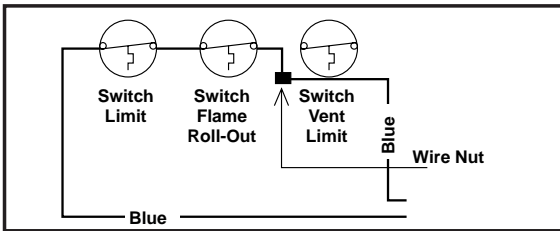


Figure 16. Limit Circuit Wiring

3. Bypass the vent switch by removing both wires from the vent switch and attaching them to the wire nut. (See Figure 16.)

*Horizontal Venting: *RK Models:*

1. By-pass the vent switch, located on blower compartment door, by removing both wires from the switch. Remove wire terminals, strip wires and tie together in a wire nut. (See Figure 16.)
2. Remove the rubber tubing from the pressure switch sensor tube and the collector pan sensor tube. Cut the tubing approximately 3" from one end. Select the appropriate dilution cover plate as noted with vent kit #903196. Insert the bleed tube into the tubing. **Do not cover the hole in the bleed tube.** Place the tubing assembly back on the pressure switch sensor tube and collector pan sensor tube. (See Figure 17.)
3. To gain access to the restrictor plate, remove and discard the combustion tube from the transition assembly. **Insure the seal between inducer and transition assembly is not broken.** (See Figure 18.)
4. Remove and discard the restrictor plate and screw from the transition assembly. (See Figure 18.)
5. Install and seal a 4" to 3" reducer to the transition. (See Figure 19.) Attach the new high temperature vent pipe to the reducer.

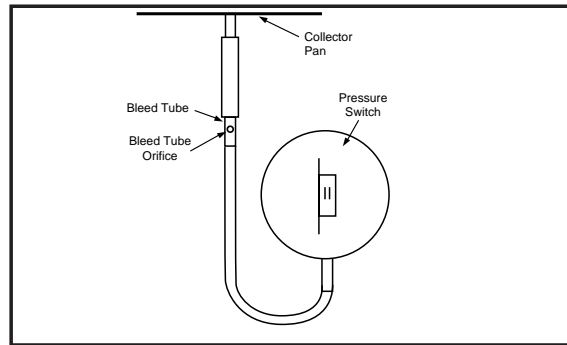


Figure 17. *RK Bleed Tube Installation

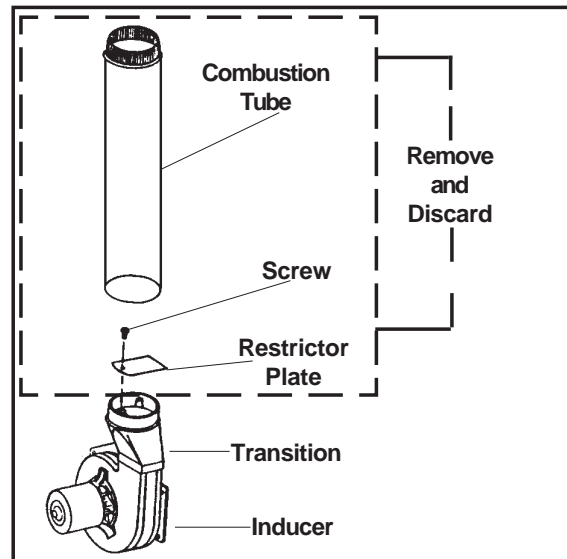


Figure 18. *RK Horizontal Vent Modification

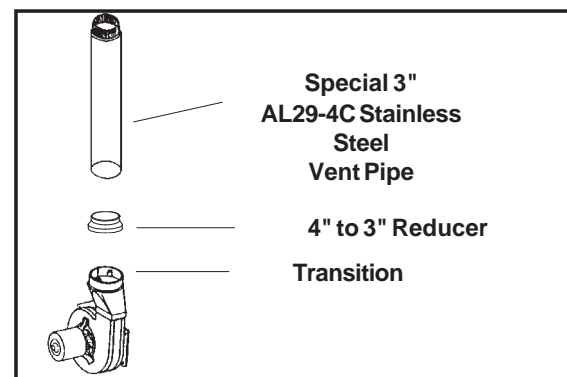


Figure 19. *RK Reducer Installation

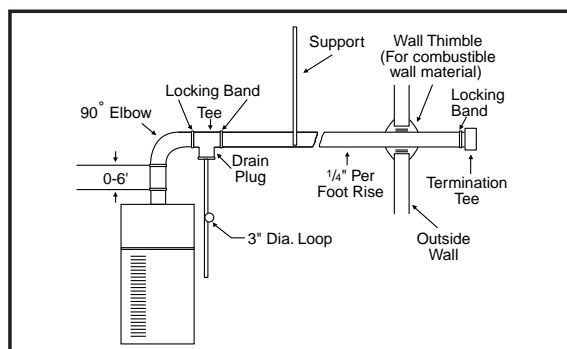


Figure 20. Typical Horizontal Vent Installation

CAUTION:

Do not drill holes through the vent pipe or fittings on a horizontal vented furnace. Do not use sheet metal screws, or rivets. Drilling, screws, or rivets will cause leaks.

The components of the horizontal vent system must not be penetrated with screws, rivets, or other devices, either when joining pipes and fittings or using support straps. All joints must be sealed with high temperature silicone before locking bands are installed. If the lengths of pipe must be cut, the joint must still be sealed with silicone and the locking band used. When installing the condensate tube be sure to form a trap by means of a 3" loop filled with water. (See Figure 20.)

Keep the number of pipe fittings to a minimum. Maintain a minimum of 6 inches of air space between the vent and combustibles at all times, this includes inside and outside the building.

NOTE: The direction of the male-female joints from the drain tee to the termination tee is opposite to standard gas appliance venting. The male end of the pipes point towards the furnace.

1. Apply an adhesive bead around the outside of the pipe approximately 1/4" from the end of the pipe. This includes the first fitting or pipe attached to the furnace.
2. Push the pipe and fitting together while twisting the pipe or fitting. Twisting the pipe or fitting spreads the adhesive completely within the fitting socket.
3. When the pipe is at the socket bottom, inspect the joint. Look for a complete, uninterrupted ring of adhesive material around the pipe at the fitting socket. Additional adhesive or rotation of the pipe or fitting may be required for a complete seal. The complete adhesive material ring provides the seal required for the positive pressure vent.
4. All vent systems must include a tee and drain plug for collection and disposal of condensate. The drain tee must be installed within the first 5 feet of vent run to protect the furnace.
5. All horizontal sections must have a slope toward the drain tee of not less than 1/4" per foot to prevent the collection of condensate at any location other than at the tee.
6. Horizontal runs must be supported with 3/4" pipe strap at a maximum of 5 foot intervals and at each point where an elbow is used.

7. Maintain a 6 inch minimum air space to combustibles from all sections of the stainless steel vent system, except when a wall thimble is used.

Horizontal Power Venting — The Tjerlund GPAK-1T* horizontal kit is certified for use with this furnace. The kit includes a power venter, a side-wall vent hood and a barometric draft control. It has an electrical interlock to assure that the furnace will not operate when the power venter is off.

The kit is for use only when exhaust is through an exterior wall, normally with horizontal vent piping. The power venter establishes negative pressure in the vent piping and the furnace operates as if connected to Category I vertical venting.

Installation Instructions are provided with the kit. Installation must conform to those instructions and applicable requirements of local codes.

 **WARNING:**

The entire vent system must be sealed with a high temperature sealant which will withstand temperatures of 450°F. Recommended sealants: Dow Corning Sealant 736 RTV; GE 106 RTV; High Tech Ind., High TEMP RED.

Horizontal Venting Requirements

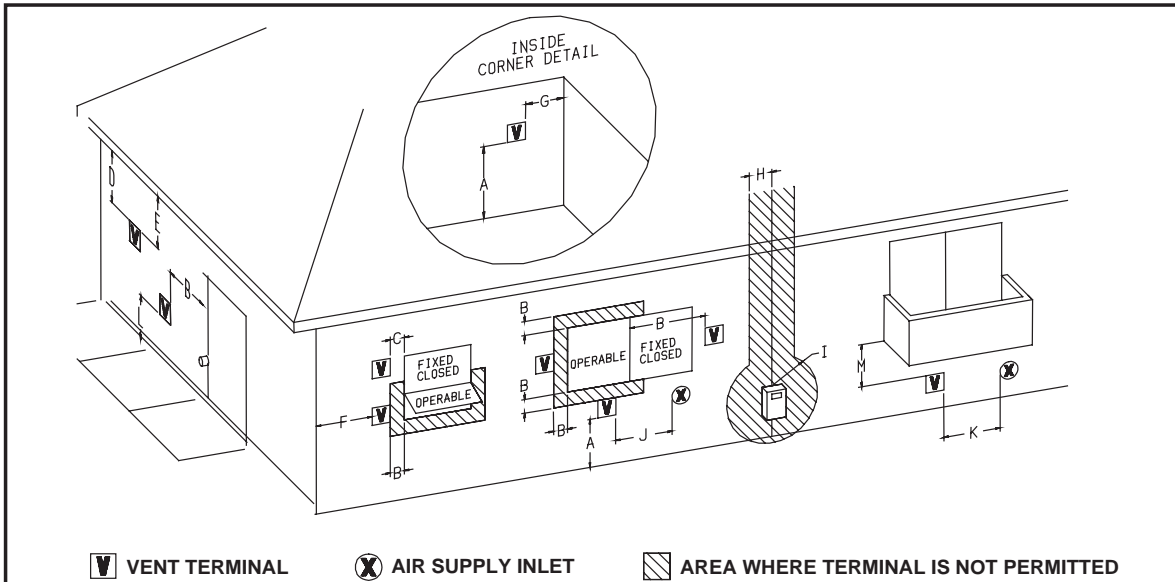
Furnace Model Number *RA	Pipe Size	Reducer Needed	Maximum # Elbows	Max. Feet Vent Pipe
045C-08	3"	None	4	35
060C-12	3"	4" to 3"	4	35
072C-12	3"	4" to 3"	4	35
072C-16	3"	4" to 3"	4	35
072C-17	3"	4" to 3"	4	35
096C-12	3"	4" to 3"	4	35
096C-16	3"	4" to 3"	4	35
096C-20	3"	4" to 3"	4	35
120C-16	3"	4" to 3"	4	35
120C-20	3"	4" to 3"	4	35
144C-20	3"	4" to 3"	3	30

Note: Special 5" to 4" Reducer Kit, p/n 902249 required for model number *RA144C-20.

Furnace Model Number *RK	Pipe Size	Reducer Needed	Maximum # Elbows	Max. Feet Vent Pipe
060C-12	3"	4" to 3"	4	35
072C-12	3"	4" to 3"	4	35
072C-16	3"	4" to 3"	4	35
096C-12	3"	4" to 3"	4	35
096C-16	3"	4" to 3"	4	35
120C-20	3"	4" to 3"	4	35
135C-20	3"	4" to 3"	4	30

Table 4. Horizontal Venting Requirements

NOTE: Reduced NOx furnaces are not approved for horizontal vent.



		Canadian Installations ¹	US Installations ²
A =	Clearance above grade, veranda, porch, deck, or balcony	12 inches (30 cm)	12 inches (30 cm)
B =	Clearance to window or door that may be opened	6 inches (15 cm) for appliances ≤ 10,000 Btuh (3 kW), 12 inches (30 cm) for appliances > 10,000 Btuh (3 kW) and ≤ 100,00 Btuh (30 kW), 36 inches (91 cm) for appliances >100,00 Btuh (30 kW)	4 feet (1.2 m) below or to side of opening; 1 foot (300 mm) above opening
C =	Clearance to permanently closed window	*	*
D =	Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 feet (61 cm) from the center line of the terminal	*	*
E =	Clearance to unventilated soffit	*	*
F =	Clearance to outside corner	*	*
G =	Clearance to inside corner	*	*
H =	Clearance to each side of center line extended above meter/regulator assembly	3 feet (91 cm) within a height 15 feet above the meter/regulator assembly	*
I =	Clearance to service regulator vent outlet	3 feet (1.83 m)	*
J =	Clearance to nonmechanical air supply inlet to building or the combustion air inlet to any other appliance	6 inches (15 cm) for appliances ≤ 10,000 Btuh (3 kW), 12 inches (30 cm) for appliances > 10,000 Btuh (3 kW) and ≤ 100,00 Btuh (30 kW), 36 inches (91 cm) for appliances >100,00 Btuh (30 kW)	4 feet (1.2 m) below or to side of opening; 1 foot (300 mm) above opening
K =	Clearance to a mechanical air supply inlet	6 feet (1.83 m)	3 feet (91 cm) above if within 10 feet (3 m) horizontally
L =	Clearance above paved sidewalk or paved driveway located on public property	7 feet (2.13 m) †	7 feet (2.13 m)
M =	Clearance under veranda, porch deck, or balcony	12 inches (30 cm) ‡	*

¹ In accordance with the current CSA B149.1 Natural Gas and Propane Installation Code

² In accordance with the current ANSI Z223.1 / NFPA 54 National Fuel Gas Code

† A vent shall not terminate directly above a sidewalk or paved driveway that is located between two single family dwellings and serves both dwellings.

‡ Permitted only if veranda, porch, deck, or balcony is fully open on a minimum of two sides beneath the floor.

* For clearances not specified in ANSI Z223.1 / NFPA 54 or CSA B149.1, one of the following statement shall be included:

“Clearance in accordance with local installation codes, and the requirements of the gas supplier and the manufacturer’s installation instructions.”

Figure 21. Vent Termination Clearances for Direct Vent Furnaces

Location of Outdoor Terminations

Horizontal Installation

The vent termination tee must be installed with the following minimum clearances. (See Figure 21.) Vent termination clearances shall be consistent with the **National Fuel Gas Code, ANSI 2223.1/NFPA 54 and/or the CSA B149.1, Natural Gas and Propane Installation Code.**

All minimum clearances specified must be maintained to protect building materials from degradation by flue gases.

1. The termination tee must be 12 inches above snow level or grade level which ever is higher. See Figure 22 for alternate method to achieve 12" above snow level.
2. Avoid areas where condensate drainage may cause problems such as above planters, patios, or adjacent to windows where the steam from the flue gases may cause fogging. Do not terminate above any public walkway.
3. Select the point of wall penetration where the minimum 1/4 inch per foot of upward slope can be maintained.
4. When penetrating a noncombustible wall, the hole through the wall must be large enough to maintain the pitch, pipe clearance for passage, and provide for proper sealing. Penetrating a combustible wall requires the use of a wall thimble. (See Figure 22.) A 6-1/2 inch square framed opening is required to insert the thimble halves. The thimble is adjustable to varying wall thickness and is held in place by applying sealant to the male sleeve before assembly. Also run a bead of sealant around the outer wall thimble.
5. The vent pipe must extend 1-1/4 inches through the outer thimble half for a combustible wall. Be sure to check this carefully before cutting the vent pipe.
6. Attach a 3 inch coupling to the end of the pipe that extends through the wall or thimble. This prevents the vent pipe from being pushed inward.
7. Cut an 8 inch minimum piece of vent pipe and connect the coupling to the termination tee. The inside of the tee must be a minimum of 12 inches from the outside of the wall. (See Figure 23.)

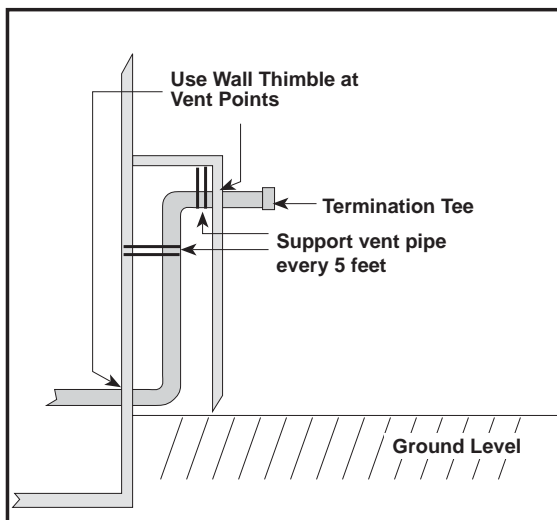


Figure 22. Alternate Horizontal Vent Installation

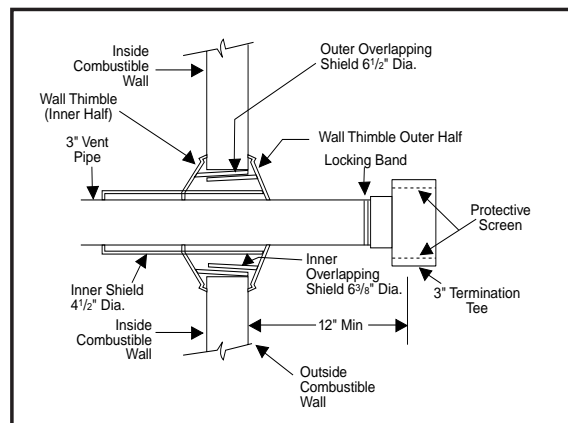


Figure 23. Typical Termination

Flexible Vent Systems

Flexible gas vent is approved for use in vertical single vent or common vent installations only. The minimum distance to combustibles is 1" for type B insulated and 6" for single wall. The venting system must be installed in accordance with the local authorities, the vent manufacturer's instructions and the instructions listed below.

The flexible vent must be installed in accordance with the venting tables for vertical or common venting only. The vent system must be supported in horizontal runs with 3/4" pipe strap at a maximum of 5 foot intervals. All horizontal sections must have a slope toward the furnace of not less than 1/4" per foot. The vent must not sag, or have any bends greater than 90 degrees.

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 the furnace 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.

For upflow/horizontal installations: The return air ductwork may be connected to the left side, right side, or bottom. NOTE: Do not use the back of the furnace for return air. Table 2 and 2a, 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.

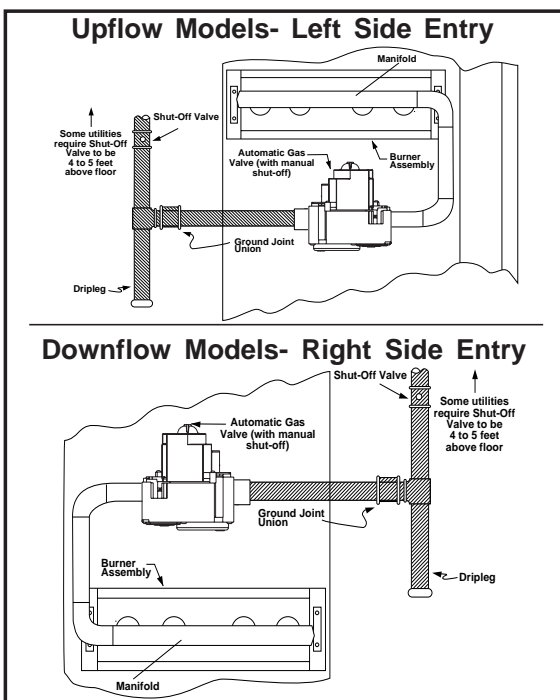


Figure 24. Typical Gas Service Connection

GAS SUPPLY AND PIPING

General

This furnace may be installed for either left or right side gas entry. A typical gas service hookup is shown in Figure 24. 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 5 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.



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.

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

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 Application

High altitude application with this furnace can be field performed by a simple adjustment of manifold pressure, and if necessary changing the orifices. 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 6 & 7 are based on sea level values.

Natural Gas High Altitude Conversion

All factory shipped furnaces are ready to operate between zero and 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 6.

LP/Propane Gas Sea Level and High Altitude Conversion

IMPORTANT NOTE: When converting a low NOx furnace from Natural gas to LP/propane gas, it is necessary to remove the NOx Baffles from the furnace.

Conversion of this furnace to utilize LP/propane gas must be made by qualified service personnel, using factory authorized or approved parts. Conversion to LP/propane gas can be accomplished by first replacing the natural gas orifices with the appropriate LP/propane orifices shown in Table 8 or 9. Note: for installations between zero and 5000 ft. above sea level, a, #53, #54

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

Furnace Rating Plate Input (Btu/h)	Orifice Drill Size	
	Nat	LP
45000	44	54
60000	45	55
72000	43	54
96000	43	54
120000	43	54
135000	41	54
144000	43	54

Table 8. 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
45000	44	55
60000	45	56
72000	43	55
96000	43	55
120000	43	55
135000	41	55
144000	43	55

Table 9. Natural and LP gas Orifice Sizes for Elevations between 5000 and 10,000 ft. Above Sea Level

or #55 drill size orifice should be used depending upon the rated firing rate of the unit (see Table 8 or 9). However for installations above 5000 ft. above sea level, a # 55 or #56 drill size orifice should be used. After changing the orifices, use Table 7 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.

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 10 for electrical requirements.

! WARNING:

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.

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 10.) 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 25.)

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

! CAUTION:

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

Verify proper operation after servicing.

Furnace Model Number *RA,*RK	Furnace Input (Btu/hr)	Cabinet Width (in.)	Nominal Electrical Supply	Maximum Operating Voltage	Minimum Operating Voltage	Maximum Furnace Amperes	Minimum Wire Gauge	Maximum Fuse or Circuit Breaker Amps**
045(†)-08	45,000	14.25	115-60-1	127	103	5.6	14	15
060(†)-12	60,000	14.25	115-60-1	127	103	7.1	14	15
072(†)-12	72,000	14.25	115-60-1	127	103	7.1	14	15
072(†)-16	72,000	19.75	115-60-1	127	103	9.0	14	15
072(†)-17	72,000	14.25	115-60-1	127	103	21.0	10	35
096(†)-12	96,000	19.75	115-60-1	127	103	7.1	14	15
096(†)-16	96,000	19.75	115-60-1	127	103	9.0	14	15
096(†)-20	96,000	22.50	115-60-1	127	103	12.2	12	20
120(†)-16	120,000	19.75	115-60-1	127	103	9.0	14	15
120(†)-20	120,000	22.50	115-60-1	127	103	12.2	12	20
135(†)-20	135,000	22.50	115-60-1	127	103	12.2	12	20
144(†)-20	144,000	22.50	115-60-1	127	103	12.2	12	20

Note: (†) can be C or N.

**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 10. Electrical Data

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 25.

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 26 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 10.

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.

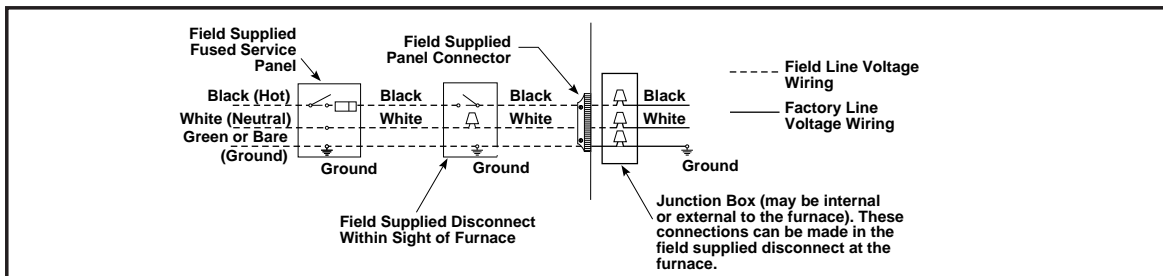


Figure 25. Line Voltage Field Wiring

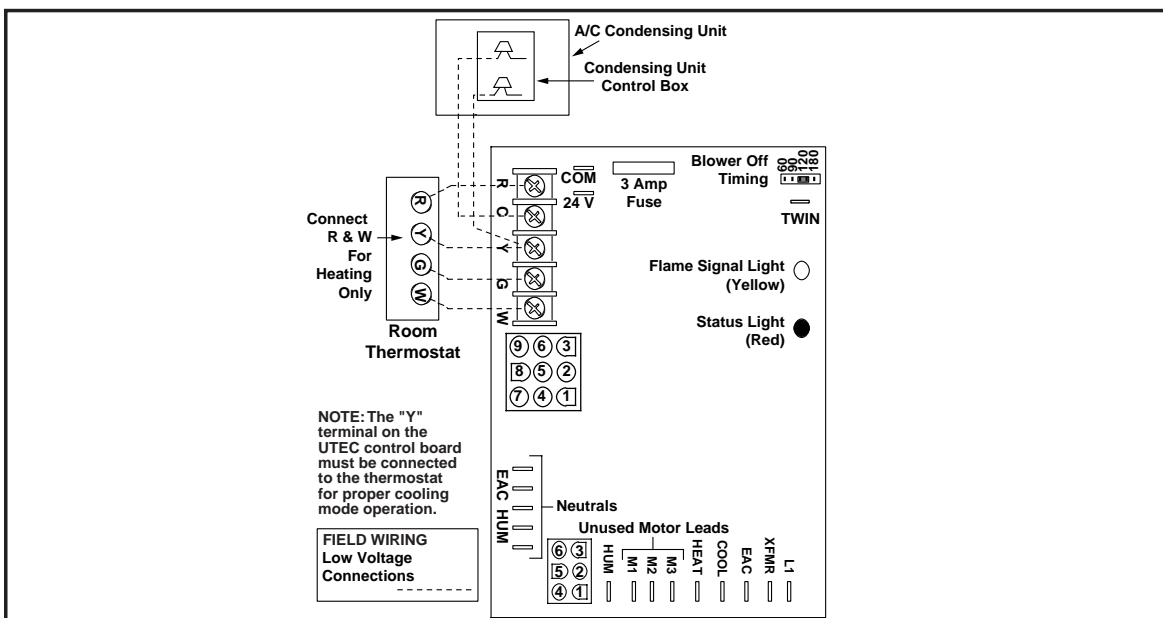


Figure 26. Low Voltage Field, Four-wire Heating/Cooling Applications

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 in. water column (0.51 psig), and must not be less than 11.0 in. w.c. (0.40 psig).
4. The roll-out and vent safety manual reset switches are 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.

IMPORTANT NOTE:

The firing rate must not exceed the rate shown on the furnace rating plate. At altitudes above 2000 feet it must not exceed that on the rating plate less 4% for each 1000 feet.

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 11.
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 11 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 6 for natural gas or Table 7 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.



CAUTION:

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

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.

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. 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 Figure 28 show the speed taps for adjusting motor speed.

If it is desired that the blower operate at the same speed for heating and cooling, tape off the

unused blower lead 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 27 for blower on and off time adjustments.

 **WARNING:**

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

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 11. Gas Flow Rate

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.

Verify 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 immedi-

ately 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 29 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.

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 of ignition.

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, if connected) will continue to operate if the flame roll-out switch opens.

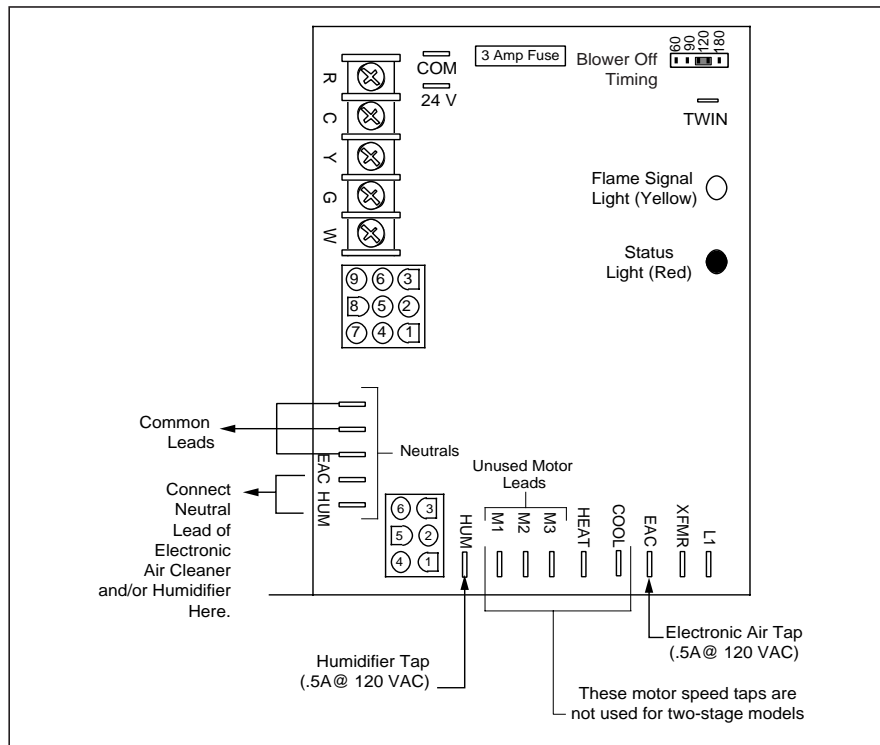


Figure 27. Integrated Control

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.

Supply Air Limit Switch

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

Vent Safety Switch

The vent safety switch shuts the furnace down if the vent becomes blocked or restricted.

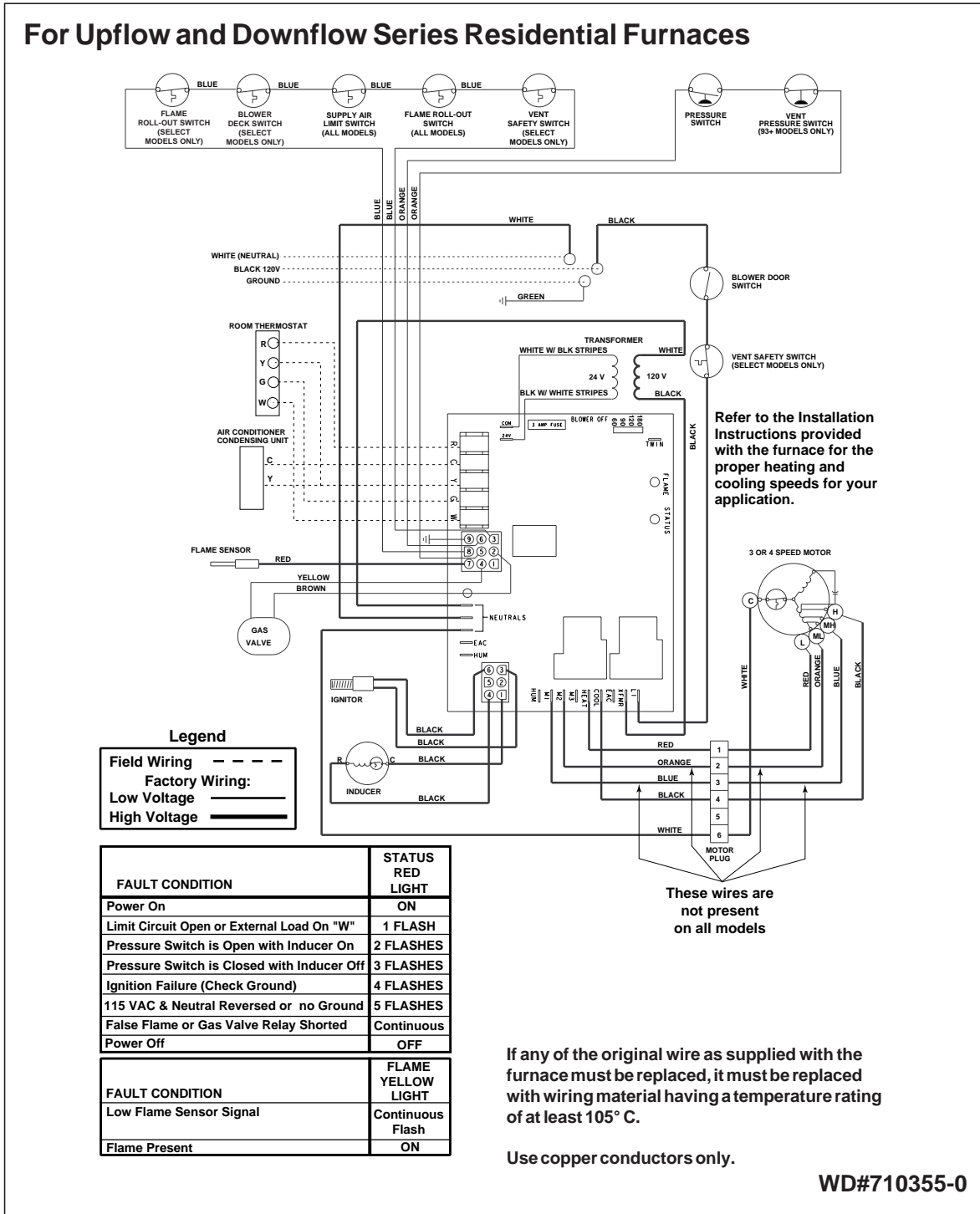


Figure 28. Wiring Diagram for Upflow and Downflow Models

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

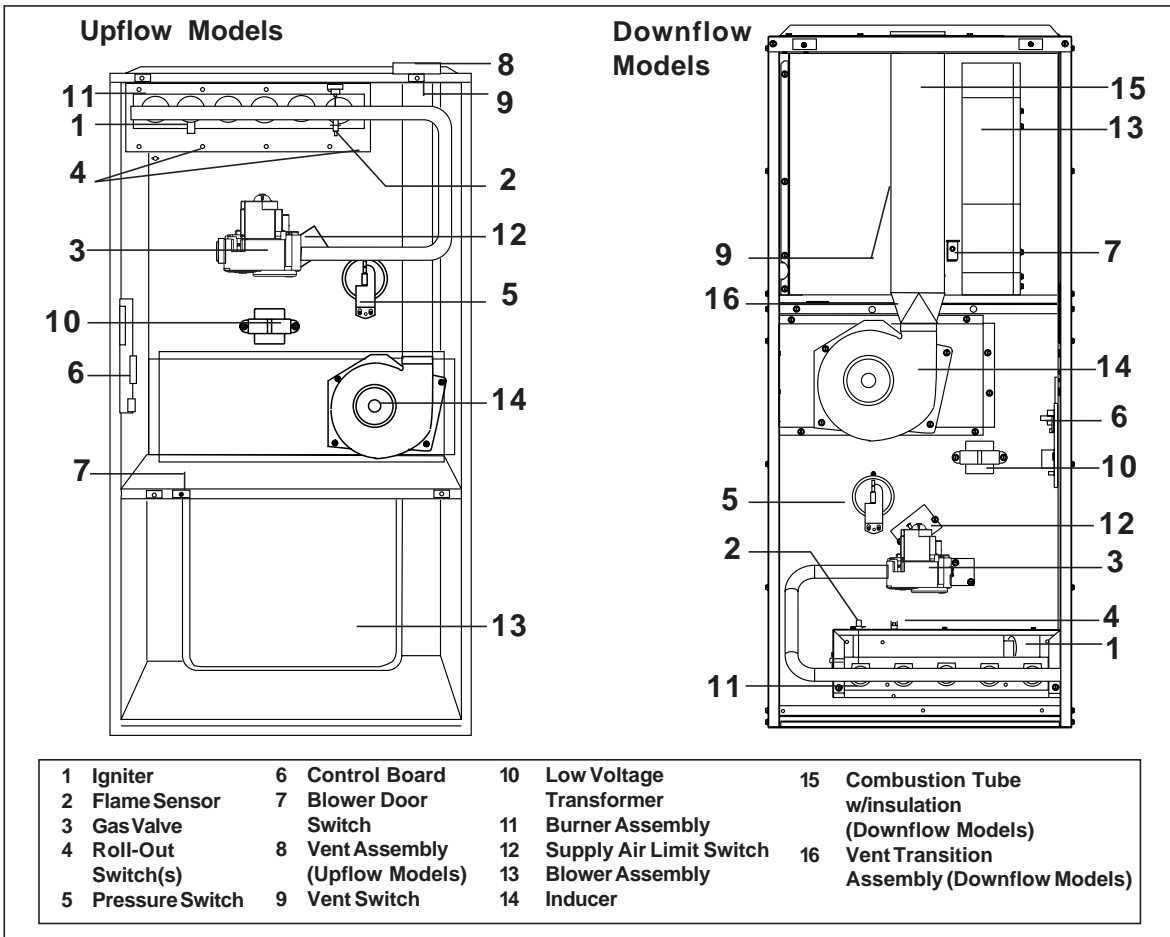


Figure 29. Location of Major Components

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 29 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, blocked vent 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. For *RA upflow models: 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 tube.
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.
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.**

Cleaning of Burners

If the burners must be cleaned, follow the steps below. See Figure 30 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.

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 25, 26, 27 and 28.

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 rollout switches and blocked vent switch in series). 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 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 postpurge.
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 27.)
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. Are the blower compartment door(s) 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 emery cloth.)

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 vent safety switch (See Figure 29). If the furnace operates after depressing the 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 29.) If the furnace operates after depressing the reset buttons, contact a qualified servicemen to identify and repair the problem.

Twinning

The control board on these furnaces is capable of being twinned to another furnace of the same series. If using UTEC Control Boards, leave the fuses installed on each board. The thermostat wires and the 1/4 inch quick-connect terminals marked "TWIN" on the furnace controls must be wired for twinning. (See Figure 30.)

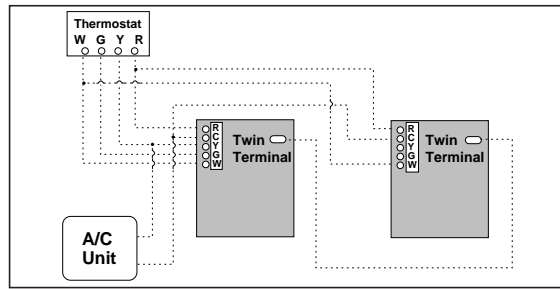


Figure 30. Twinning

INSTALLATION/PERFORMANCE CHECKLIST

LOCATION _____ CITY _____ STATE _____

INSTALLER _____ CITY _____ STATE _____

UNIT MODEL NUMBER _____

UNIT SERIAL NUMBER _____

Minimum Clearances per Table 3? _____

Are Flue Connections tight? _____

Electrical Connections tight? _____

Is there Proper Draft? _____

Line Voltage Polarity correct? _____

Is Vent free from restrictions? _____

Supply Voltage: _____ Volts

Blower Motor HP: _____

Is the Filter(s) secured in place? _____

Is the Filter(s) clean? _____

FUEL TYPE:

Natural Gas _____

LP/Propane _____

Gas Piping Connections

leak-tested? _____

Has the Thermostat been calibrated? _____

Is the Thermostat level? _____

Is the Heat Anticipator Setting correct? _____

Gas Line Pressure: _____

(in. water column, with furnace operating)

Has the Owner's Information been reviewed

with the homeowner? _____

Manifold Pressure: _____

(in. water column, with furnace operating)

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

Has the Literature Package been left near

the furnace? _____

Furnace Input: _____ (Btuh)

Supply Air Temperature: _____ (° F)

Return Air Temperature: _____ (° F)

Temperature Rise: _____ (° F)



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