

Installation Instructions


GUK Series

SAFETY CONSIDERATIONS

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

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

Follow all safety codes. In the United States, follow all safety codes including the current edition National Fuel Gas Code (NFPA No. 54/ANSI Z223.1. In Canada, refer to the current edition of the National Standard Canada CAN/CGA-B149.1- and .2-M91 Natural Gas and Propane Installation Codes (NSCNGPIC). Wear safety glasses and work gloves. Have fire extinguisher available during start-up and adjustment procedures and service calls.

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

Understand the signal word *DANGER*, *WARNING*, or *CAUTION*. These words are used with the safety-alert symbol. *DANGER* identifies the most serious hazards **will** result in severe personal injury or death. *WARNING* signifies a hazard that **could** result in personal injury or death. *CAUTION* is used to identify unsafe practices which **would** result in minor personal injury or product and property damage.

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

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Manufactured By: Inter-City Products Corporation (USA)
Lavergne, TN USA 37086

WARNING

This furnace is not designed for use in mobile homes, trailers or recreational vehicles. Such use could result in property damage, bodily injury and/or death.

1. Safe Installation Requirements

WARNING

Installation or repairs made by unqualified persons can result in hazards to you and others. Installation **MUST** conform with local codes or, in the absence of local codes, with codes of the country having jurisdiction.

The information contained in this manual is intended for use by a qualified service technician familiar with safety procedures and equipped with the proper tools and test instruments.

Failure to carefully read and follow all instructions in this manual can result in furnace malfunction, property damage, personal injury and/or death.

NOTE: This furnace is design certified by the American Gas Association and the Canadian Gas Association for installation in the United States and Canada. Refer to the appropriate codes, along **Figure 1** with this manual, for proper installation.

- This furnace is **NOT** approved for installation in mobile homes, trailers or recreation vehicles.
- Do **NOT** use this furnace as a construction heater.
- Use only the Type of gas approved for this furnace (see **Rating Plate** on unit). Overfiring will result in failure of heat exchanger and cause dangerous operation.
- Do **NOT** use open flame to test for gas leak.
- Ensure adequate combustion and ventilation air is provided to the furnace.

- Seal supply and return air ducts.
- The vent system **MUST** be checked to determine that it is the correct type and size.
- Install correct filter type and size.
- Unit **MUST** be installed so electrical components are protected from direct contact with water.

NOTE: It is the personal responsibility and obligation of the customer to contact a qualified installer to ensure that the installation is adequate and conforms to governing codes and ordinances.

WARNING

Carbon Monoxide Poisoning Hazard.

This furnace can **NOT** be common vented or connected to any type B, BW or L vent or vent connector, nor to any portion of a factory-built or masonry chimney. If this furnace is replacing a previously common-vented furnace, it may be necessary to resize the existing vent line and chimney to prevent oversizing problems for the other remaining appliance(s). See *Venting and Combustion Air Check* in *Gas Vent Installation* section. This furnace **MUST** be vented to the outside.

Failure to properly vent this furnace or other appliances can result in property damage, personal injury and/or death.

START-UP CHECK SHEET

(Keep this page for future reference)

Dealer Name: _____

Address: _____

City, State(Province), Zip or Postal Code: _____

Phone: _____

Owner Name: _____

Address: _____

City, State(Province), Zip or Postal Code: _____

Model Number: _____

Serial Number: _____

Type of Gas: Natural: LP:

Blower Motor H.P.: _____

Supply Voltage: _____

Limit Opens at...(°F)____or(°C)

Limit Closes at...(°F)____or(°C)

Which blower speed tap is used?
(Heating)_____ (Cooling)_____

Temperature of Supply Air: (°F)____or(°C)

Temperature of Return Air: (°F)____or(°C)

Rise (Supply Temp – Return Temp): (°F)____or(°C)

Filter Type and Size: _____

Fan "Time ON" Setting: _____

Fan "Time OFF" Setting: _____

Dealer Comments: _____

Business Card Here

Manual Gas Shut-Off Upstream
of Furnace/Drip-Leg? YES NO

Drip-Leg Upstream of Gas Valve? YES NO

Condensate Drain Connected? YES NO

Blower Speed Checked? YES NO

All Electrical Connections Tight? YES NO

Gas Valve OK? YES NO

Measured Line Pressure When Firing Unit: _____

Calculated Firing Rate:(See *Checks and Adjustments* Section). _____

Measured Manifold Pressure: _____

Thermostat OK? YES NO

Subbase Level? YES NO

Anticipator Set? YES NO Set At?: _____

Breaker On? YES NO

Date of Installation: _____

Date of Start-Up: _____

2. Installation

Location and Clearances

1. Refer to **Figure 1** for typical installation and basic connecting parts required. Supply and return air plenums and duct are also required.
2. If furnace is a replacement, it is usually best to install the furnace where the old one was. Choose the location or evaluate the existing location based upon the minimum clearance and furnace dimensions (**Figure 2**).

CAUTION

Special precautions **MUST** be made if installing furnace in an uninhabited home which may drop below freezing. This can cause improper operation or damage to equipment. If furnace environment has the potential of freezing, the drain trap and blower must be protected with antifreeze. During uninhabited time, disconnect the rubber coupling on top of furnace and pour 8 ounces of sanitary type (RV) antifreeze into the vent pipe to protect the blower and drain trap from freeze damage.

Do **NOT** operate furnace in a contaminated atmosphere containing chlorine, fluorine or any other damaging chemicals. Refer to *Combustion & Ventilation Air section, Contaminated Combustion Air*.

Installation Requirements

1. Install furnace level.
2. This furnace is **NOT** to be used for temporary heat of buildings or structures under construction.
3. Install furnace as centralized as practical with respect to the heat distribution system.
4. Install the vent pipes as short as practical. (See *Vent and Combustion Air Piping* section).
5. Maintain clearance for fire safety and servicing. A front clearance of 30" (762mm) is recommended for access to the burner, controls and filter.
6. Use a raised base if the floor is damp or wet at times.
7. Residential garage installations require:
 - Burners and ignition sources installed at least 18" (457mm) above the floor.
 - Located or physically protected from possible damage by a vehicle.

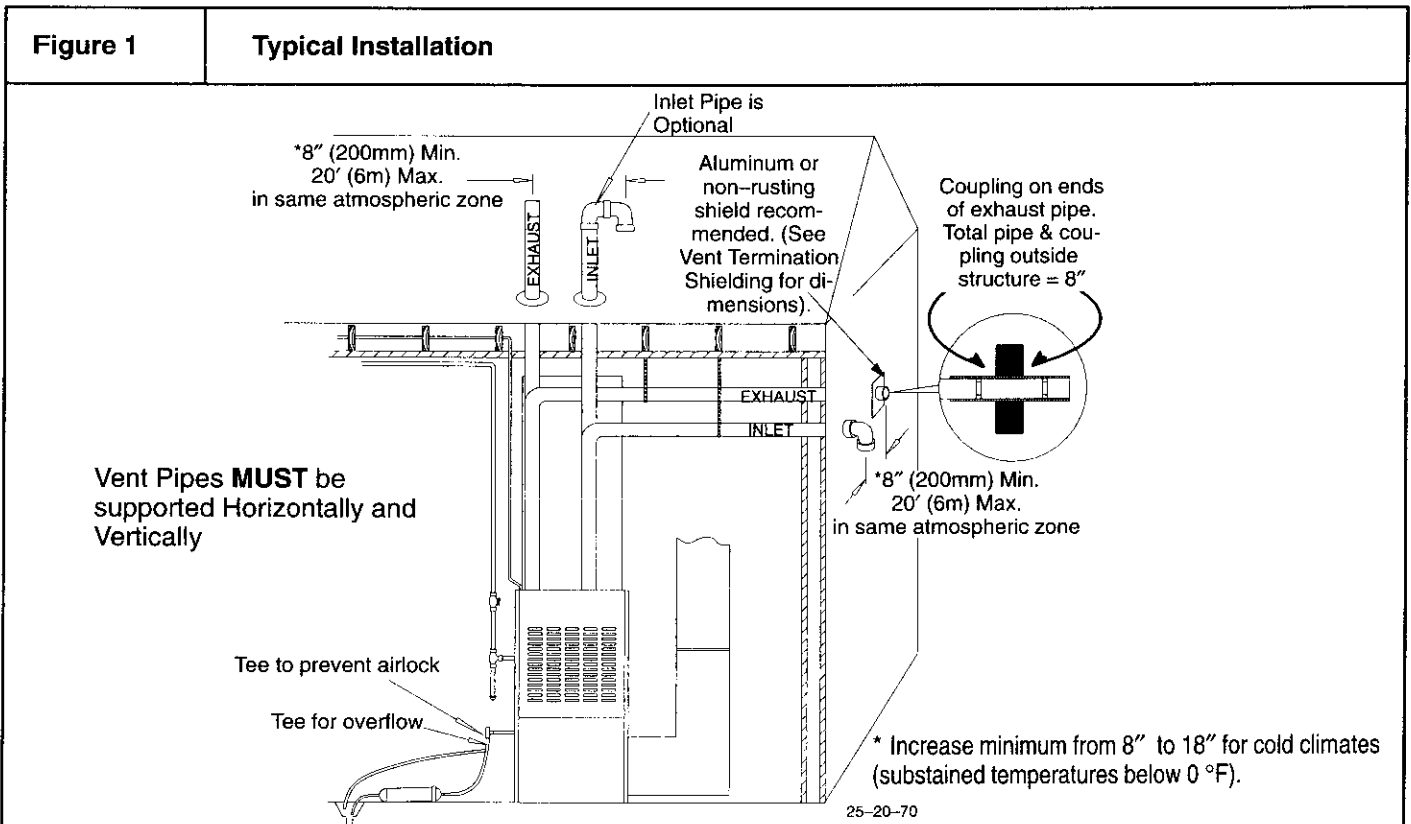
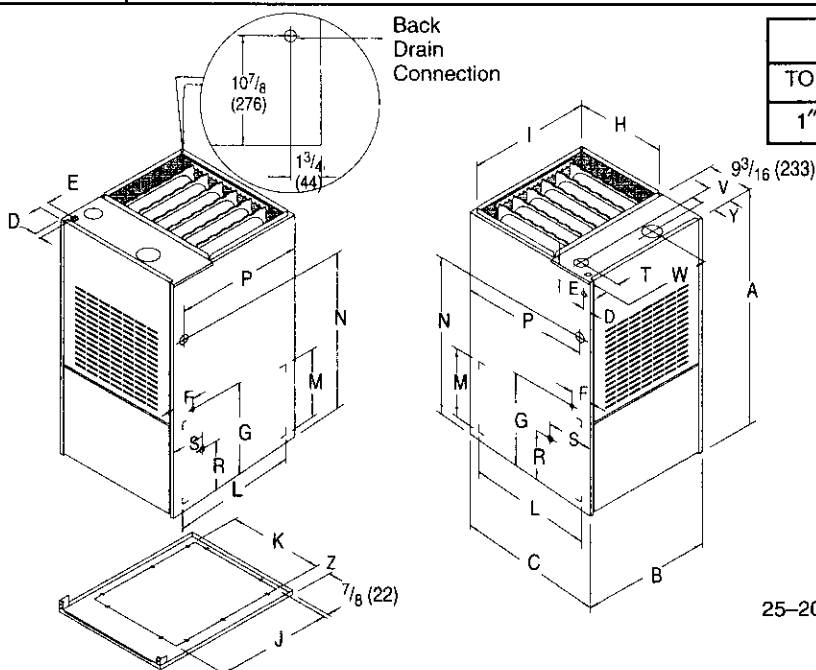


Figure 2

Dimensions and Clearances



Cabinet Clearances						
TOP	BOT	RH	LH	BACK	FRNT	FLUE
1"	0"	0"	0"	0"	3"	0"

25-20-65

Unit Capacity	CABINET			ELECTRICAL CONNECTIONS						SUPPLY AIR		RETURN AIR			
				TOP		LEFT SIDE		LOW VOLT				BOTTOM		SIDE	
	A	B	C	D	E	D	E	F	G	H	I	J	K	L	M
50,000	48	19-1/8	28-1/2	1-1/2	1-1/2	1-5/8	2-1/2	4-1/2	17-5/16	18-1/2	17-5/8	23-1/8	14-3/4	22-1/2	14-1/2
75,000	48	19-1/8	28-1/2	1-1/2	1-1/2	1-5/8	2-1/2	4-1/2	17-5/16	18-1/2	17-5/8	23-1/8	14-3/4	22-1/2	14-1/2
100,000	48	22-3/4	28-1/2	1-1/2	1-1/2	1-5/8	2-1/2	4-1/2	17-5/16	18-1/2	21-1/4	23-1/8	18-3/4	22-1/2	14-1/2
125,000	48	26-3/8	28-1/2	1-1/2	1-1/2	1-5/8	2-1/2	4-1/2	17-5/16	18-1/2	24-7/8	23-1/8	23-1/2	22-1/2	14-1/2

Unit Capacity	GAS CONNECTIONS				DRAIN CONNECTIONS			SUPPLY AIR		RETURN AIR		
	RIGHT SIDE		LEFT SIDE		R	RIGHT SIDE	LEFT SIDE			BOTTOM		Z
	N	P	N	P		S	S	T	V	W	Y	
50,000	35-1/2	23-7/8	35-1/2	26-1/16	10-7/8	2-3/4	6-1/2	2-11/16	4-13/16	12-7/8	2-11/16	2-1/8
75,000	35-1/2	23-7/8	35-1/2	26-1/16	10-7/8	2-3/4	6-1/2	2-11/16	4-13/16	12-7/8	2-11/16	2-1/8
100,000	35-1/2	23-7/8	35-1/2	26-1/16	10-7/8	2-3/4	6-1/2	2-11/16	4-13/16	14-11/16	2-11/16	1-7/8
125,000	35-1/2	23-7/8	35-1/2	26-1/16	10-7/8	2-3/4	6-1/2	2-11/16	4-13/16	18	2-11/16	1-7/16

CONVERSION FROM INCHES TO METRIC (mm)	48" = (1219)	28-1/2" = (724)	10-7/8" = (276)	17-5/16" = (440)	23-1/8" = (587)	14-11/16" = (373)	22-1/2" = (572)
	35-1/2" = (902)	1-1/2" = (38)	4-1/2" = (114)	6-1/2" = (165)	21-1/4" = (540)	12-7/8" = (327)	2-11/16" = (68)
	19-1/8" = (486)	26-1/16" = (662)	2-3/4" = (70)	17-5/8" = (448)	24-7/8" = (632)	18" = (457)	1-7/8" = (48)
	22-3/4" = (578)	1-5/8" = (41)	18-1/2" = (470)	6-1/2" = (165)	2-11/16" = (68)	14-3/4" = (375)	2-1/8" = (54)
	23-7/8" = (606)	2-1/2" = (64)	17-5/8" = (448)		4-13/16" = (122)	18-3/4" = (476)	14-1/2" = (368)
	26-3/8" = (670)					23-1/2" = (597)	1-7/16" = (37)

ALL DIMENSIONS IN INCHES (MM)

3. Combustion & Ventilation Air

WARNING

Carbon monoxide Poisoning Hazard.

Use methods described here to provide combustion and ventilation air.

Failure to provide adequate combustion and ventilation air can result in personal injury and/or death.

Venting and Combustion Air Check

NOTE: This section of the manual applies to this furnace **IF venting as a non-direct vent (single pipe) appliance.** The following information is supplied to allow the installer to make adjustments to the setup of existing appliances, **IF NEEDED.** These instructions are presented to be used for reference **ONLY IF NEEDED,** based on good trade practices, local codes, and good judgment of the installer. Manufacturer does **NOT** take responsibility for modifications made to existing equipment.

NOTE: If this installation removes an existing furnace from a venting system serving one or more other appliances, and to make sure there is adequate combustion air for all appliances, **MAKE THE FOLLOWING CHECK.**

1. Seal any unused openings in the venting system.

2. Visually inspect the venting system for proper size and horizontal pitch to ensure there is no blockage or restriction, leakage, corrosion or other deficiencies which could cause an unsafe condition.
3. Insofar as is practical, close all doors and windows and all doors between the space in which the appliance(s) remaining connected to the venting system are located and other spaces of the building.
4. 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 will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.
5. Follow the lighting instructions for each appliance being inspected. Adjust thermostat so appliance(s) will operate continuously.
6. Allow 5 minutes of main burner operation, then check for spillage at the draft hood relief opening of each appliance. Use the flame of a match or candle (**Figure 3**).
7. After it has been determined that each appliance vents properly, return doors, windows, appliances etc. to their normal condition.
8. If improper venting is observed, the cause **MUST** be corrected using the appropriate tables in code books of country having jurisdiction.

NOTE: If flame pulls towards draft hood, this indicates sufficient infiltration air.

NOTE: Non direct vent appliances occupying same enclosed space as furnace **MUST** have enough air for proper combustion and ventilation. All duct or openings for supplying combustion and ventilation air must comply with the gas and electrical codes of the country having jurisdiction.

When the installation is complete, check that all appliances have adequate combustion air and are venting properly. See *Venting And Combustion Air Check* in this manual.

Air Openings and Connecting Ducts

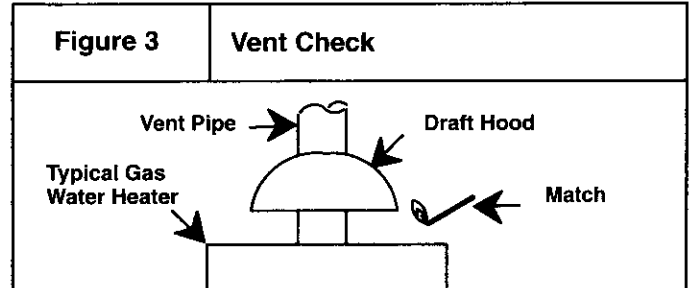
1. Total input rating for all non direct vent gas appliances **MUST** be considered when determining free area of openings.
2. Connect ducts or openings directly to outside.
3. When screens are used to cover openings, they **MUST** be no less than 1/4" (6mm) mesh.
4. The minimum dimension of rectangular air ducts **MUST NOT** be less than 3" (75mm).
5. When sizing grille or louver, use the free area of opening. If free area is **NOT** stamped or marked on grill or louver, assume a 20% free area for wood and 60% for metal.

Confined Space Installation

NOTE: A confined space is defined as an area with less than 50 cubic feet (1.4m³) per 1,000 BTUH input rating for all gas appliances installed in the area.

Requirements

1. Provide confined space with sufficient air for proper combustion and ventilation of flue gases using horizontal or vertical ducts or openings.
2. **Figure 4** illustrate how to provide combustion and ventilation air. A minimum of two permanent openings, one inlet and one outlet, are required.
3. One opening **MUST** be within 12" (300mm) of the floor and the second opening within 12" (300mm) of the ceiling.
4. Size openings and ducts per **Figure 3**.



5. Horizontal duct openings require 1" square (25sq. mm) of free area per 2,000 BTUH of combined input for all gas appliances in area (**see Table 1**).
6. Vertical duct openings or openings directly to outside require 1" square (6.5mm²) of free area per 4,000 BTUH for combined input of all gas appliances in area (**see Table 1**).

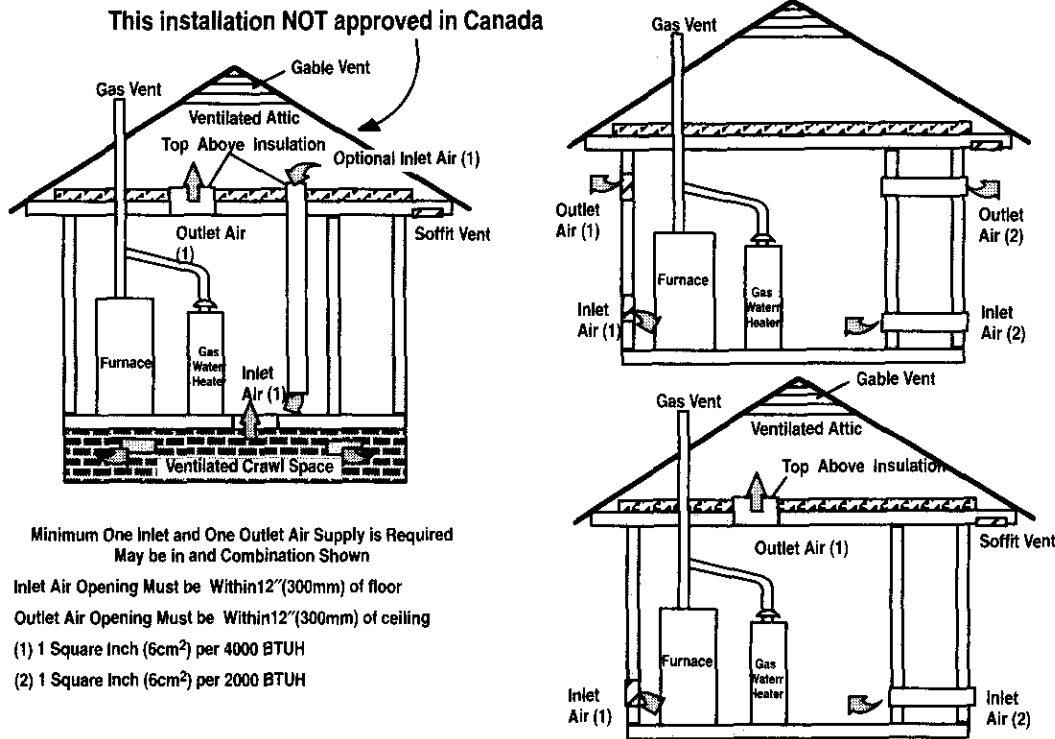
Table 1		Free Area		
BTUH Input Rating	Minimum Free Area Required for Each Opening			Round Duct (4,000 BTUH)
	Horizontal Duct (2,000 BTUH)	Vertical Duct or openings to outside (4,000 BTUH)		
50,000	25 sq. in.(161 cm ²)	12.5 sq. in.(81 cm ²)		4"
75,000	35.5 sq. in.(242 cm ²)	18.75 sq. in.(121 cm ²)		5"
100,000	50 sq. in.(323 cm ²)	25 sq. in.(161 cm ²)		6"
125,000	62.5 sq. in.(403 cm ²)	31.25 sq. in.(202 cm ²)		7"
150,000	71 sq. in.(484 cm ²)	37.5 sq. in.(242 cm ²)		7"

EXAMPLE: Determining Free Area

Appliance 1	Appliance 2	Total Input
100,000 + 30,000 = (130,000 ÷ 4,000) = 210 cm ²		(32.5 Sq. In.) Vertical
Appliance 1	Appliance 2	Total Input
100,000 + 30,000 = (130,000 ÷ 2,000) = 419 cm ²		(65 Sq. In.) Horizontal

Figure 4

Outside Air (This is ONLY a guide. Subject to codes of country having jurisdiction.)



Unconfined Space Installation

WARNING

Carbon Monoxide Poisoning Hazard.

Most homes will require additional air.

An unconfined space or homes with tight construction may not have adequate air infiltration for proper combustion and ventilation of flue gases.

Failure to supply additional air by means of ventilation grilles or ducts could result in personal injury and/or death.

An unconfined space is defined as an area having a minimum volume of 50 cubic feet (1.4m³) per 1,000 Btuh total input rating for all gas appliances in area. Refer to Table 2 for minimum area required.

Table 2		Unconfined Space Minimum Area in Square Feet
BTUH Input Rating	Minimum Area in Square Feet	
50,000	312(29m ²)	
78,000	490(46m ²)	
114,000	712(66m ²)	
155,000	968(90m ²)	

EXAMPLE: NOTE: Square feet is based on 8 foot ceilings.
 $\frac{28,000 \text{ BTUH}}{1,000} \times 50 \text{ Cubic Ft.} = \frac{1,400}{8' \text{ Ceiling Height}} = 175 \text{ Sq. Ft.}$

NOTE: Refer to definitions in section titled *Unusually Tight Construction*. If any one of the conditions apply, the space **MUST** be considered confined space regardless of size.

1. Adjoining rooms can be considered part of an unconfined area if there are openings without doors between rooms.
2. An attic or crawlspace may be considered an unconfined space provided there are adequate ventilation openings directly to outdoors. Openings **MUST** remain open and **NOT** have any means of being closed off. Ventilation openings to outdoors **MUST** be at least 1" square (25mm²) of free area per 4,000 BTUH of total input rating for all gas appliances in area.
3. Install air intake a minimum of 12" (300mm) above maximum snow level and clear of any obstruction. Duct or ventilation opening requires one square inch of free area per 4,000 BTUH of total input rating for all gas appliances in area.
4. Air inlet **MUST** be screened with not less than 1/4" (6mm) mesh screen.

Unusually Tight Construction

In unconfined spaces, infiltration may be adequate to provide air for combustion, ventilation and dilution of flue gases. However, in buildings with unusually tight construction, additional air **MUST** be provided using the methods described in section titled *Confined Space Installation*.

Unusually tight construction is defined as: Construction with

1. Walls and ceilings exposed to the outside have a continuous, sealed vapour barrier. Openings are gasketed or sealed and
2. Doors and openable windows are weather stripped and
3. Other openings are caulked or sealed. These include joints around window and door frames, between sole plates and floors, between wall-ceiling joints, between wall panels, at penetrations for plumbing, electrical and gas lines, etc.

Ventilation Air

Some provincial codes and local municipalities require ventilation or make-up air be brought into the conditioned space as replacement air. Whichever method is used, the mixed return air temperature across the heat exchanger **MUST** not fall below 60°F (15° c) or flue gases will condense in the heat exchanger. This will shorten the life of the heat exchanger and possibly void your warranty.

4. Vent and Combustion Air Piping

WARNING

Carbon monoxide poisoning, fire and explosion hazard.

Read and follow all instructions in this section.

Failure to properly vent this furnace can result in property damage, personal injury and/or death.

Dual Certified Furnace

This furnace is certified as a category IV appliance and is dual certified as a direct vent furnace using outside air for combustion or it can use air from inside the structure for combustion. The **INLET** air pipe is optional. If combustion air comes from inside the structure, adequate make up air **MUST** be provided to compensate for oxygen burned. See **Confined Space Installation** in the **Combustion and Ventilation Air** chapter. If combustion air is drawn from outside the structure, it **MUST** be taken from the same atmospheric pressure zone as the vent pipe.

Contaminated Combustion Air

Installations in certain areas or types of structures will increase the exposure to chemicals or Halogens which may harm the furnace.

The following areas or types of structures may contain or have exposure to the substances listed below. The installation must be evaluated carefully as it may be necessary to provide outside air for combustion.

- Commercial buildings.
- Buildings with indoor pools.
- Furnaces installed in laundry rooms.
- Furnaces installed in hobby or craft rooms.
- Furnaces installed near chemical storage areas.
- Permanent wave solutions for hair.
- 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.
- Sulfuric Acid.
- Solvent cements and glues.
- Antistatic fabric softeners for clothes dryers.
- Masonry acid washing materials.

Vent and Combustion Air Piping Guidelines

1. Determine the best routing and termination for the vent pipe and air inlet pipe (when used) by referring to all of the instructions and guidelines in this Section.
2. Determine the size required for the vent pipe and air inlet pipe (when used).
3. Loosely assemble all venting parts without adhesive (pipe joint cement) for correct fit before final assembly.

4. Use of vertical piping is preferred because there will be some moisture in the flue gases that may condense as it leaves the vent pipe (See *Special Instruction For Horizontal Vents*).
5. The vent **MUST** exit the furnace at the top left side.
6. The vertical vent pipe **MUST** be supported so that no weight is allowed to rest on the combustion blower.
7. Exhaust vent piping diameter **MUST NOT** be reduced.
8. All exhaust vent piping from the furnace to termination **MUST** slope upwards, away from furnace, a minimum of $\frac{1}{4}''$ per foot of run (6mm per 300mm).
9. Use DWV type long radius elbows whenever possible, as they provide for the minimum slope on horizontal runs and they provide less resistance in the vent system. If DWV elbows cannot be used, use two, 45° elbows when possible. On horizontal runs the elbows can be slightly misaligned to provide the correct slope.
10. All horizontal pipe runs **MUST** be supported at least every five feet with metal pipe strapping. **NO** sags or dips are permitted.
11. All vertical pipe runs **MUST** be supported every six feet where accessible.
12. The maximum pipe length is 40' (12m) total in the inlet **or** outlet side of the system. Up to five, 90° elbows can be used on the inlet **or** the outlet. If more than five elbows are required, reduce the length of both the inlet and exhaust pipes 5' (1.5m) for each additional elbow used. (See **Vent Tables**).
13. The minimum pipe run length is 2' (.6m).
14. The piping can be run in the same chase or adjacent to supply or vent pipe for water supply or waste plumbing. It can also be run in the same chase with a vent from another 90+ furnace.
NOTE: In **NO** case can the piping be run in a chase where temperatures can exceed 140° F. or where radiated heat from adjacent surfaces would exceed 140° F.
15. If installing as a direct-vent appliance, the vent outlet **MUST** be installed to terminate in the same atmospheric pressure zone as the combustion air inlet.
16. The vent system can be installed in an existing unused chimney provided that:
 - Both the exhaust vent and air intake run the length of the chimney.
 - No other gas fired appliance or fireplace (solid fuel) is vented into the chimney.
 - The top of the chimney **MUST** be sealed flush or crowned up to seal against rain or melting snow so **ONLY** the piping protrudes.
 - The termination clearances shown in **Figure 10** are maintained.

Piping Insulation Guidelines

NOTE: In general, chimneys on an outside wall and attics are exposed to cold conditions which can cause the vent pipe to sweat from condensation. This can lead to moisture damage to living spaces. It is highly recommended that piping in these cases be insulated to insure proper protection from condensation damage.

Use $\frac{1}{2}''$ (50mm) wall, closed cell, neoprene insulation or equivalent. If Fibreglas or equivalent insulation is used it must have a vapor barrier. Use R values of 7 up to 10, R-11 if exposure exceeds 10'. If Fibreglas insulation is used, exterior to the structure, the pipe **MUST** be boxed in and sealed against moisture.

1. Insulate pipe when the exhaust vent passes through an unconditioned space or raceway.
2. If situations require pipe to be run on the exterior wall to reach a suitable termination point, it **MUST** be properly insulated.
3. If it is necessary to insulate piping when an inactive chimney is used as a chase, the top of the chimney **MUST** be sealed flush or crowned up to seal against rain or melting snow so **ONLY** the piping protrudes.
4. When the vent or combustion air pipe height above the roof exceeds 30" (760mm), or if an exterior vertical riser is used on a horizontal vent to get above snow levels, the exterior portion **MUST** be insulated.
5. When combustion air inlet piping is installed above a suspended ceiling, the pipe **MUST** be insulated with moisture resistant insulation such as Armaflex or other equivalent type of insulation.
6. Insulate combustion air inlet piping when run in warm, humid spaces such as basements.

Sizing Combustion Air and Vent Pipe

- Single Pipe Installation**—If installing as a non-direct vent appliance, (single outlet pipe and no inlet pipe) refer to **Table 3**. The table shows the maximum number of elbows allowed with any given pipe diameter and length of run.
- Double Pipe Installation**—If installing as a direct-vent appliance, consult **Table 4** to select the proper diameter exhaust and combustion air piping. Exhaust and combustion air piping is sized for each furnace Btuh size based on total lineal vent length (on inlet *or* outlet side), and number of 90° elbows required.
- Use of Elbows**—Two 45° elbows can be substituted for one 90° elbow. The elbow or elbows used for vent termination outside the structure **ARE** counted, including elbows needed to bring termination above expected snow levels. **When the vent system length used is borderline with the next size combination category, always use the next larger size.**

EXAMPLE: Refer to, 75,000 Btuh Furnace, Table 4.

- A vent system uses 25' of Inlet pipe and 24' of Outlet pipe. Use the maximum length found in your system, so 25' is the length to use in these tables. The 25–30 column should be used.
- There are 4 elbows on the Outlet and 2 elbows on the Inlet. Use the 4 elbows row because that is the maximum number of elbows on any *one* side (Inlet or Exhaust).
- In this example, combinations **C** or **F** are allowed. Using the legend at the bottom of the table, combination **C** is 3" Inlet with a 2½" Exhaust. Combination **F** is a 3" Inlet with a 3" Exhaust. Either combination is allowed together, but they can **NOT** be mixed. In other words, part of a **C** combination can **NOT** be used with part of an **F** combination just because they are listed together in the same block.

Table 3		Pipe Diameter Table Single Piping ONLY						
		50,000 & 75,000 Btuh Furnaces						
Max No. Of Elbows in One Side Ⓢ	Feet of Pipe*							
	0-9	10-14	15-19	20-24	25-29	30-34	35-40	
UP TO 5	All combinations use "A" a 2" Exhaust							
		100,000 Btuh Furnace						
Max No. Of Elbows in One Side Ⓢ	Feet of Pipe*							
	0-9	10-14	15-19	20-24	25-29	30-34	35-40	
1	A	A	A	A	A	A	B,C	
2	A	A	A	A	A	B,C	B,C	
3	A	A	A	A	B,C	B,C	B,C	
4	A	A	A	B,C	B,C	B,C	B,C	
5	A	A	B,C	B,C	B,C	B,C	B,C	
		125,000 Btuh Furnace						
Max No. Of Elbows in One Side Ⓢ	Feet of Pipe*							
	0-9	10-14	15-19	20-24	25-29	30-34	35-40	
1	A	A	B,C	B,C	B,C	B,C	C	
2	A	B,C	B,C	B,C	B,C	C	C	
3	B,C	B,C	B,C	B,C	C	C	C	
4	B,C	B,C	B,C	C	C	C	C	
5	B,C	B,C	C	C	C	C	C	
Possible combination legend: A = 2" Exhaust B = 2½" Exhaust C = 3" Exhaust Elbows are DWV Long Radius Type for 2" and 3" vents. Schedule 40 (sharp radius) for 2½"								

Ⓢ - Signifies the maximum number of elbows, including the termination elbow(s), on any one part of the system. Example: 4 elbows on the exhaust and 5 elbows on the inlet would use the chart showing 5 elbows, because 5 is the maximum number on any one side.

If more than five elbows are required, reduce the length of both the inlet and exhaust pipes 5' (1.5m) for each additional elbow used.

*Feet of pipe is whichever pipe run is the longest, either inlet *or* outlet side.

Table 4		Pipe Diameter Table Dual Piping ONLY						
		50,000 Btuh Furnaces						
Max No. Of Elbows in One Side Ⓢ	Feet of Pipe*							
	0-9	10-14	15-19	20-24	25-29	30-34	35-40	
UP TO 5	All combinations use "A" a 2" Exhaust and 2" Air Inlet Pipe							
		75,000 Btuh Furnace						
Max No. Of Elbows in One Side Ⓢ	Feet of Pipe*							
	0-9	10-14	15-19	20-24	25-29	30-34	35-40	
1	A	A	A	A	D,B	E,B	E,B	
2	A	A	A	D,B	E,B	E,B	C,F	
3	A	A	D,B	E,B	E,B	C,F	C,F	
4	A	D,B	E,B	E,B	C,F	C,F	C,F	
5	D,B	E,B	E,B	C,F	C,F	C,F	C,F	
		100,000 Btuh Furnace						
Max No. Of Elbows in One Side Ⓢ	Feet of Pipe*							
	0-9	10-14	15-19	20-24	25-29	30-34	35-40	
1	A	A	A	D,B	E,B	E,B	C,F	
2	A	A	D,B	E,B	E,F	C,F	C,F	
3	A	D,B	E,B	E,F	C,F	C,F	C,F	
4	D,B	E,B	E,F	C,F	C,F	C,F	C,F	
5	D,B	E,F	C,F	C,F	C,F	C,F	C,F	
		125,000 Btuh Furnace						
Max No. Of Elbows in One Side Ⓢ	Feet of Pipe*							
	0-9	10-14	15-19	20-24	25-29	30-34	35-40	
UP TO 5	All combinations use "F" a 3" Exhaust and 3" Air Inlet Pipe							
Possible combination legend: A = 2" Inlet with a 2" Exhaust B = 3" Inlet with a 2" Exhaust C = 3" Inlet with a 2½" Exhaust D = 2½" Inlet with a 2" Exhaust E = 2½" Inlet with a 2½" Exhaust F = 3" Inlet with a 3" Exhaust Elbows are DWV Long Radius Type for 2" and 3" vents. Schedule 40 (sharp radius) for 2½"								

Vent Termination Clearances

WARNING

Carbon monoxide poisoning, fire and explosion hazard.

Inlet and outlet pipes may NOT be vented directly above each other.

Failure to properly vent this furnace can result in property damage, personal injury and/or death.

- Determine termination locations based on clearances specified in following steps and as shown in **Figure 5**, **Figure 8**, **Figure 9** and **Figure 10**.
- The vent termination must be located at least 12" (300mm) above ground or normally expected snow accumulation levels.

- Do **NOT** terminate over public walkways. Avoid areas where condensate may cause problems such as above planters, patios, or adjacent to windows where steam may cause fogging.
- The vent termination shall be located at least 4' (1220mm) horizontally from any electric meter, gas meter, regulator, and any relief equipment. These distances apply **ONLY** to U.S. installations.
- The vent termination is to be located at least 3' (914mm) above any forced air inlet located within 10' (3m); and at least 10' (3m) from a combustion air intake of another appliance, except another direct vent furnace intake.
- In Canada, the *Canadian Fuel Gas Code* takes precedence over the preceding termination instructions.
- A condensate pump **MUST** have an auxiliary safety switch to prevent operation of furnace and resulting overflow of condensate in the event of pump failure. The safety switch **MUST** be wired through the R circuit **ONLY** (low voltage) to provide operation in either heating or cooling modes.
- Install an overflow line if routing to floor drain or sump pump. See **Figure 1** for example of proper routing and installation of overflow line.
- If the condensate drain has the potential for freezing, heat tape must be used on the drain trap and condensate drain.

Connecting Furnace and Piping

WARNING

Carbon monoxide poisoning hazard.

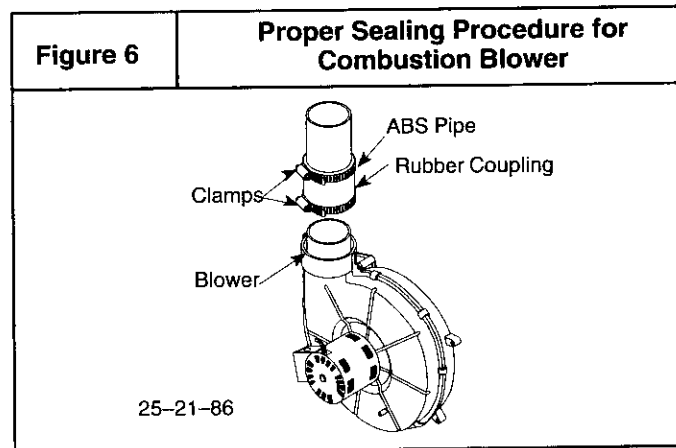
Cement or mechanically seal all joints, fittings, etc. to prevent leakage of flue gases.

Failure to properly seal vent piping can result in personal injury and/or death.

- Preassemble the exhaust and combustion air piping from the furnace to the vent termination. Do **NOT** cement any joints together until the preassembly process is complete.

Vent Pipe Connection

- Install the section ABS vent pipe (supplied) to the combustion blower using the flexible coupling and clamps (provided). Remove the three screws holding the vent collar to the top panel. Remove the vent collar. Remove the two screws in the chase tube. Squeeze the chase tube together and slide the chase tube through the top panel. The blower snout is now accessible for installing the ABS pipe. See **Figure 6** and **Figure 7**. Reassemble in reverse order.



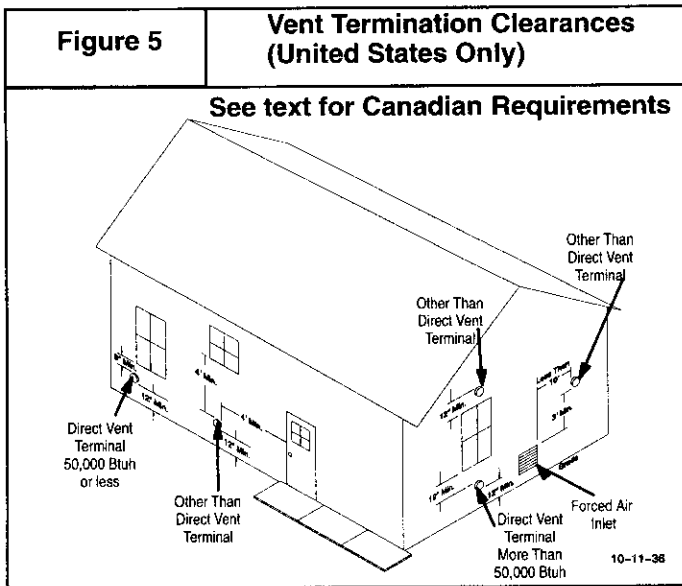
- Install the remaining flexible coupling and clamps (supplied) on the end of the ABS vent pipe from the combustion blower. This will be used to connect to the rest of the vent system. See **Figure 7**.

Air Inlet Pipe Connection

NOTE: Air Inlet Collar is sized for 3" PVC pipe. If 2" (50mm) or 2 1/2" (64mm) combustion air piping is used, a 3" (75mm) to 2" (50mm) or 3" (75mm) to 2 1/2" (64mm) reducer fitting is required. The reducing section can be before the 90° elbow in a horizontal section.

- Install pipe section or pipe/reducer fitting (as required) to the inlet collar using RTV sealant **ONLY** to provide for future serviceability.

NOTE: On single pipe installation, using combustion air from inside the structure, it is recommended that a screen be placed inside the Combustion Air Inlet. A 3" plastic screen is provided for this purpose. It will prevent small objects from falling into the combustion chamber. Use RTV sealant **ONLY** to provide for future serviceability.



Condensate Drain Trap and Neutralizer

This furnace removes both sensible and latent heat from the combustion flue gases. Removal of latent heat results in condensation of flue gas (water vapor). This condensed water vapor drains from the secondary heat exchanger, through a built-in drain trap transition, and out of the unit. Condensate line can exit from the right side, left side, or rear of the cabinet.

NOTE: The 90° compression fitting elbow (provided), requires the drain line to be 1/2" (13mm) CPVC* (5/8" OD), 5/8" (16mm) I.D. vinyl tubing may be used outside the furnace cabinet to connect to the drain line. Internal trap assembly provides the required 4" water column, so no additional trap is required.

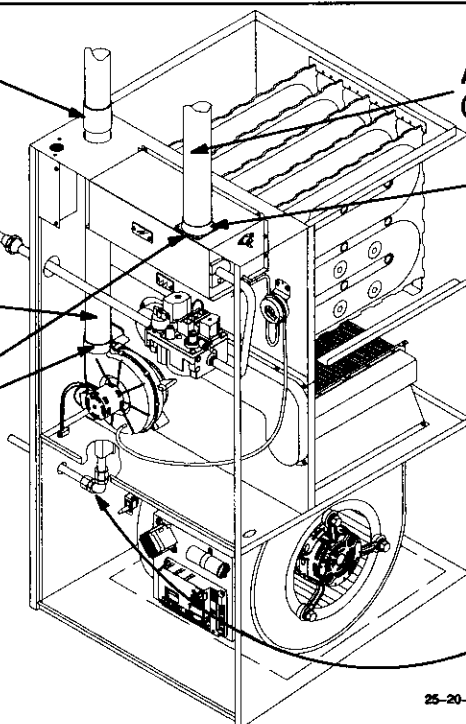
* Make sure the 1/2" CPVC is 5/8" OD as there is also a schedule 40 available that will not work.

- Do **NOT** put a loop in the drain piping. This would cause an extra water column pressure in addition to the pressure inside the built-in drain trap.
- Drains must terminate at an inside drain to prevent freezing of condensate and possible property damage.
- Consideration **MUST** be given to type of filter being installed. 125,000 Btuh furnace require 2-16"x25"x1" filters (one on each side of furnace). This configuration does **NOT** allow the condensate drain line to be run out the side of furnace. If line **MUST** be run out the side, an optional standoff filter rack with one 20"x25"x1" filter is needed. Install optional filter rack on side of furnace opposite the side where condensate drain line will exit.
- A condensate or sump pump **MUST** be used if local codes require, or if no inside floor drain is available. If pump is approved for use with acidic condensate, a neutralizer cartridge is not needed. If using a neutralizer cartridge, it **MUST** be installed in the drain line in a horizontal position **ONLY**.

Figure 7

Vent Trap and Furnace Connections

Flexible coupling and clamps (supplied) are installed outside the cabinet. (2")



Air Intake Pipe (Direct-Vent Installation only)
Place a 3" Plastic Screen (Optional) inside the Air Inlet Collar when Combustion Air comes from inside the structure.

Condensate compression fitting can be turned to exit out the left side, right side, or rear of cabinet. If piping is exiting out the right side of cabinet, it is necessary to use an elbow to run pipe in front of electronic module. Cabinet entrance hole is offset enough to allow adequate clearance.

ABS pipe (supplied) MUST be installed between combustion blower and coupling.

RTV sealant used to join combustion blower and ABS pipe and Air Inlet Pipe to Combustion Air Inlet. See Figure 6.

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Joining Pipe and Fittings

WARNING

Fire hazard.

Provide adequate ventilation and do NOT assemble near heat source or open flame. Do NOT smoke while using solvent cements and avoid contact with skin or eyes.

Observe all cautions and warnings printed on material containers to prevent possible personal injury and/or death.

NOTE: All PVC, CPVC, ABS, and Cellular Core pipe fittings, solvent cement, primers and procedures MUST conform to American National Standard Institute and American Society for Testing and Materials (ANSI/ASTM) standards. Schedule 40 is the ONLY approved wall thickness.

- Pipe and Fittings – ASTM D1785, D2466, D2661, D2665, F-891
- PVC Primer and Solvent Cement – ASTM D2564
- Procedure for Cementing Joints – Ref ASTM D2855

NOTE: In order to create a seal that allows future removal of pipe, RTV sealant MUST be used on both the inlet and the exhaust pipes where they join to the furnace. PVC, CPVC, ABS, and Cellular Core pipe and cement may be used on all other joints.

CAUTION

Do NOT use solvent cement that has become curdled, lumpy or thickened and do NOT thin. Observe precautions printed on containers. For applications below 32° F., use only low temperature type solvent cement.

- 1.. Cut pipe end square, remove ragged edges and burrs. Chamfer end of pipe, then clean fitting, socket and pipe joint of all dirt, grease, or moisture.

NOTE: Stir the solvent cement frequently while using. Use a natural bristle brush or the dauber supplied with the cement. The proper brush size is one inch.

- 2.. After checking pipe and socket for proper fit, wipe socket and pipe with cleaner-primer. Apply a liberal coat of primer to inside surface of socket and outside of pipe. Do NOT allow primer to dry before applying cement.
- 3.. Apply a thin coat of cement evenly in the socket. Quickly apply a heavy coat of cement to the pipe end and insert pipe into fittings with a slight twisting movement until it bottoms out.

NOTE: Cement MUST be fluid while inserting pipe. If NOT, recoat pipe.

- 4.. Hold the pipe in the fitting for 30 seconds to prevent the tapered socket from pushing the pipe out of the fitting.
- 5.. Wipe all excess cement from the joint with a rag. Allow 15 minutes before handling. Cure time varies according to fit, temperature and humidity.

Connecting Vent Pipes and Termination

NOTE: Combustion air intake and vent MUST terminate in the same atmospheric pressure zone. If installation is in a cold climate (substantiated temperatures below 0° F), increase the minimum distance between vent pipe and air intake from 8" to 18".

CAUTION

Maintain a minimum of 36" (1m) between combustion air inlet and clothes dryer vent. Terminate the combustion air intake as far as possible from any air conditioner, heat pump, swimming pool, swimming pool pumping, chlorinator or filtration unit.

WARNING

Carbon monoxide poisoning, fire and explosion hazard.

Inlet and outlet pipes may NOT be vented directly above each other.

Failure to properly vent this furnace can result in property damage, personal injury and/or death.

1. Install all couplings, nipples and elbows using proper procedures for **Joining Pipe and Fittings** and maintain spacing between vent and combustion air piping as indicated in **Figure 8** through **Figure 10**.

Vent Termination Shielding

Under certain wind conditions some building materials may be affected by flue products expelled in close proximity to unprotected surfaces. Sealing or shielding of the exposed surfaces with a corrosion resistant material (such as aluminum sheeting) may be required to prevent staining or deterioration. The protective material should be attached and sealed (if necessary) to the building before attaching the vent terminal.

A metal shield is recommended 18" x 18" (457mm x 457mm) min. or 18" (457mm) min. diameter around the vent termination at the exterior wall to protect the house exterior materials from flue product or condensation (freezing) damage.

Vertical Termination

1. **NO TAG** shows the proper installation and clearances for vertical vent termination. The vertical roof termination should be sealed with a plumbing roof boot or equivalent flashing. The inlet of the intake pipe and end of the exhaust vent must be terminated no less than 12" (300mm) above the roof or snow accumulation level, and 12" (300mm) away from a vertical wall or other protrusion.
2. If the vent system is installed in an existing chimney make sure clearances shown in **Figure 10** are maintained. Horizontal section before the termination elbow can be extended on the inlet air to provide necessary clearance.

Horizontal Termination

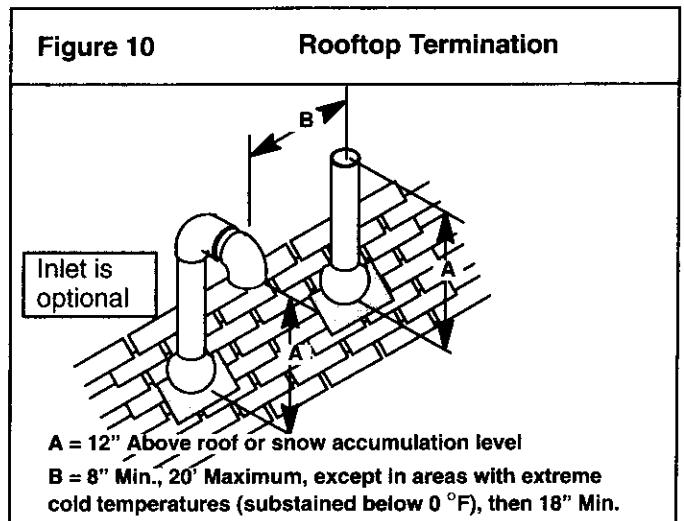
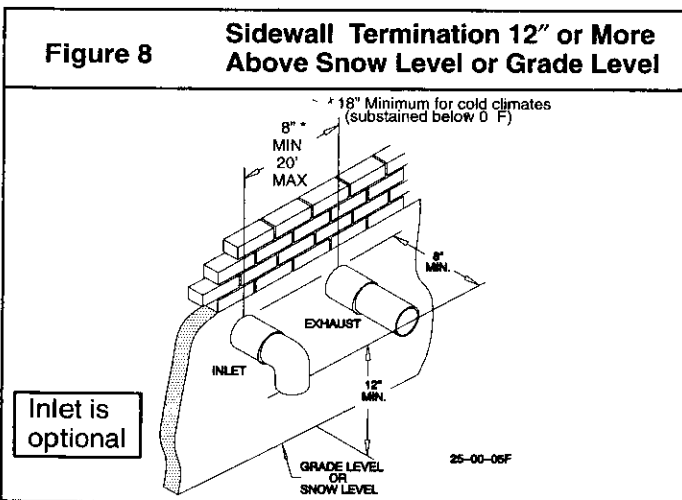
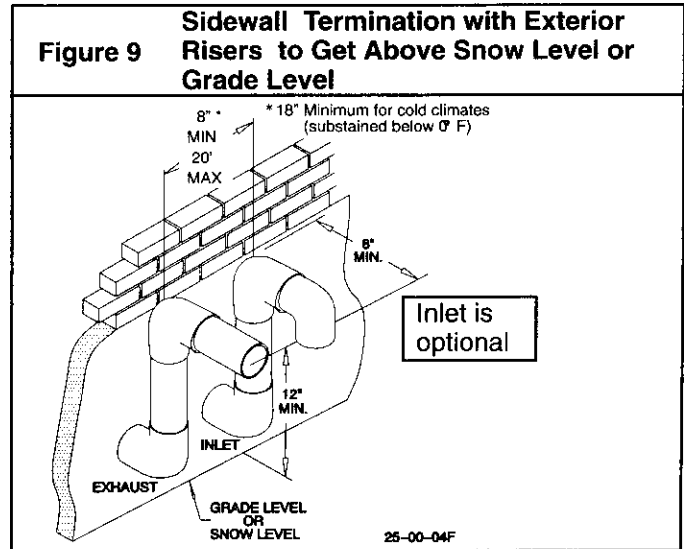
1. If installing as a direct-vent appliance, cut two holes. 2¹/₂" (67mm) for 2" (50mm) pipe, 3" (75mm) for 2¹/₂" (67mm) pipe, or 3¹/₂" (90mm) for 3" (75mm) pipe. Do **NOT** make the holes oversized, or it will be necessary to add a sheet metal or plywood plate on the outside with the correct size hole in it. If venting as a single pipe appliance, cut only one hole.
2. Check hole sizes by making sure it is smaller than the couplings or elbows that will be installed on the outside. The couplings or elbows **MUST** prevent the pipe from being pushed back through the wall.
3. Extend vent pipe and combustion air pipe through the wall 3/4" to 1" (19 to 25mm) and seal area between pipe and wall.
4. Install the couplings, nipple and termination elbows as shown and maintain spacing between vent and combustion air piping as indicated in **Figure 8** through **Figure 10**.

Using Exterior Risers

1. Install elbows and pipe to form riser as shown in **Figure 9**.
2. Secure vent pipe to wall with galvanized strap or other rust resistant material to restrain pipe from moving.
3. Insulate pipe with Armaflex or equivalent moisture resistant closed cell foam insulation or Fiberglass insulation if boxed in and sealed against moisture.

Optional Vent Screens

To prevent unwanted pests or foreign material from entering terminated pipes, plastic vent screens are available in 2" and 3" sizes (check parts list). Use of these screens is recommended except in cold climate areas where ice is likely to form on them. Glue the screen inside the termination elbow using pipe cement. Screens should be inspected monthly for blockage and cleaned yearly prior to startup.



5. Gas Supply and Piping

WARNING

Fire and explosion hazard.

Natural Gas

Models designated for Natural Gas are to be used with Natural Gas Only, unless properly converted to use with LP gas.

NOTE: The rating plate is stamped with the model number, gas type and gas input rating. In addition, models manufactured for sale in Canada have orifice size information stamped on the rating plate.

Alternate BTUH Input Ratings (USA Only)

The input rating of these furnaces can be changed from the standard input rating to the alternate input rating shown in **Table 5**, by changing the main burner orifices. Changing of burner orifices **MUST** be done by a qualified service technician. See section on changing orifices.

BTUH Standard Rating	BTUH Alternate Rating	Natural Gas Orifice	LP Gas Orifice
50,000	40,000	#44	#55
75,000	60,000	#44	#55
100,000	80,000	#44	#55
125,000	100,000	#44	#55

Supply Pressure

WARNING

Fire hazard.

Do **NOT** set input rating above that shown on rating plate.

Failure to properly set input pressure can result in property damage, personal injury and/or death.

- Supply pressure can be checked using the $\frac{1}{8}$ "(3.2mm) NPT port on the supply side of the gas valve.
- Gas input to burners **MUST NOT** exceed the rated input shown on rating plate.
- Do **NOT** allow minimum gas supply pressure to vary downward. Doing so will decrease input to furnace. Refer to **Table 6** for normal gas supply and manifold pressures.

Gas Type	Supply Pressure			Manifold Pressure
	Recommended	Max.	Min.	
Natural	7 inches	14 inches	4.5 inches	3.5 inches
LP	11 inches	14 inches	11 inches	10 inches

Important Notes

- With Propane gas, the rated input is obtained when the BTU content is 2,500 BTU per cubic foot and manifold pressure set at 10 inches W.C.
- If Propane gas has a different BTU content, orifices **MUST** be changed by licensed Propane installer.
- Measured input can **NOT** exceed rated input.
- Combustion Air Box Cover **MUST** be removed when adjusting manifold pressure.
- Any major change in gas flow requires changing burner orifice size.

General Derating Rules

- For operation with natural gas at altitudes 2,000' and above, orifice change and/or manifold pressure adjustment may be required to suit gas supplied. Check with gas supplier. If orifice sizing is needed, it should be based on reducing the input rating by 4 percent for each 1,000' above sea level. See **Table 7** and **Figure 11** for required pressure change and/or orifice change for high altitudes.

Heat Value Btu/Cu.Ft.	Elevation Above Sea Level						
	0–1999	2000–2999	3000–3999	4000–4999	5000–5999	6000–6999	7000–7999
800	3.5	3.5	3.5	3.5	3.5	3.2	2.9
850	3.5	3.5	3.5	3.5	3.2	2.9	2.6
900	3.5	3.5	3.4	3.1	2.8	2.5	2.3
950	3.5	3.3	3.1	2.8	2.5	2.3	3.5
1000	3.5	3.0	2.8	2.5	2.3	3.5	3.1
1050	3.2	2.7	2.5	2.3	3.5	3.2	2.8
1100	2.9	2.5	2.3	3.5	3.2	2.9	2.6
Orifice Size	#42	#42	#42	#45	#45	#45	#45

Shaded box requires orifice change.
No Shading indicates factory installed orifice and manifold pressure change only.

- For operation with LP gas, gas orifices **MUST** be changed and manifold pressure **MUST** be *maintained* as per **Table 6**. Orifice sizes for 0–2000' above sea level are #54. 2000–7000' above sea level, use #55. 7000–8000' above sea level, use #56 orifices. Orifices can be ordered through your distributor.

Manifold Gas Pressure Adjustment

NOTE: Gas supply pressure **MUST** be within minimum and maximum values listed on rating plate. Pressures are usually set by gas suppliers. Make adjustment to manifold pressure with burners operating and combustion air box cover removed.

1. Remove combustion air box cover.
2. Connect U-Tube manometer to the tapped opening on the outlet side of gas valve. Use manometer with a 0–min. 12" water column range.
3. Turn gas **ON**, fire the furnace and remove adjustment screw cover on gas valve.
4. Turn counterclockwise to decrease pressure and clockwise to increase.
5. Set pressure to value shown in **Table 6**. Refer to **Important Notes** in **Table 6**. Pressure is also listed on furnace rating plate.
6. When pressure is set, replace adjustment screw cover on gas valve.
7. Replace combustion air box cover.

NOTE: Adjustment screw cover **MUST** be replaced on gas valve **BEFORE** reading manifold pressure and operating furnace.

High Altitude Air Pressure Switch

Altitudes over 4,000' require a different air pressure switch than the one installed at the factory. Check parts list for pressure switch and consult your distributor for part number and availability. In Canada, provincial codes may govern installation of switch. Check with governing authorities.

Changing Orifices for High Altitude

WARNING

Electrical shock, fire or explosion hazard.

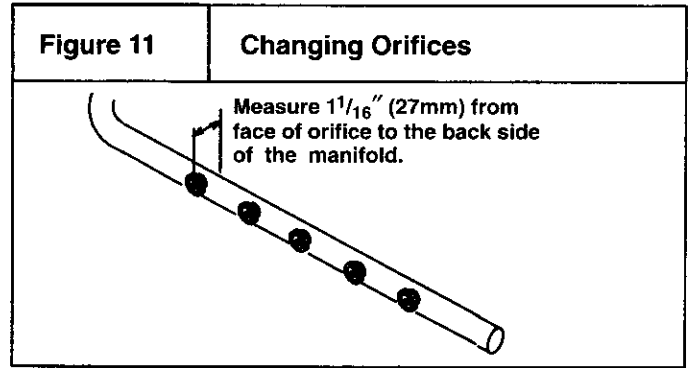
Turn **OFF** electric power (at disconnect) and gas supply (at manual valve in gas line) when installing orifices. Installation of orifices requires a qualified service technician.

Failure to properly install orifices can result in property damage, personal injury and/or death.

NOTE: Main burner orifices can be changed for high altitudes.

1. Disconnect gas line from gas valve.
2. Remove combustion box front cover and manifold from furnace.
3. Remove the orifices from the manifold and replace them with properly sized orifices.

4. Tighten orifices so there is $1\frac{1}{16}$ " (27mm) from the faces of the orifices to the back side of the manifold, **Figure 11**.



5. Reinstall manifold and combustion air box cover. Ensure burners do **NOT** bind on new orifices.

Natural Gas Input Rating Check

NOTE: The gas meter can be used to measure input to furnace. Rating is based on a natural gas BTU content of 1,000 BTU's per cubic meter. Check with gas supplier for actual BTU content.

1. Make sure combustion air box cover is in place and closed before performing the following steps.
2. Turn **OFF** gas supply to all appliances and start furnace.
3. Time how many seconds it takes the smallest dial on the gas meter to make one complete revolution. Refer to **Example**.

Example			
Natural Gas BTU Content	No. of Seconds Per Hour	Time Per Cubic Foot in Seconds	BTU Per Hour
1,000	3,600	48	75,000
$1,000 \times 3,600 \div 48 = 75,000 \text{ BTUH}$			

NOTE: If meter uses a 2 cubic foot dial, divide results (seconds) by two.

4. Relight all appliances and ensure all pilots are operating.

Gas Piping Requirements

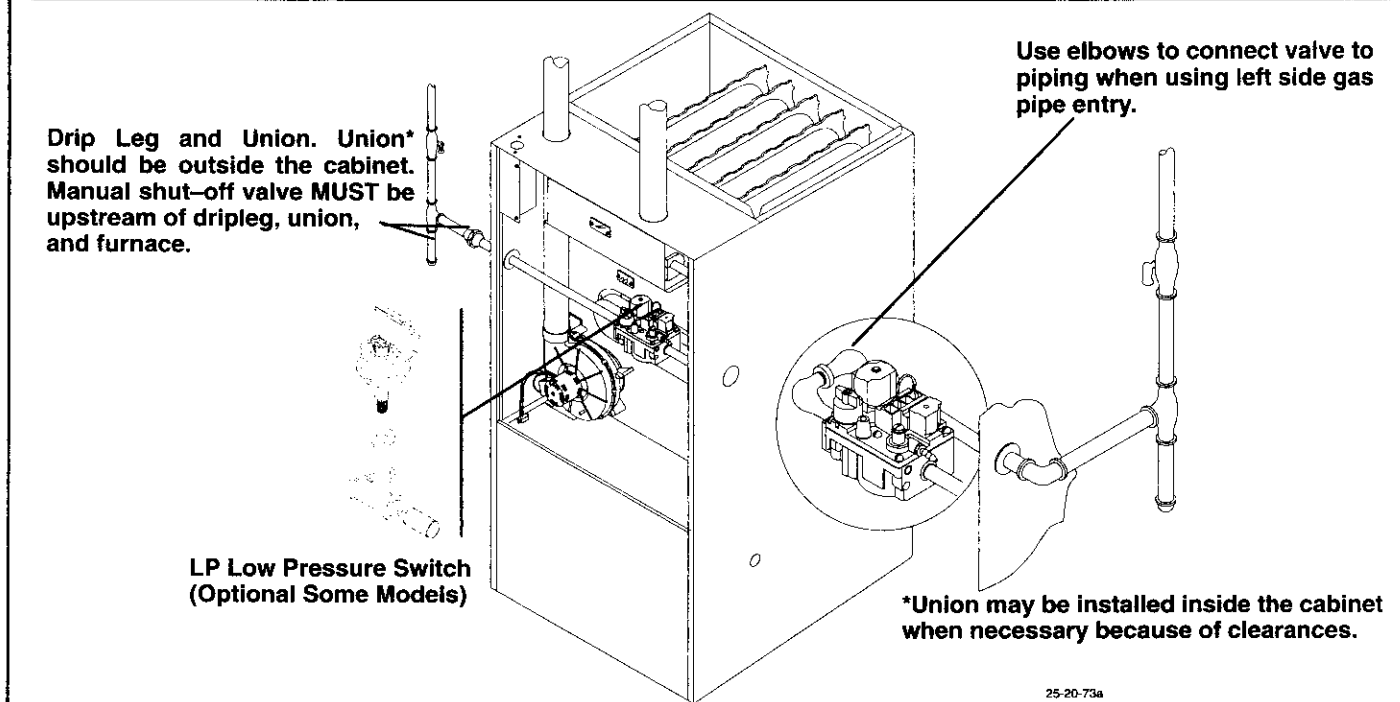
1. Properly size gas pipe to handle combined appliance load or run gas pipe directly from gas meter or LP gas regulator. Refer to NFGC and ANSI Z223.1 for proper gas pipe size.
2. Install correct pipe size for run length and furnace rating.
3. Measure pipe length from gas meter or LP second stage regulator.

Connections

NOTE: Refer to **Figure 12** for the general layout at the furnace. The rules listed apply to natural and LP gas pipe installations.

Figure 12

Typical Gas Piping



25-20-73a

1. Use black iron or steel pipe and fittings or other pipe approved by local code.
2. Use ground joint unions and install a drip leg no less than 3" long to trap dirt and moisture before it can enter gas valve.
3. Use two pipe wrenches when making connections to prevent gas valve from turning.
4. Install a manual shut-off valve external to furnace casing and tighten all joints securely.

Additional LP Connection Requirements

1. Have a licensed LP gas dealer make all connections at storage tank and check all connections from tank to furnace.
2. If copper tubing is used, it **MUST** comply with limitation set in National Fuel Gas Code or CGA codes.
3. Two-stage regulation of LP gas is recommended.

6. Electrical Wiring

WARNING

Electrical shock hazard.

Turn OFF electric power at fuse box or service panel before making any electrical connections and ensure a proper ground connection is made before connecting line voltage.

Failure to do so can result in property damage, personal injury and/or death.

Final Check

1. The furnace and its individual shut-off valve must be disconnected from the gas supply piping system during any pressure testing of that system at test pressures in excess of $\frac{1}{2}$ " PSIG (3.5 kPa).

The furnace must be isolated from the gas supply piping system by closing its individual manual shut-off valve during any pressure testing of the gas supply piping system at test pressures equal to or less than $\frac{1}{2}$ " PSIG (3.5 kPa).

2. Test all pipes for leaks.
3. Gas pressure **MUST NOT** exceed $\frac{1}{2}$ " PSIG to gas valve. Checking gas piping above $\frac{1}{2}$ " PSIG requires the furnace and manual shut-off valve to be disconnected during testing.
4. Apply soap suds (or a liquid detergent) to each joint. Bubbles forming indicate a leak.
5. Correct even the smallest leak at once.
6. If orifices were changed, make sure they are checked for leakage.

Grounding

NOTE: The furnace **MUST** be electrically wired and grounded in accordance with local codes or, in the absence of local codes, with the electrical codes of the country having jurisdiction. Electronic controls and furnace will **NOT** operate unless properly grounded. A ground lug wire is provided for ground connection. Use an approved copper connector from furnace to service panel or properly driven ground rod.

Polarizing

NOTE: To insure safe, reliable operation, unit **MUST** be polarized. Proper polarity is shown in **Figure 13**. The white wire is neutral and the black wire is hot.

Labeling

CAUTION

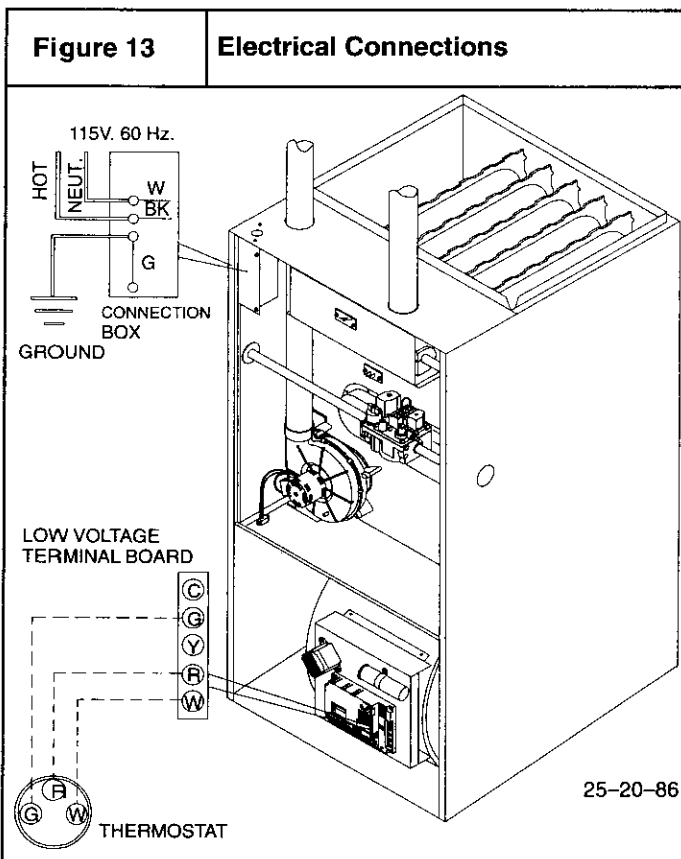
Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation. Verify proper operation after servicing.

Power Supply

The furnace **MUST** be electrically wired and grounded in accordance with local codes, or in the absence of local codes, the applicable national codes.

Field wiring connections must be made inside the furnace connection box. A suitable strain relief should be used at the point the wires exit the furnace casing.

Copper conductors must be used. Line voltage wires should be sized for the input amps stated on the rating plate. Furnace should be connected to its own separate circuit.



Thermostat

NOTE: Thermostat location has an important effect on the operation of the unit. Follow instructions included with thermostat for correct mounting and wiring.

Heat Anticipator

- Set thermostat heat anticipator in accordance with thermostat instructions and actual measured value. To measure heat anticipator, do the following:
 - Wrap 10 loops of single strand, insulated thermostat wire around the prongs of an amp meter. Set the scale on the amp meter to measure no more than 10 amps.

- Connect the uninsulated ends of this wire jumper across terminals **R** and **W** on the subbase. (Multi-stage thermostats use **RH** and **W**) Do **NOT** attach thermostat to subbase.
- Fire the thermostat for about one minute. Read the amp meter. Divide the amp reading by 10 and set anticipator to this number.
- Remove wires from subbase and attach thermostat to subbase.

Optional Equipment

NOTE: All wiring (except thermostat) from furnace to optional equipment **MUST** conform to the temperature limitations of local codes or, in the absence of local codes, with the electrical codes of the country having jurisdiction. See Appendix. Install wiring in accordance with manufacturer's instructions.

Humidifier/Electronic Air Cleaner

The furnace is pre-wired for humidifier and/or electronic air cleaner connection.

CAUTION

Do **NOT** exceed 115V/1.0 amp maximum current load for both the **EAC** terminal and the **HUM** terminal combined.

- For connection of a humidifier, connect the spade terminal wires of the humidifier to the **HUM** and **HUM** Neutral.
- For connection of an electronic air cleaner, connect the spade terminal wires of the humidifier to the **EAC** and **EAC** Neutral.

NOTE: The humidifier will be powered when the combustion blower is energized. The electronic air cleaner will be powered anytime the thermostat calls.

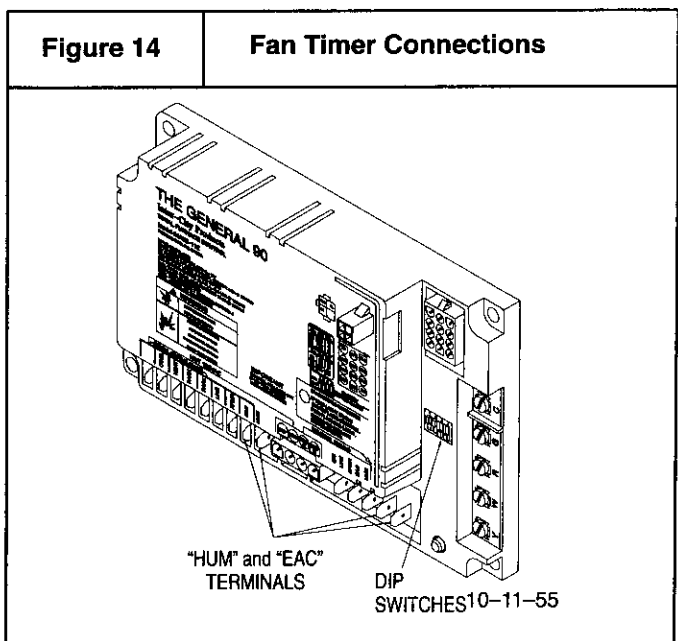
NOTE: The furnace electronic fan control will change fan speeds automatically as heat and cool are selected at the thermostat.

Fan Control

The fan control can be set to turn **ON** at 15, 30, 45, 60 seconds after the burners light. It can be adjusted to turn **OFF** at 60, 90, 120, and 180 seconds. Refer to "Furnace Wiring Diagram" for desired setting.

NOTE: It is recommended to achieve maximum efficiency that the fan control be set to turn on at 30 seconds after the burners light.

Operate the furnace and ensure that the blower turns **ON** and **OFF** at the appropriate time to provide the desired comfort level.



7. Ductwork and Filter

WARNING

Carbon monoxide poisoning hazard.

Do NOT draw return air from inside a closet or utility room. Return air duct MUST be sealed to furnace casing.

Failure to properly seal duct can result in personal injury and/or death.

Installation

NOTE: Design and install air distribution system to comply with Air Conditioning Contractors of America manuals and/or NFPA pamphlets 90A and 90B or other approved methods that conform to local codes and good trade practices.

1. When furnace supply ducts carry air outside furnace area, seal return air duct to furnace casing and terminate duct outside furnace space.
2. Install air conditioning cooling coil (evaporator) on outlet side of furnace.
3. For furnaces installed without a cooling coil it is recommended that the outlet duct be provided with a removable access panel. This panel should be accessible when the furnace is installed so the exterior of the heat exchanger can be viewed for inspections. The access panel **MUST** be sealed to prevent leaks.
4. If separate evaporator and blower units are used, install good sealing dampers for air flow control. Chilled air going through the furnace could cause condensation and shorten the furnace life.

NOTE: Dampers (field supplied) can be either automatic or manual. Manually operated dampers **MUST** be equipped with a means to prevent furnace or air conditioning operation unless damper is in the full heat or cool position.

WARNING

Carbon monoxide poisoning hazard.

Cool air passing over heat exchanger can cause condensate to form resulting in heat exchanger failure.

This could result in personal injury and/or death.

Connections

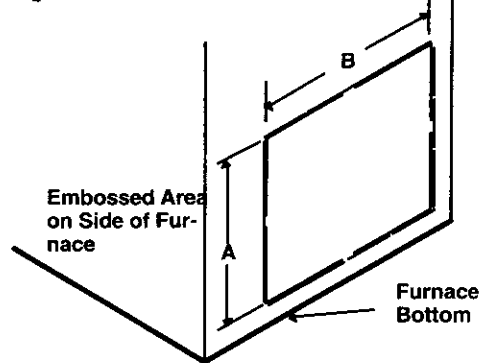
NOTE: Return air can enter through either side, both sides, or the bottom. Return air **can not** enter through rear of the furnace. When the furnace is located in an area near or adjacent to the living area, the system should be carefully designed with returns to minimize noise transmission through the return grille. Any blower moving a high volume of air will produce audible noise which could be objectionable to when the unit is located very close to living areas. It is advisable to route the return air ducts under the floor or through the attic.

1. For side connections using a 16" x 25" internal filter, cut out the embossed area shown in Figure 15. This will provide a 14 $\frac{1}{2}$ " x 22 $\frac{1}{2}$ " approximate opening.

Figure 15

Side Return Air Cutout

A = 14 $\frac{1}{2}$ " Height of Cutout for 16" x 25" Filter
B = 22 $\frac{1}{2}$ " Width of Cutout for 16" x 25" Filter



NOTE: A 125,000 Btuh furnace requires two side returns or a bottom return for 5 tons cooling. If two side returns are used it does **NOT** allow the condensate drain line to be run out the side of furnace. If line **MUST** be run out the side, an optional standoff filter rack with one 20x25x1 filter is needed. Install optional filter rack on side of furnace opposite the side where condensate drain line will exit.

2. Bottom returns can be made by removing the knockout panel in the furnace base. Do **NOT** remove knock-out except for a bottom return. A 20" x 25" filter can be used for a bottom return for a 100,000 Btuh furnace. A 25" x 25" filter is required for 125,000 Btuh furnaces.
3. An optional 20" x 25" duct standoff (NAHA001TK) is available to be used in lieu of one filter on each side of furnace.
4. Installation of locking-type dampers are recommended in all branches, or in individual ducts to balance system's air flow.
5. Non-combustible, flexible duct connectors are recommended for return and supply connections to furnace.
6. If air return grille is located close to the fan inlet, install at least one, 90 degree air turn between fan and inlet grille to reduce noise.

NOTE: To further reduce noise, install acoustical air turning vanes and/or line the inside of duct with acoustical material.

Sizing

Existing or new ductwork **MUST** be sized to handle the correct amount of airflow for either heating only or heating and air conditioning.

Insulation

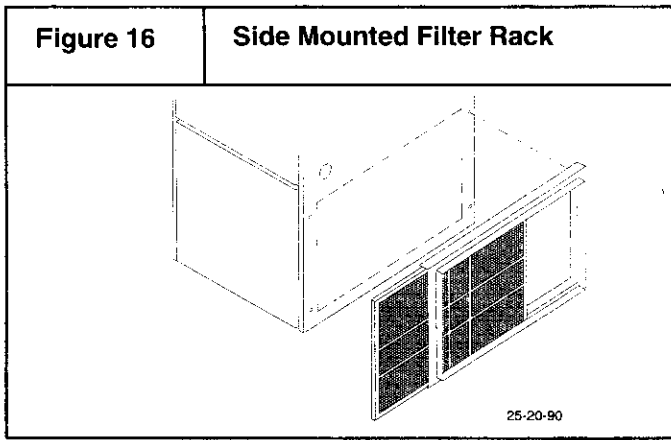
1. Insulate ductwork installed in attics or other areas exposed to outside temperatures with a minimum of 2" insulation and vapor barrier.
2. Insulate ductwork in indoor unconditioned areas with a minimum of 1" insulation with indoor type vapor barrier.

Filters

Use either filter type:

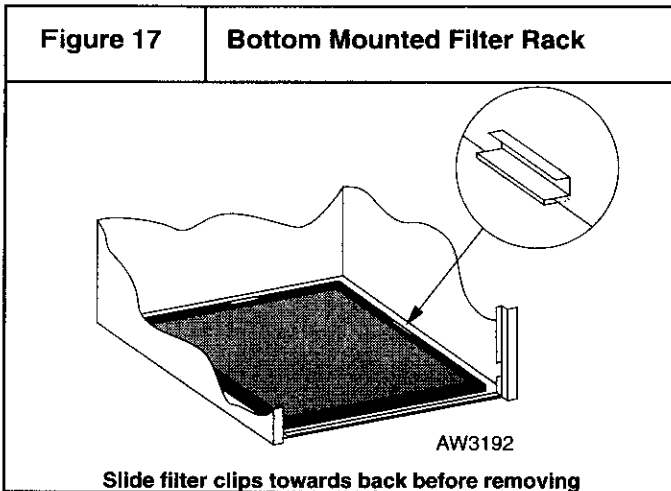
- Washable, high velocity filters are based on a maximum air flow rating of 600 FPM.
- Disposable, low velocity filters are based on a maximum air flow of 300 FPM when used with filter grille.

NOTE: Disposable, low velocity filters may be replaced with washable, high velocity filter providing they meet the minimum size areas. Washable, high velocity filters can be replaced **ONLY** with same type and size.



Filter Installation

When installing or removing a bottom mounted filter, slide the two side filter clips to the back of the furnace **BEFORE** installing or removing. This will allow the filter to clear the front raised edge of the furnace. Insert filter into side clips first and push filter back until it is fully engaged into back clip. When filter is in place, slide clips back into place midway on filter as shown in **Figure 17**.



Refer to **Figure 18** through **Figure 19** for guidelines to install filters. Furnaces which require larger filter media and have limited clearances on one side of furnace, require a standoff filter rack, see **Figure 18**, available from your distributor.

CAUTION

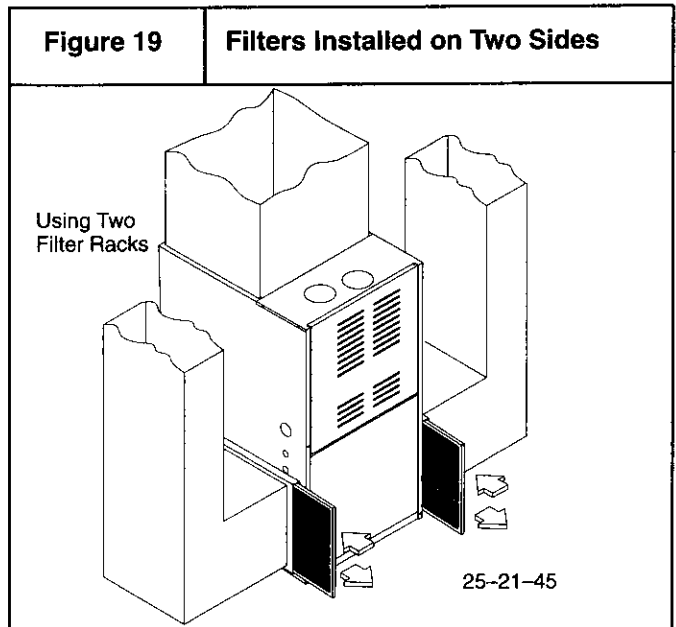
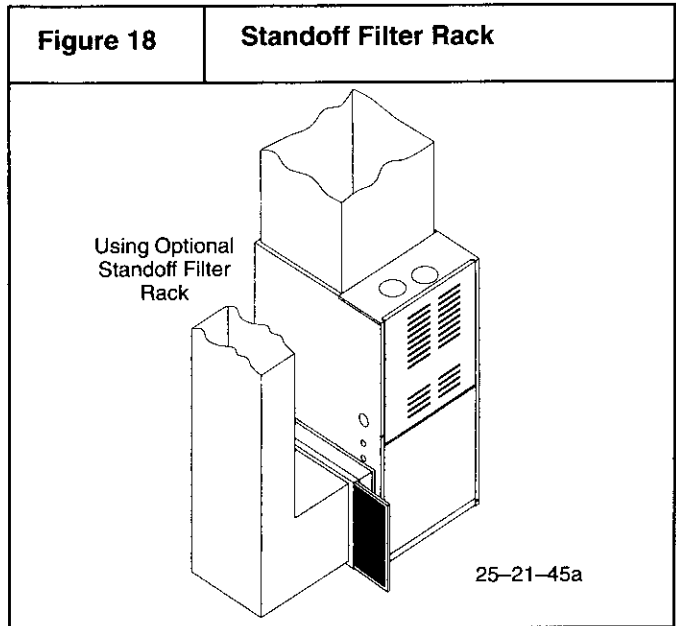
If filters are only suitable for heating application, advise homeowner that filter size may need to be increased if air conditioning is added.

Addition Of Air Conditioning

When a refrigeration coil is used in conjunction with this unit, it must be installed on the discharge side of the unit to avoid condensation on the

heat exchanger. The coil installation instructions must be consulted for proper coil location and installation procedures. With a parallel flow arrangement, dampers must be installed to prevent chilled air from entering the furnace. If manually operated dampers are used, they must be equipped with a means to prevent operation of either unit unless the damper is in full heat or full cool position.

A 3" (75mm) clearance is required on the right side of the furnace in order to run the condensate drain line. Copper, iron or plastic tubing may be used for the condensate drain line.



8. Checks and Adjustments

Startup

NOTE: Refer to Start-up procedures in the user's information manual.

CAUTION

If any sparks, odors or unusual noises occur, immediately shut OFF power to furnace. Check for wiring errors or obstruction to blower.

Main Burner Flame Check

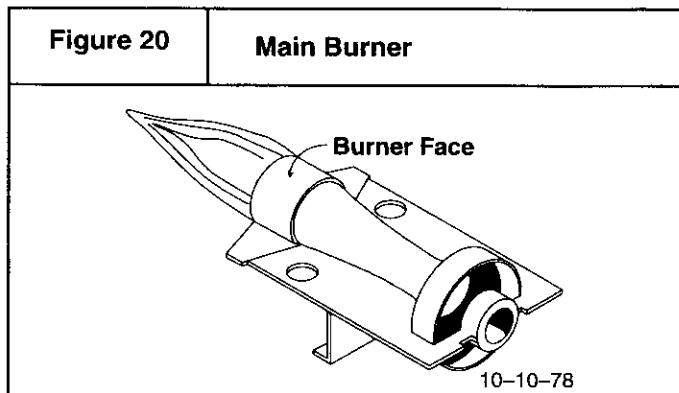
Allow the furnace to run approximately 10 minutes then inspect the main burner and pilot flames. See **Figure 20**.

Check for the following (**Figure 20**):

- Stable and blue flames. Dust may cause orange tips or wisps of yellow, but flames **MUST NOT** have solid, yellow tips.
- Flames extending directly from burner into heat exchanger.

- Flames do **NOT** touch sides of heat exchanger

If any problems with main burner flames are noted, it may be necessary to adjust gas pressures, or check for drafts.



Temperature Rise Check

The blower speed **MUST** be set to give the correct air temperature rise through the furnace as marked on the rating plate. Temperature rise is the difference between supply and return air temperatures.

To check temperature rise, use the following procedure:

1. Place thermometers in supply and return air registers as close to furnace as possible, avoiding direct radiant heat from heat exchangers.
2. Operate furnace continuously for 15 minutes with all registers and duct dampers open.
3. Take reading and compare with range specified on rating plate.
4. If the correct amount of temperature rise is **NOT** obtained, it may be necessary to change blower speed. A higher blower speed will lower the temperature rise. A lower blower speed will increase the temperature rise.

9. Furnace Maintenance

CAUTION

It is recommended that the furnace be inspected and serviced on an annual basis (before the heating season) by a qualified service technician.

See "User's Information Manual".

Changing Blower Speed

WARNING

Electrical shock hazard.

Turn OFF power to furnace before changing speed taps.

Failure to do so can result in personal injury and/or death.

The blower is factory set for heating and cooling. If it is necessary to change speeds, refer to steps below.

1. Refer to *Furnace Wiring Diagram* for location of the heating and cooling speed taps located on the electronic fan control as well as location of unused blower motor speed leads. Use the chart (Table 8) to determine the blower motor speed settings.

Wire Color	Motor Speed
Black	High
Orange*	Med-High
Blue	Medium
Red	Low
* Med-High speed may not be provided on all models.	

2. Change the heat or cool blower motor speed by removing the motor lead from the "Heat" or "Cool" terminal and replace it with the desired motor speed lead from the "Park" location. Connect the wire previously removed from the "Heat" or "Cool" terminal to the vacated "Park" terminal.
3. If the same speed must be used for both heating and cooling, remove the undesired motor speed lead from the "Heat" or "Cool" terminal and connect that lead to the open terminal at "Park" location. Attach a jumper between the "Heat" and "Cool" terminals and the remaining motor speed lead.

A terminal is provided on the electronic fan control located in the circulating blower compartment for operation of the continuous fan option. This connection is intended for the low speed motor tap, and has a lower contact rating (8 amps) than the heat and cool taps. When the low speed blower lead is connected to this terminal, this will provide low speed blower operation whenever the other two speeds (Heat or Cool) are not energized.