

Installation Instructions

NDN5/GDJ Downflow Only Series

SAFETY CONSIDERATIONS

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.

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.

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.

Table of Contents

1. Installation	2	6. Electrical Wiring	11
2. Combustion & Ventilation Air	4	7. Ductwork and Filter	12
3. Gas Vent Installation	6	8. Checks and Adjustments	15
4. Horizontal	7	9. Furnace Maintenance	16
5. Gas Supply and Piping	8		



Manufactured by:

Inter-City Products Corporation (USA)
Lewisburg, TN USA 37091

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. Installation

⚠ 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 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.
- It is the suggestion of this manufacturer to install fire and carbon monoxide detectors.

⚠ WARNING

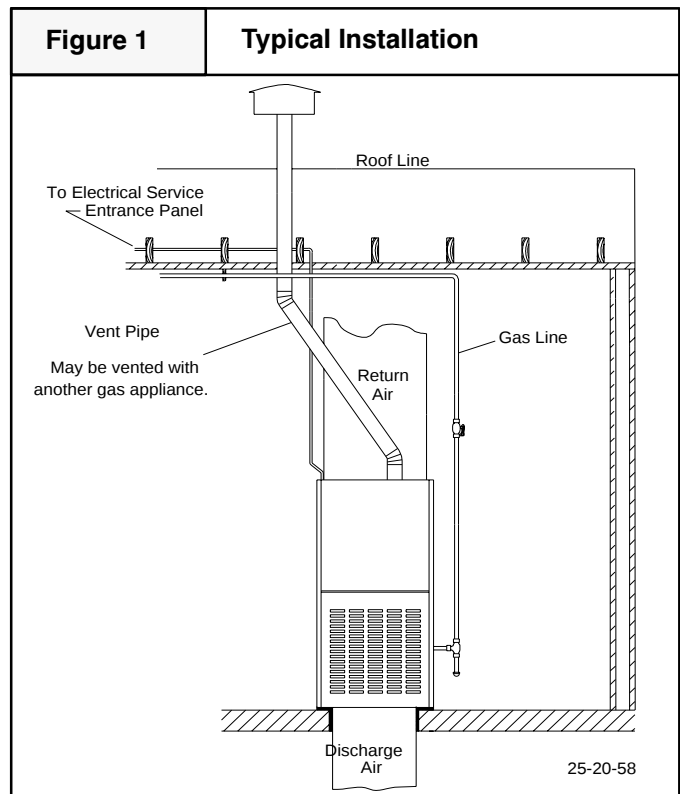
Poison carbon monoxide gas hazard.

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 appliances(s). See applicable codes and *Venting and Combustion Air Check in Gas Vent Installation* section.

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

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.



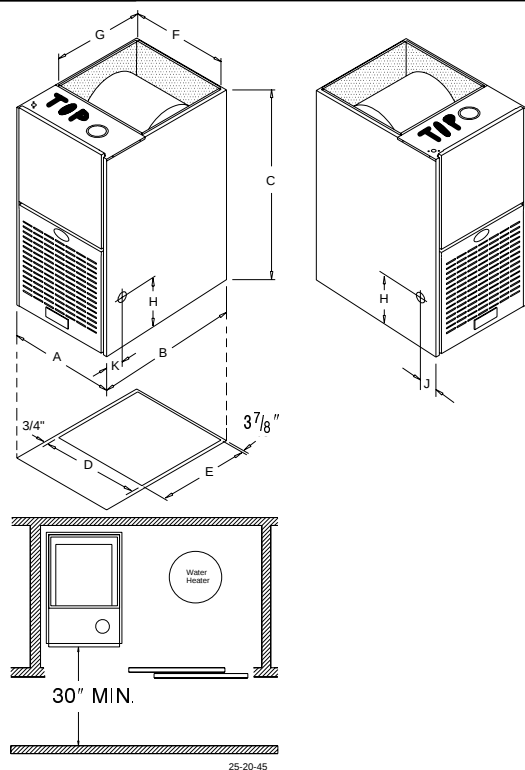
2. If furnace is a replacement, it is usually best to install the furnace where the old one was. Choose the location or evaluate the existing location based upon the minimum clearance and furnace dimensions (**Figure 2**).

CAUTION

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**.

Figure 2

Dimensions and Clearances


**RECOMMENDED CLEARANCES TO
COMBUSTIBLE
MATERIALS FOR ALL UNITS**

REAR	0
FRONT	3" (75mm)
Single Wall Vent	6" (150mm)
Type B-1 Double Wall Vent	3" (75mm)
For Service	30" (760mm)
ALL SIDES OF SUPPLY PLENUM	1" (25mm)
SIDES	0
VENT	
Single Wall Vent	6" (150mm)
Type B-1 Double Wall Vent	1" (25mm)
Thermoplastic Pipe	4" (102mm)
TOP OF FURNACE	6" (150mm)

DIMENSIONAL INFORMATION

MODEL	CABINET			BOTTOM OPENING		RETURN OPENING		GAS CONNECTIONS		
	A	B	C	D	E	F	G	H	J	K
050BF	15 ¹ / ₂	28 ¹ / ₂	40	14	15 ¹ / ₂	14	18 ¹⁷ / ₃₂	9 ¹³ / ₁₆	2 ¹ / ₂	4 ¹¹ / ₁₆
075BF	15 ¹ / ₂	28 ¹ / ₂	40	14	15 ¹ / ₂	14	18 ¹⁷ / ₃₂	9 ¹³ / ₁₆	2 ¹ / ₂	4 ¹¹ / ₁₆
100BH	19 ¹ / ₈	28 ¹ / ₂	40	17 ⁹ / ₁₆	15 ¹ / ₂	17 ⁹ / ₁₆	18 ¹⁷ / ₃₂	9 ¹³ / ₁₆	2 ¹ / ₂	4 ¹¹ / ₁₆
125BK	22 ³ / ₄	28 ¹ / ₂	40	21 ³ / ₁₆	15 ¹ / ₂	21 ³ / ₁₆	18 ¹⁷ / ₃₂	9 ¹³ / ₁₆	2 ¹ / ₂	4 ¹¹ / ₁₆
Equivalents Inches (mm)	15 ¹ / ₂ (394) 19 ¹ / ₈ (486) 22 ³ / ₄ (578)	28 ¹ / ₂ (724)	40 (1016)	14 (356) 17 ⁹ / ₁₆ (446) 21 ³ / ₁₆ (538)	15 ¹ / ₂ (394)	14 (356) 17 ⁹ / ₁₆ (446) 21 ³ / ₁₆ (538)	18 ¹⁷ / ₃₂ (471)	9 ¹³ / ₁₆ (249)	2 ¹ / ₂ (64)	4 ¹¹ / ₁₆ (119)

ALL DIMENSIONS IN INCHES (mm)

Installation Requirements

1. Install furnace level.
2. Install furnace as centralized as practical with respect to the heat distribution system.
3. Install the vent pipes as short as practical. (See **Gas Vent Installation** section).
4. Do **NOT** install furnace directly on combustible floors unless using a special noncombustible subbase. See **Ductwork and Filter** section later in this manual.

⚠ WARNING
Fire Hazard.

Place furnace on noncombustible cement board or sheet metal.

Failure to install unit on noncombustible cement board or sheet metal can result in property damage, personal injury and/or death.

5. Maintain clearance for fire safety and servicing. A front clearance of 30" (760mm) 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.

2. Combustion & Ventilation Air

WARNING

Poison carbon monoxide gas 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.

Furnaces require ventilation openings to provide sufficient air for proper combustion and ventilation of flue gases. All duct or openings for supplying combustion and ventilation air must comply with the gas and electrical codes, or in the absence of local codes, the applicable national codes.

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.

Contaminated Combustion Air

Installations in certain areas or types of structures will increase the exposure to chemicals or Halogens which may harm the furnace. These instances must use only outside air for combustion.

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.

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.

Air Openings and Connecting Ducts

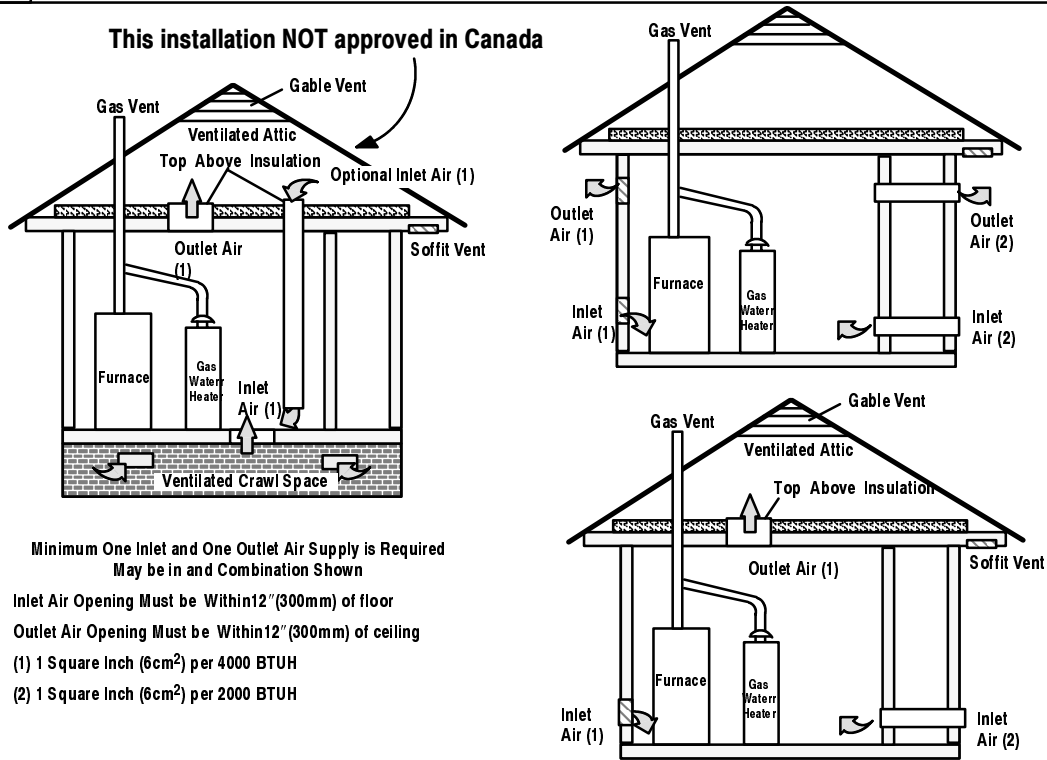
1. Total input rating for all gas appliances **MUST** be considered when determining free area of openings.
2. Connect ducts or openings directly to outside.
3. When screens are used to cover openings, they **MUST** be no less than $\frac{1}{4}$ " (6mm) mesh.
4. The minimum dimension of rectangular air 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.

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 3** illustrates how to provide combustion and ventilation air. A minimum of two permanent openings, one inlet and one outlet, are required.

Figure 3

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



- One opening **MUST** be within 12" (300mm) of the floor and the second opening within 12" (300mm) of the ceiling.
- Size openings and ducts per **Table 1**.
- Horizontal duct openings require 1 square inch (25sq. mm) of free area per 2,000 BTUH of combined input for all gas appliances in area (see **Table 1**).
- Vertical duct openings or openings directly to outside require 1 square inch (6.5mm²) of free area per 4,000 BTUH for combined input of all gas appliances in area (see **Table 1**).

(16 cm) from the front of the appliance. The opening shall directly communicate with the outdoors or shall communicate through a vertical or horizontal duct to the outdoors or spaces (crawl or attic) that freely communicate with the outdoors, and shall have a minimum free area of:

- 1 sq. in per 3000 Btu per hr (7cm² per kW) of the total input rating of all equipment located in the enclosure, and
- Not less than the sum of the areas of all vent connectors in the confined space.

Unconfined Space Installation

⚠ WARNING

Poison carbon monoxide gas 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 Btu total input rating for all gas appliances in area.

Adjoining rooms can be considered part of an unconfined area if there are no doors between rooms.

An attic or crawl space 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

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

EXAMPLE: Determining Free Area

Furnace Water Heater Total Input

100,000 + 30,000 = (130,000 ÷ 4,000) = 210 cm²
(32.5 Sq. In.) Vertical

Furnace Water Heater Total Input

100,000 + 30,000 = (130,000 ÷ 2,000) = 210 cm²
(65 Sq. In.) Horizontal

One permanent opening, commencing within 12" (30 cm) of the top of the enclosure, shall be permitted where the equipment has clearances of at least 1" (2.5 cm) from the sides and back and 6"

least 1 square inch (25mm²) of free area per 4,000 BTUH of total input rating for all gas appliances in area.

In unconfined spaces, infiltration should 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 vapor barrier. Openings are gasketed or sealed and

3. Gas Vent Installation

⚠ WARNING

Poison carbon monoxide gas, 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.

Install the vent in compliance with codes of the country having jurisdiction and the **GAMA** venting tables, local codes or ordinances and these instructions.

These fan assisted combustion furnaces have been classified as Category I appliances which means that they **MUST** operate with a negative vent pressure. Category III classification approval has been obtained for these furnaces **if vented horizontally with a combination single wall metal/high temperature plastic venting system**.

Category I Safe Venting Requirements

NOTE: The following instructions comply with the United States National Fuel Gas Code.

1. If a Category I vent passes through an attic, any concealed space or floor, use **ONLY** Type B or Type L double wall vent pipe. If vent pipe passes through interior wall, use type B vent pipe with ventilated thimble **ONLY**.
2. Do **NOT** vent furnace into any chimney serving an open fireplace or solid fuel burning appliance.
3. Use the same diameter Category I connector or pipe as the furnace minimum vent size as noted on label adjacent to the flue outlet, except as permitted by the **GAMA** venting tables.
4. Keep vertical Category I vent pipe or vent connector runs as short and direct as possible.
5. Vertical outdoor runs of type B or **ANY** single wall vent pipe below the roof line are **NOT** permitted.
6. Slope all horizontal runs upwards away from furnace a minimum of 1/4" (6mm) per foot.
7. Support all horizontal vent pipe every 6' (2m) using proper clamps and metal straps.
8. Check existing gas vent or chimney to ensure they meet clearances and local codes.

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.

9. The furnace **MUST** be connected to a factory built chimney or vent complying with a recognized standard. **Venting into a masonry or concrete chimney is only permitted as outlined in the GAMA venting tables or Masonry Chimney section in these instructions.**
10. All Category I and Category III pipe **MUST** be attached to the factory provided 3" vent pipe where it exits the furnace. Do **NOT** remove the factory installed 3" vent pipe from vent enclosure. At least two (2) holes are recommended to attach pipe firmly. If your furnace came with a section of preinstalled vent pipe, inspect connection to ensure connection is tight and all screws are in place.

⚠ WARNING

Poison carbon monoxide gas hazard.

If this furnace is replacing a previously common-vented furnace, it may be necessary to resize the existing chimney liner or vent to prevent over sizing problems for the other remaining appliances(s). See codes of country having jurisdiction.

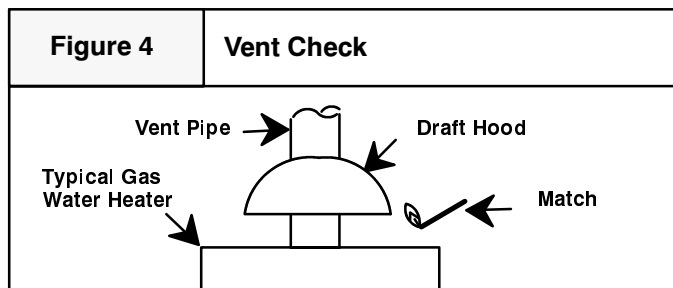
Failure to properly vent this furnace or other appliances can result in property damage, personal injury and/or death.

Venting and Combustion Air Check

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.

- Follow the lighting instructions for each appliance being inspected. Adjust thermostat so appliance(s) will operate continuously.
- 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 4**).



- After it has been determined that each appliance vents properly, return doors, windows, appliances etc. to their normal condition.
- If improper venting is observed, the cause **MUST** be corrected.

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

4. Horizontal Venting

This section of the installation instructions deal with both Category I and Category III installation.

CAUTION

It is the responsibility of the installer to properly terminate the vent and provide adequate shielding. This is essential in order to avoid water/ice damage to building, shrubs and walk-ways.

Category I Furnaces With External Power Venters

In order to maintain a Category I classification of fan assisted furnaces when vented horizontally with sidewall termination, a power venter is **REQUIRED** to maintain a negative pressure in the venting system. Please consult the Fields Controls Co. or Tjernlund Products, Inc. for power venters certified for use with our furnaces.

Category III Furnaces Without External Power Venters

A horizontal vent system with side wall termination **WITHOUT** a power venter **MUST** use a combination single wall metal/high temperature plastic venting system and sealants and be installed as shown in this section. Furnaces using this type of venting system have a Category III classification.

Horizontal Venting With Metal/Plastic Materials

When metal/plastic venting materials are used to horizontally vent an induced draft furnace, positive pressure exists throughout the horizontal vent. Special high temperature plastic pipe and fittings must be used and the furnaces using this method of side wall venting have a Category III classification.

Important Installation Requirements for Category III Venting with Thermoplastic Materials

- Install Only in UNINHABITED Spaces (i.e.: crawl spaces, attics, vent chases, etc.)

Venting to Existing Masonry Chimney

NOTE: The tables and notes referred to below are found in the most recent printing of the **GAMA** venting tables.

Dedicated venting of one fan assisted furnace into any masonry chimney is prohibited. The chimney must first be lined with either type B vent sized in accordance with tables 1 or 2 or a listed single wall, metal lining system, sized in accordance with the following:

Listed, corrugated metallic chimney liner systems in masonry chimneys shall be sized by using **GAMA** tables 1 or 2 for dedicated venting and **GAMA** tables 3 or 4 for common venting with the maximum capacity reduced by 20% (0.80 X maximum capacity) and the minimum capacity as shown in the applicable table. Corrugated metal vent systems installed with bends or offsets require additional reduction of 10% of the vent capacity for each 90° elbow.

NOTE: Two(2) 45° elbows are equivalent to one (1) 90° elbow.

Combined Venting into a Masonry Chimney

Venting into a masonry or concrete chimney is only permitted as outlined in the GAMA venting tables. Follow all safe venting requirements.

NOTE: See section "Masonry Chimney Venting"

- Avoid any installation where leakage of flue products can communicate with indoor living areas.
- Use Only Vent System Pipe & Fittings Constructed of Amoco Radel® A-200 Material from the following manufacturers:
 - Only Ultra Vent® (date code 08/01/93 or later), Plex-vent "II"®, & Selvent®, which are manufactured with Radel A-200®.
- Be Thoroughly Familiar with the Vent Manufacturers Current Instructions.
 - Specific instructions may vary. Use only the installation methods prescribed by the manufacturer of the material you are using in accordance with Inter-City Products restrictions.

⚠ WARNING

Poison carbon monoxide poisoning, fire and explosion hazard.

Approved vent materials listed MUST be used.

Failure to use approved vent materials specified can result in property damage, personal injury and/or death.

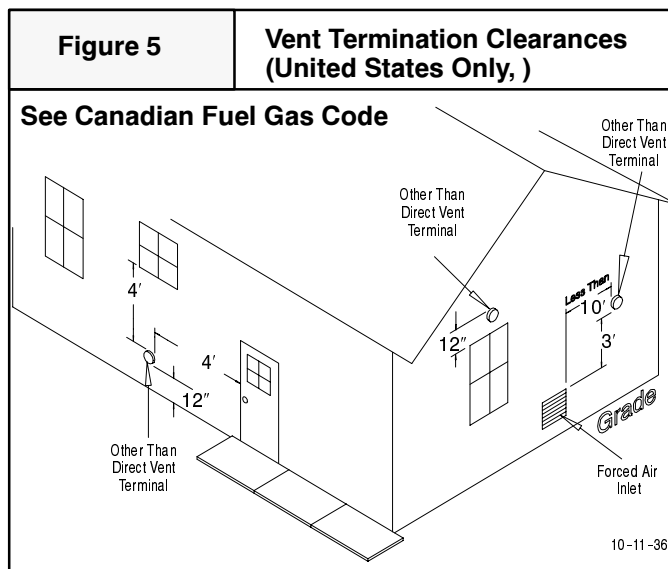
General Safe Venting Requirements

Do **NOT** connect this Category III vent directly into a B-Vent or factory-built chimney nor use this vent for appliances burning wood, coal, or oil or incinerators of any kind.

Do **NOT** insulate vent pipe or fittings.

- 50,000 thru 125,000 BTU input models are approved for use with 3" dia. vent. 150,000 BTU input models require 4" dia. vent.

2. The maximum vent length, regardless of pipe diameter, is 30' (10m) plus a maximum of up to three(3) 90° long radius or "sweep" elbows. If fewer than three elbows are used, maximum vent length is still 30' (10m).
3. A 12" (300mm) minimum to 18" (450mm) maximum section of single wall 26 gauge (.134" [.86mm]) minimum galvanized or stainless steel is required at the vent collar of the furnace prior to connection of the plastic vent pipe. Use 3" diameter for 50,000 through 125,000 Btuh input models and 4" diameter for 150,000 Btuh input models.
4. Minimum of 18" (450mm) vent from the furnace connector is required before the first 90° elbow.
5. Maintain a 4" (102mm) minimum air space to combustibles from all sections of the vent system, except where a wall thimble is used for horizontal venting, or as allowed by local or national codes.
6. A plastic tee vent outlet with screen for vent termination is required to be spaced a distance of 8" from the exterior wall. If possible, the wall through which the vent will pass should not be exposed to the prevailing wind. If this is not possible, steps to protect the vent termination from strong winds should be considered, such as a fence or a hedge.
3. The venting system shall terminate at least 4' (1220mm) below, 4' (1220mm) horizontally from, or 1' (300mm) above any door, window, or gravity air inlet into any building. 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.
4. The vent termination shall terminate at least 3' (914mm) above any forced air inlet located within 10' (3.1m). See **Figure 5**.



Vent Termination

Vent Termination Clearances

1. The vent termination must be located at least 12" (300mm) above ground or normally expected snow accumulation levels.
2. 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.
5. In Canada, the Canadian Fuel Gas Code takes precedence over the preceding termination instructions.

Venting Through a Non-Combustible and Combustible Wall

Please consult Thermoplastic vent manufacturer for proper method of venting through a non-combustible and combustible wall.

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.

Failure to follow these instructions can result in property damage, personal injury and/or death.

Gas Supply Requirements

- Use only the Type of gas approved for this furnace. See rating plate for approved gas type.
- Gas input must not exceed the rated input shown on the rating plate. Overfiring will result in failure of heat exchanger and cause dangerous operation.
- Do not allow minimum supply pressure to vary downward. Doing so will decrease input to furnace. Refer to **Table 2** for Gas supply and manifold pressures.

Table 2		Gas Pressures		
Gas Type	Supply Pressure			Manifold Pressure
	Recommended	Max.	Min.	
Natural	7" (1.7 kPa)	14" (3.5 kPa)	4.5" (1.1 kPa)	3.5" (0.9 kPa)
Propane	11" (2.7 kPa)	14" (3.5 kPa)	11" (2.7 kPa)	10" (2.5 kPa)

Natural Gas Input Rating Check

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 foot. Check with gas supplier for actual BTU content.

1. Turn **OFF** gas supply to all appliances other than furnace and start furnace.
2. Time how many seconds it takes the smallest dial on the gas meter to make one complete revolution. Refer to **Example**.
Note: If meter uses a 2 cubic foot dial divide results (seconds) by two.

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
$1,000 \times 3,600 \div 48 = 75,000 \text{ BTUH}$			

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

Orifice Sizing

NOTE: Factory sized orifices for natural and LP gas are listed in the furnace Technical Support manual.

Ensure furnace is equipped with the correct main burner orifices. Refer to **Table 3** for correct orifice size for a given heating value and specific gravity for natural and propane gas. Note that this chart is **ONLY** for installations *below* 2000' in altitude.

Table 3		Orifice Sizes (below 2000')		
Gas Type	Manifold Pressure	Specific Gravity	Heating Value (BTU per Cubic Ft.)	Orifice Size (Drill #)
Natural	3.5" w.c. 0.9kPa w.c.	0.6	800	40
			900	41
			1000	42
			1100	43
Propane	10" w.c. 2.5kPa w.c.	1.53	2500	54

Operation Above 2000' Altitude

⚠ WARNING

Fire, Explosion, Poison carbon monoxide gas hazard.

This conversion shall be done by a qualified service agency in accordance with the Manufacturer's instructions and all applicable codes and requirements, or in the absence of local codes, the applicable national codes.

Failure to follow these instructions exactly can result in property damage, personal injury and/or death.

These units may be used at full input rating when installed at altitudes up to 2000'. When installed above 2000', the input must be decreased 4% for each 1000' above sea level. This may be accomplished by a simple adjustment of manifold pressure or an orifice change, or a combination of a pressure adjustment and an orifice change. The changes required depend on the installation altitude and the heating value of the fuel. **TABLES 4 & 5** show the proper furnace manifold pressure and gas orifice size to achieve proper performance based on elevation above sea level for both natural gas and propane.

To use the natural gas table, first consult your local gas utility for the heating value of the gas supply. Select the heating value on the vertical border and follow across the table until the appropriate elevation for the installation is reached. The first value in the box at the intersection of the heating value and elevation will be the manifold pressure required. If a gas orifice change is also required, the box is shaded. The required orifice size is shown at the bottom of the table.

Sea Level
High Altitude Input Rate = Nameplate x (Multiplier)
Input Rate

Elevation	High Altitude Multiplier
2000' - 2999'	0.92
3000' - 3999'	0.88
4000' - 4999'	0.84
5000' - 5999'	0.80
6000' - 6999'	0.76
7000' - 8000'	0.72

For installations above 4000', the inlet air restrictor of the combustion air blower **MUST** be changed, whether gas has been derated by the utility or orifices have been changed.

A High Altitude Kit is available which includes restrictors, orifices and installation instructions.

Natural Gas - 1160993

LP Gas - 1160992

MANIFOLD PRESSURE AND ORIFICE SIZE FOR HIGH ALTITUDE APPLICATIONS

Table 4	NATURAL GAS					
MEAN ELEVATION FEET ABOVE SEA LEVEL						
HEATING VALUE BTU/CU. FT.	2000 to 2999	3000 to 3999	4000 to 4999	5000 to 5999	6000 to 6999	7000 to 8000
800	3.5" wc	3.5" wc	3.5" wc	3.5" wc	3.2" wc	2.9" wc
850	3.5" wc	3.5" wc	3.5" wc	3.2" wc	2.9" wc	2.6" wc
900	3.5" wc	3.4" wc	3.1" wc	2.8" wc	2.5" wc	2.3" wc
950	3.3" wc	3.1" wc	2.8" wc	2.5" wc	2.3" wc	3.5" wc
1000	3.0" wc	2.8" wc	2.5" wc	2.3" wc	3.5" wc	3.1" wc
1050	2.7" wc	2.5" wc	2.3" wc	3.5" wc	3.2" wc	2.8" wc
1100	2.5" wc	2.3" wc	3.5" wc	3.2" wc	2.9" wc	2.6" wc
Orifice Size	#42	#42	#45	#45	#45	#45

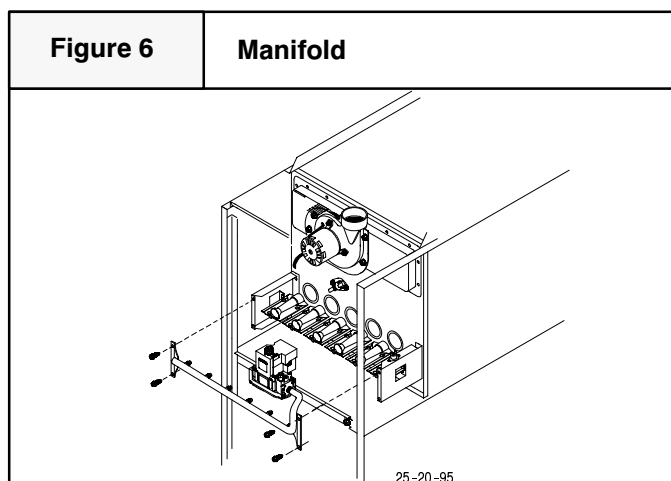
SHADED AREA REQUIRES ORIFICE CHANGE. NO SHADING INDICATES MANIFOLD PRESSURE CHANGE ONLY.

Table 5	PROPANE						
MEAN ELEVATION FEET ABOVE SEA LEVEL							
HEATING VALUE BTU/CU. FT.	0 to 1999	2000 to 2999	3000 to 3999	4000 to 4999	5000 to 5999	6000 to 6999	7000 to 8000
2500	10.0" wc	10.0" wc	9.4" wc	10.0" wc	9.8" wc	8.8" wc	7.9" wc
Orifice Size	#54	#54	#54	#55	#55	#55	#55

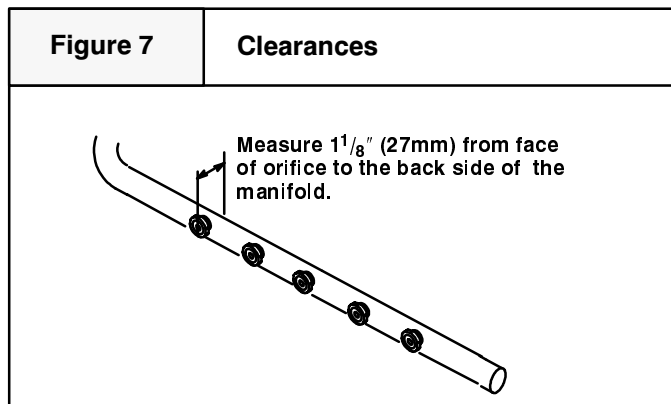
NOTE: NATURAL GAS DATA BASED ON 0.60 SPECIFIC GRAVITY. PROPANE DATA BASED ON 1.53 SPECIFIC GRAVITY. FOR FUELS WITH DIFFERENT SPECIFIC GRAVITY CONSULT THE LATEST EDITION OF THE NATIONAL FUEL GAS CODE ANSI Z223.1 and CAN B149.

Changing Orifices

1. After disconnecting power and gas supply to the furnace, remove the access door, exposing gas valve and burner compartment.
2. Disconnect gas line, pilot tubing from gas valve so manifold can be removed.
3. Disconnect wiring at gas valve. Be sure to note the proper location of any and all electrical wiring disconnected.
4. Replace the four (4) screws holding the manifold and gas valve to the manifold supports. Do not discard any screws. See **Figure 6**.



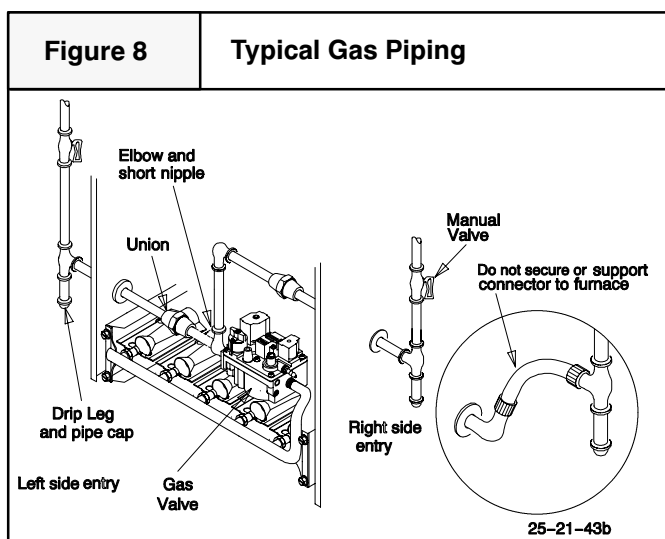
5. Carefully remove the manifold assembly.
6. Remove the orifices from the manifold and replace them with proper sized orifices.



7. Tighten orifices so there is 1 1/8" from the face of the orifice to the back side of the manifold. See **Figure 7**.
8. Reassemble all parts in reverse order as removed. Be sure to engage the main burner orifices in the proper opening in the burners.
9. After reassembling, turn gas on and check all joints for gas leaks using a soapy solution. All leaks must be repaired immediately.

Gas Piping Requirements

1. Install gas piping in accordance with local codes, or in the absence of local codes, the applicable national codes.
2. It is recommended that a manual shutoff valve be installed in the gas supply line outside the unit. Locate valve as close to the furnace as possible where it is readily accessible. Refer to **Figure 8**.



3. Use black iron or steel pipe and fittings or other pipe approved by local code.
4. Use pipe thread compound which is resistant to natural and LP gases.
5. Install a drip leg no less than 3" long to trap dirt and moisture before it can enter gas valve.
6. Provide a 1/8" plug for test gauge connection immediately up stream of gas supply connection to furnace.
7. Use two pipe wrenches when making connections to prevent gas valve from turning.
8. Flexible corrugated metal gas connector may **NOT** be used inside the furnace or be secured or supported by the furnace or ductwork.
9. Properly size gas pipe to handle combined appliance load or run gas pipe directly from gas meter or LP gas regulator.
10. Install correct pipe size for run length and furnace rating.
11. Measure pipe length from gas meter or LP second stage regulator.

WARNING

Fire or explosion hazard.

Gas connector must be properly installed, cannot go through the side of the furnace, and can not be used inside the furnace.

Failure to properly install gas connector can result in property damage, bodily injury and/or death.

Additional LP Piping Requirements

- Have a licensed LP gas dealer make all connections at storage tank and check all connections from tank to furnace.
- If copper tubing is used, it **MUST** comply with limitation set in Local Codes, or in the absence of local codes, the gas codes of the country having jurisdiction.
- Two-stage regulation of LP gas is recommended.

Final Check

- Test all pipe for leaks.
- If orifices were changed, make sure they are checked for leaks.

6. Electrical Wiring

Power Supply Wiring

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

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

Low voltage connections to furnace must be made on terminal board to fan control.

- During pressure testing of gas piping system, observe the following:
 - a. If test pressure does not exceed $\frac{1}{2}$ PSIG, isolate the furnace by closing its individual manual shutoff valve.
 - b. If test pressure exceeds $\frac{1}{2}$ PSIG, the furnace and its individual shutoff valve must be disconnected from the gas supply system.
- To check for leaks apply soap suds or a liquid detergent to each joint. Bubbles forming indicate a leak.
- Do not use an open flame to test for gas leaks. Fire or explosion could occur.
- Correct even the smallest leak at once.

WARNING

Fire or explosion hazard.

Liquid petroleum (LP) gas is heavier than air and will settle and remain in low areas and open depressions.

Thoroughly ventilate area and dissipate gas. Do NOT use a match or open flame to test for leaks, or attempt to start up furnace before thoroughly ventilating area.

An open flame or spark can result in property damage, personal injury and/or death.

Set thermostat heat anticipator in accordance with the *Technical Support Manual*.

Optional Equipment

All wiring from furnace to optional equipment **MUST** conform to local codes or, in the absence of local codes, the applicable national codes. Install wiring in accordance with manufacturer's instructions.

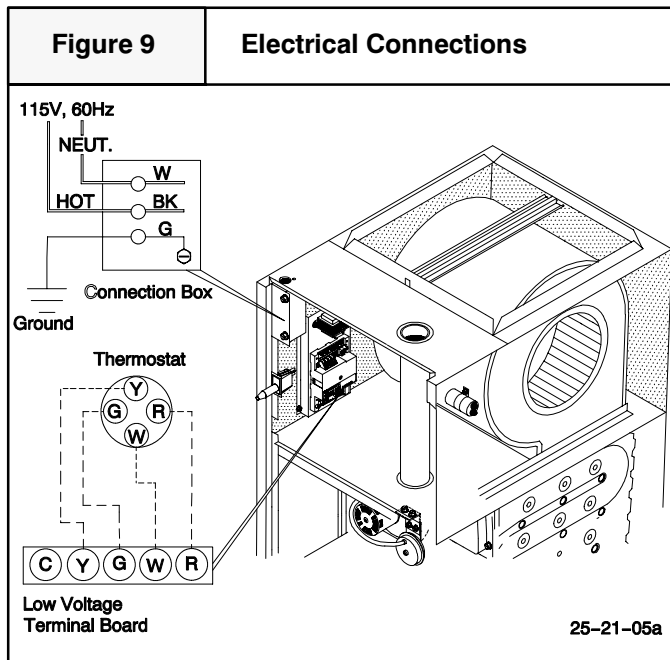
Humidifier/Electronic Air Cleaner

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

CAUTION

Do NOT exceed 115V/0.8 amp maximum current load for both the EAC terminal and the HUM terminal combined.

NOTE: The humidifier will be powered when the furnace is fired and the circulating air blower comes on. The electronic air cleaner will be powered anytime the thermostat calls for air movement. However, the electronic air cleaner is **NOT** energized during continuous fan operation controlled by the electronic fan control.



7. Ductwork and Filter

Subbase for Combustible Floors - Furnace Only

The Subbase for Combustible Floors **MUST** be used when a downflow furnace is set on combustible material even when the furnace is installed on a coil box.

NOTE: Supply opening is $3\frac{7}{8}$ " from the rear of the furnace. Therefore maintain a $3\frac{7}{8}$ " clearance from wall (where applicable).

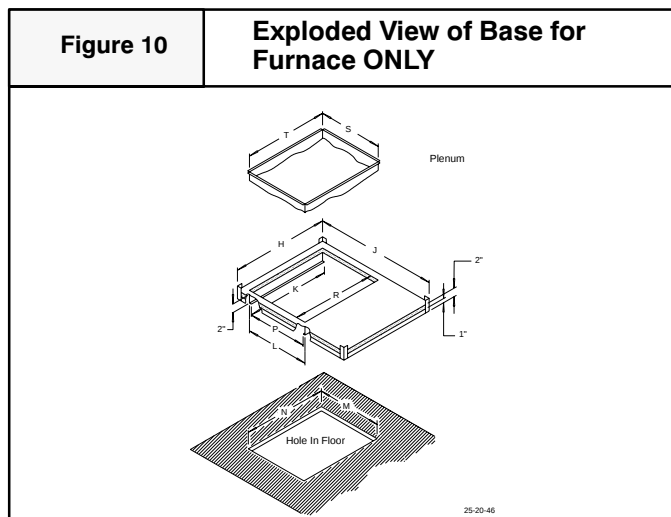
since the base is equipped with locating tabs that center the base over the opening.

The opening in the base is $1\frac{1}{4}$ " (32mm) shorter and $1\frac{1}{8}$ " (29mm) narrower than the recommended size of the opening in the floor. This is done to maintain a 1" clearance between the floor and the plenum.

1. Cut the opening in the floor according to **Table 6**. The hole in the floor must be cut to the dimensions listed in **Table 6**
2. Fabricate the plenum to the dimensions given in **Table 6**. Note that the dimensions given are outside dimensions.

Table 6 Subbases for Combustible Floors Dimensions										
Subbase for Combustible Floors Part Number	Subbase for Combustible Floor Dimensions				Opening In Floor		Opening In Base For Plenum		Typical Plenum Dimensions	
	H ¹	J ¹	K ²	L	M	N	P	R	S	T
(Furnace Only)										
NAHH001SB	$15\frac{11}{16}$	$28\frac{3}{4}$	$14\frac{9}{16}$	16	$16\frac{1}{4}$	$14\frac{5}{8}$	15	$13\frac{1}{2}$	15	$13\frac{1}{2}$
NAHH002SB	$19\frac{5}{16}$	$28\frac{3}{4}$	$18\frac{3}{16}$	16	$16\frac{1}{4}$	$18\frac{1}{4}$	15	$17\frac{1}{8}$	15	$17\frac{1}{8}$
NAHH003SB	$22\frac{15}{16}$	$28\frac{3}{4}$	$21\frac{13}{16}$	16	$16\frac{1}{4}$	$21\frac{7}{8}$	15	$19\frac{3}{4}$	15	$19\frac{3}{4}$
Subbase for Coil Box										
NAHH004SB	$15\frac{11}{16}$	$20\frac{9}{16}$	$14\frac{9}{16}$	16	$16\frac{1}{4}$	$14\frac{5}{8}$	15	$13\frac{1}{2}$	15	$13\frac{1}{2}$
NAHH005SB	$19\frac{5}{16}$	$20\frac{9}{16}$	$18\frac{3}{16}$	16	$16\frac{1}{4}$	$18\frac{1}{4}$	15	$17\frac{1}{8}$	15	$17\frac{1}{8}$
NAHH006SB	$22\frac{15}{16}$	$20\frac{9}{16}$	$21\frac{13}{16}$	16	$16\frac{1}{4}$	$21\frac{7}{8}$	15	$19\frac{3}{4}$	15	$19\frac{3}{4}$
Equivalents in mm	$15\frac{11}{16} = 398$ $19\frac{5}{16} = 491$ $22\frac{15}{16} = 583$	$28\frac{3}{4} = 730$ $20\frac{9}{16} = 522$	$14\frac{9}{16} = 370$ $18\frac{3}{16} = 462$ $21\frac{13}{16} = 554$	16 = 406	$16\frac{1}{4} = 412$	$14\frac{5}{8} = 371$ $18\frac{1}{4} = 464$ $21\frac{7}{8} = 556$	15 = 381	$13\frac{1}{2} = 343$ $17\frac{1}{8} = 435$ $19\frac{3}{4} = 502$	15 = 381	$13\frac{1}{2} = 343$ $17\frac{1}{8} = 435$ $19\frac{3}{4} = 502$
¹ Outside Dimension ² Base Spacer Side To Side										

- Set the base over the opening in the floor, centering the opening in the base over the opening in the floor. Fasten the base to the floor with screws or nails. See **Figure 10** and **Figure 12**.



- Drop the plenum through the opening in the base. The flange of the plenum should rest on top of the combustible floor base.

Subbase for Combustible Floors- Downflow Coil Box

The Subbase for Combustible Floors **MUST** be used when a downflow furnace, **used with a downflow coil box**, is set on combustible flooring.

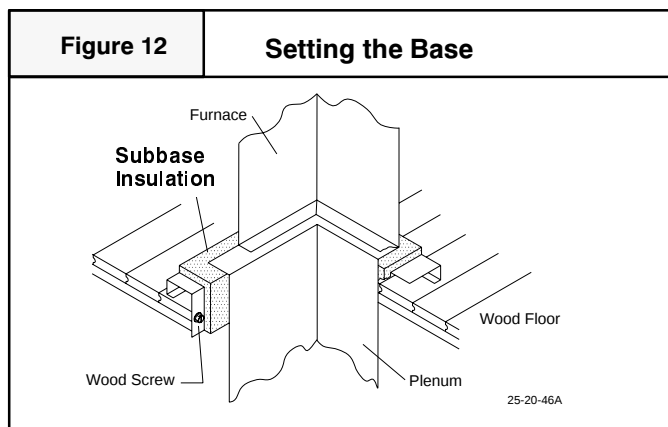
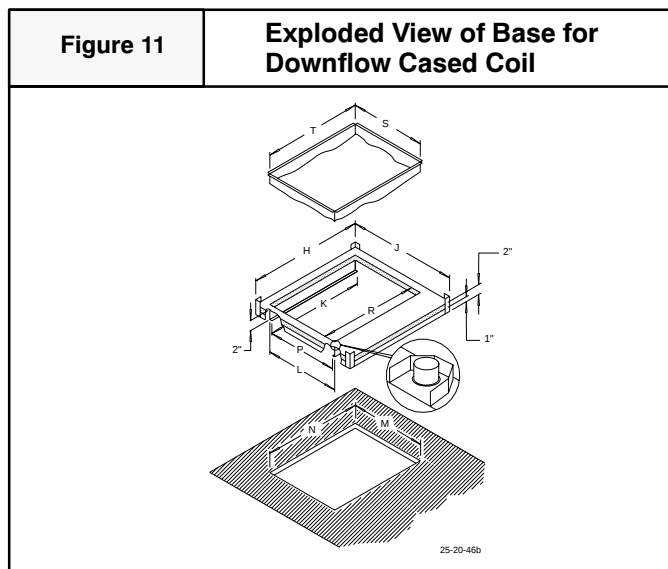
NOTE: Supply opening is $3\frac{7}{8}$ " from the rear of the furnace. Therefore maintain a $3\frac{7}{8}$ " clearance from wall (where applicable).

- Cut the opening in the floor according to **Table 6**. The hole in the floor must be cut to the dimensions listed in **Table 6** since the base is equipped with locating tabs that center the base over the opening.

The opening in the base is $1\frac{1}{4}$ " (32mm) shorter and $1\frac{1}{8}$ " (29mm) narrower than the recommended size of the opening in the floor. This is done to provide a 1" clearance between the floor and the plenum.

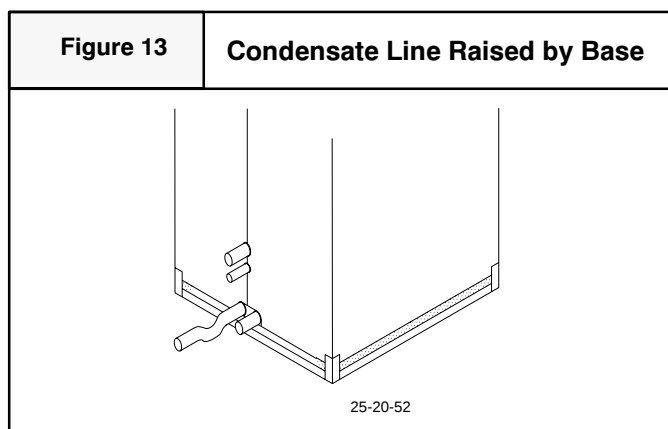
- Fabricate the plenum to the dimensions given in **Table 6**. Note that the dimensions given are outside dimensions.
- Set the base over the opening in the floor, centering the opening in the base over the opening in the floor. Fasten the base to the floor with screws or nails. See **Figure 11** and **Figure 12**.
- Drop the plenum through the opening in the base. The flange of the plenum should rest on top of the combustible floor base.

This subbase for combustible floors has been designed so that the height of the subbase raises the downflow coil off the floor to allow easy installation of the condensate drain. See **Figure 13**.



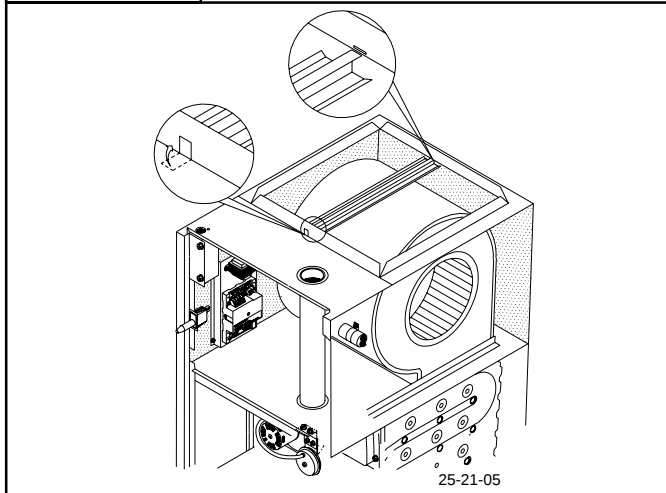
Non-Combustible Floor:

Set the furnace over the opening in the floor. If necessary, grout around the base to seal air leaks between the base and the floor.



Filters:

The filters supplied with the furnace may be installed in the return air plenum above the furnace. A filter rack is supplied with each furnace. See **Figure 14**.

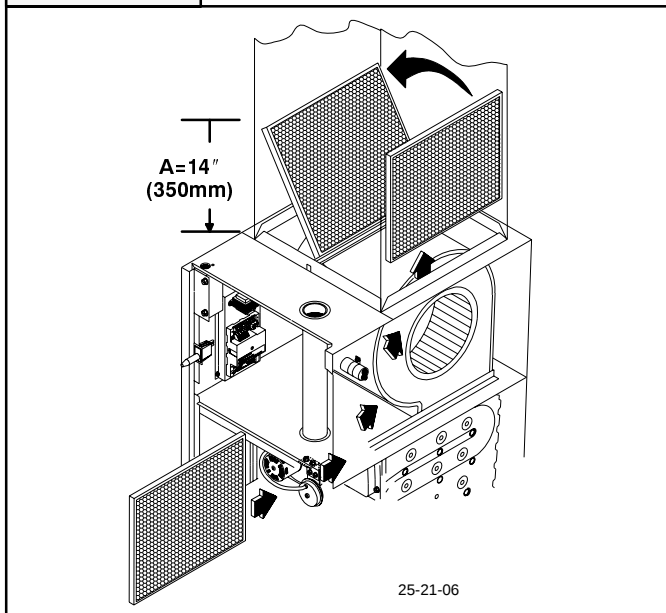
Figure 14**Filter Rack Installation**

NOTE: The return air plenum **MUST** extend a sufficient height above dimension "A" (**Figure 15**) to provide for the attachment of a return air duct or grille above the filters.

1. Insert end of filter rack with $\frac{3}{4}$ " (19mm) flange into slot in the back of the unit. See **Figure 15**.
2. With filter rack pushed back, insert front end with $\frac{1}{4}$ " (6mm) flange into position and push into front slot. With filter rack pushed as far forward as it will go, bend $\frac{1}{4}$ " (6mm) flange and $\frac{3}{4}$ " (19mm) flange up 90 degrees. See **Figure 15**.

NOTE: Plenum must be fitted as close to the return air flange of the unit as possible to eliminate any air bypassing the filters.

3. Filters can only be installed through the right hand side of the unit blower opening. Slide filter into unit until it is in position to be pushed up and over into place on the left hand side of unit. See **Figure 16**.
4. Slide remaining filter into unit and up into place on left hand side of unit. See **Figure 16**.

Figure 15**Filter Installation**

If there is insufficient plenum height for this type of installation, filters may be installed in any accessible location in the return air system. In such a case, the filters should be of equivalent size and style as originally supplied with the furnace.

Filter Removal

1. Remove compartment door.
2. Reach up above right side of blower and lift dirty filters out of rack at top of furnace.
3. Straighten up filters and pull straight down at side of blower. Pull out through right door opening.
4. Vacuum clean or wash with warm water and dry thoroughly before replacing.

Filters

NOTE: The furnace is provided with high velocity type filter(s). The size, quantity, and type of filter supplied with the furnace will handle the airflow required if central air conditioning is used with the furnace.

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.

Gas Supply Pressure

Gas supply pressure should be within minimum and maximum values listed on rating plate. Pressures are usually set by gas suppliers.

Manifold Gas Pressure Adjustment

NOTE: Make adjustment to manifold pressure with burners operating.

⚠ WARNING

Fire or explosion hazard.

Turn OFF gas at shut off before connecting U-tube manometer.

Failure to turn OFF gas at shut off before connecting U-tube manometer can result in personal injury and/or death.

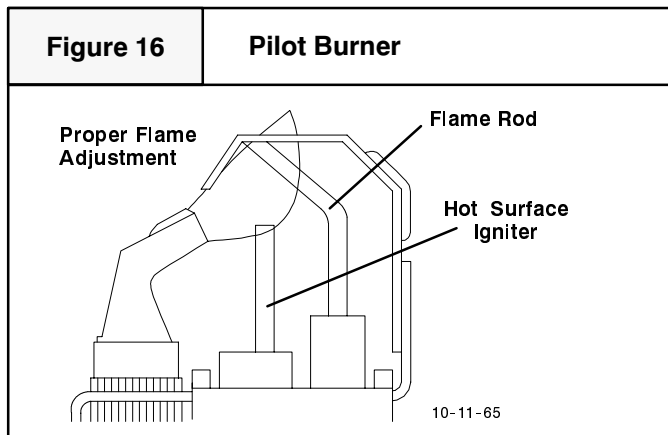
1. With gas **OFF**, Connect U-Tube manometer to tapped opening on gas valve. Use manometer with a 0 to min. 12" water column range.
2. Turn gas **ON** and remove adjustment screw cover on gas valve. Turn counterclockwise to decrease pressure and clockwise to increase.

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

3. For altitudes up to 2000', set pressure to value shown in **Table 2**, $\pm 0.3"$ (8mm) water column. For altitudes of 2000' to 8000', see Section 5 "Gas Supply & Piping" for correct pressure valve.

Adjust Pilot Burner

The furnace has a pilot flame to light the main burner. The flame should surround $\frac{3}{8}"$ to $\frac{1}{2}"$ of the thermocouple. See **Figure 16**. To adjust, remove cap from pilot adjusting screw on gas valve. Turn screw counterclockwise to increase or clockwise to decrease flame as required. Replace cap for adjusting screw.



Main Burner Flame Check

Allow the furnace to run approximately 10 minutes then inspect the main burner and pilot flames. See **Figure 17**.

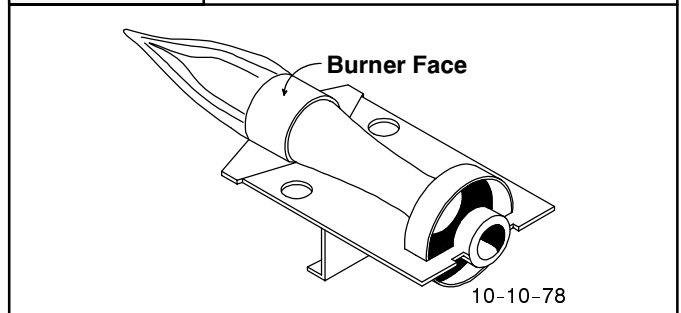
Check for the following (**Figure 17**):

- 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.

Figure 17

Main Burner



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.

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.

NOTE: The speed taps that the manufacture sets from the factory for this product are based on a nominal 400 CFM per ton cooling and the basic mid range on the temperature rise for heating.

Since the manufacturer cannot establish the static pressure that will be applied to the unit, it is the responsibility of the installer dealer/contractor to select the proper speed taps for the application when the unit is installed.

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 7**) to determine the blower motor speed settings.

Table 7	Blower Speed Chart
Wire Color	Motor Speed
Black	High
Orange*	Med-High
Blue	Medium
Red	Low
* Med-High speed may not be provided on all models.	

- 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 “**Unused Motor Lead**” location. Connect the wire previously removed from the “**Heat**” or “**Cool**” terminal to the vacated “**Unused Motor Lead**” terminal.
- 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 “**Unused Motor Lead**” location. Attach a jumper between the “**Heat**” and “**Cool**” terminals and the remaining motor speed lead.

Note: For motors with (4) speed leads, it will be necessary to tape off the terminal of the motor speed lead removed from the “**Heat**” or “**Cool**” terminal with electrical tape since an open terminal will not be available at the “**Unused Motor Lead**” location.

Continuous Fan Operation

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.

Thoroughly check the system after modification to ensure the proper operation of the circulating air blower in all modes of operation.

Separate speed selections for Heat, Cool, and Continuous Fan

Connect low speed lead from circulating motor to the “**Cont**” terminal at the electronic fan control. The appropriate motor leads should already be connected to the “**Heat**” and “**Cool**” terminals.

Heating and Continuous Blower Speed the Same

If it is necessary to operate the heating speed and continuous blower speed using the same blower speed, connect a jumper between the “**Heat**” and “**Cont**” terminals on the electronic fan control.

Note: There should be only **ONE** motor lead going to the “**Heat**” and “**Cont**” terminals.

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*”.

Pressure Switch

During regular yearly maintenance check for cracks in any tubes on the pressure switch.