INSTALLATION INSTRUCTION

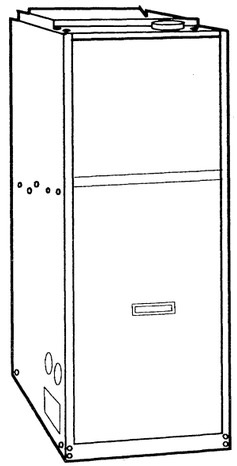
GAS-FIRED FURNACES CONDENSING HIGH-EFFICIENCY DOWNFLOW MODELS

Supersedes: Nothing

650.75-N5W (298)

035-14310

MODELS: PBLD, 40 THRU 120 MBH INPUT
NATURAL GAS



DOWNFLOW MODELS
CATEGORY IV/DUAL CERTIFIED
DIRECT VENT TYPE FSP
AND 1-PIPE VENT

FOR YOUR SAFETY

WHAT TO DO IF YOU SMELL GAS

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

FOR YOUR SAFETY

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

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

SHU 5M 298 1.32 Codes: SBF, L 650.75-N5W

Unitary Products Group | **745 Industrial Parkway West** | **Elyria OH 44035**

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GENERAL INFORMATION

DESCRIPTION

This Category IV, dual certified, direct vent and 1-pipe vent furnace is designed for residential or commercial installation in a basement, closet, recreation room, garage or other location provided space temperature is 32°F or higher.

INSPECTION

As soon as a unit is received, it should be inspected for possible damage during transit. If damage is evident, the extent of the damage should be noted on the carrier's freight bill. A separate request for inspection by the carrier's agent should be made in writing. Also, before installation the unit should be checked for screws or bolts which may have loosened in transit. There are no shipping or spacer brackets which need to be removed.

NOTES, CAUTIONS, & WARNINGS

The installer should pay particular attention to the words:

NOTE, CAUTION and **WARNING. NOTES** are intended to clarify or make the installation easier. **CAUTIONS** are given to prevent equipment damage. **WARNINGS** are given to alert the installer that personal injury and/or equipment or property damage may occur if installation procedures are not handled properly.

⚠ ***CAUTION:*** *The cooling coil must be installed in the supply air duct, downstream of the furnace. This is under the furnace in a downflow application.*

The furnace room must not be used as a broom closet or for any other storage purposes as a fire hazard may be created. Never store items such as the following on, near, or in contract with the furnace.

1. Spray or aerosol cans, rags, brooms, dust mops, vacuum cleaners or other cleaning tools.
2. Soap powders, bleaches, waxes or other cleaning compounds; plastic items or containers; gasoline, kerosene, cigarette lighter fluid; dry-cleaning fluids or other volatile fluid.
3. Paint thinners and other painting compounds.
4. Paper bags or other paper products.

⚠ ***WARNING:*** *Never operate the furnace with the blower door removed. To do so could result in serious personal injury and/or equipment damage.*

⚠ ***WARNING:*** *This furnace may not be common vented with any other appliance, since it requires separate, properly-sized air intake and vent lines. The furnace shall not be connected to any type of B, BW or L vent or vent connector, and not connected to any portion of a factory-built or masonry chimney.*

VENT SAFETY CHECK PROCEDURE

If this furnace is replacing a common-vented furnace, it may be necessary to resize the existing vent line and chimney to prevent oversizing problems for the new combination of units. Refer to the National Gas Code (ANSI Z223.1-) or CANI-B149.1 or .2 Installation Code (latest editions).

The following steps shall be followed with each appliance connected to the venting system placed in operation, while any other appliances connected to the venting system are not in operation:

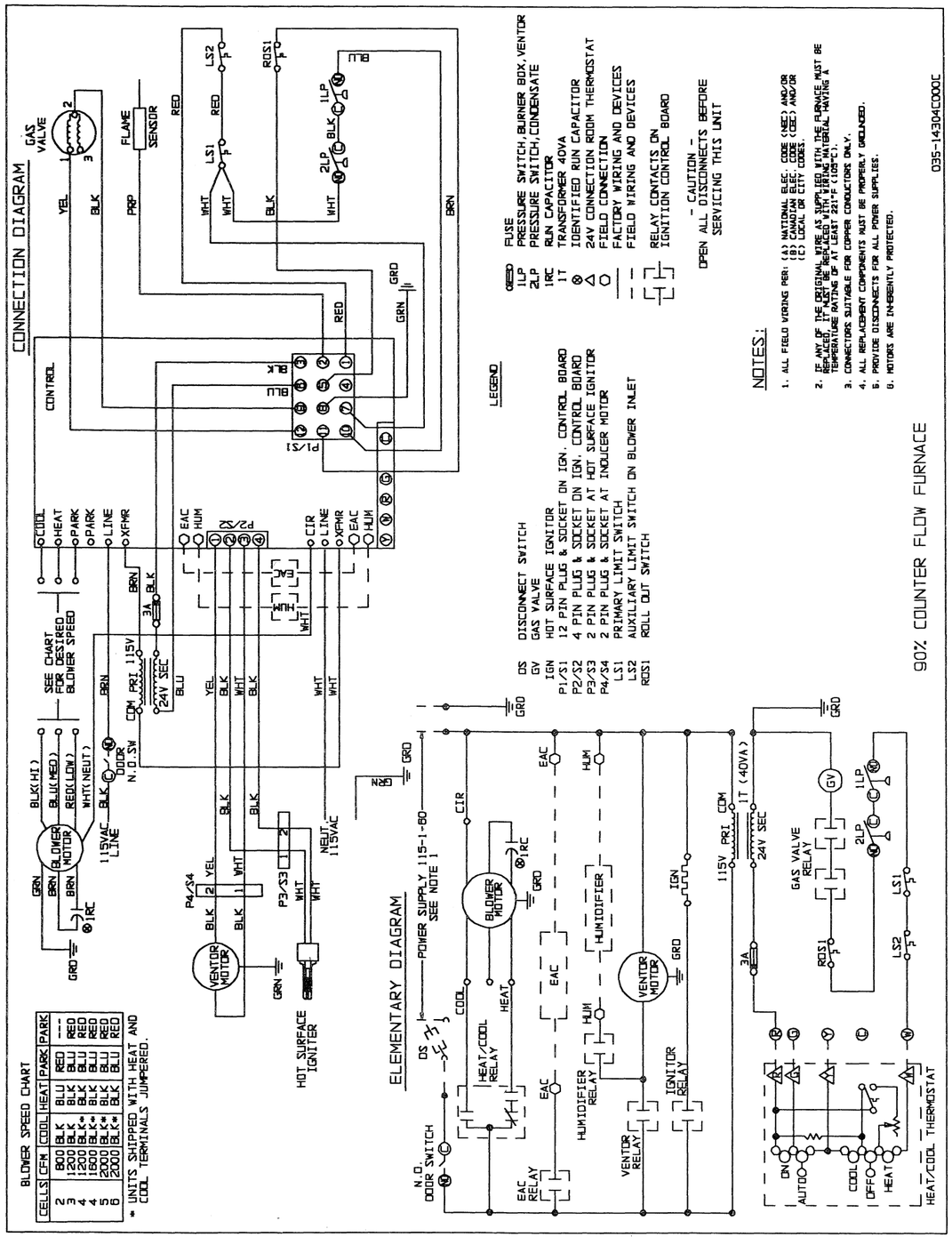
1. Seal any unused openings in the venting system.
2. Inspect the venting system for proper size and horizontal pitch, as required in the National Fuel Gas Code, ANSI Z223.1, or the CAN/CGA B149 Installation Codes and these instructions. Determine that there is no blockage or restriction, leakage, corrosion or other deficiencies which could cause an unsafe condition.
3. Insofar as is practical, close all building doors and windows and all doors between the space in which the appliance(s) is located and other spaces of the building. Turn on clothes dryers. Turn on any exhaust fans, such as range

AIRFLOW DATA

MODEL	SPEED TAP	EXTERNAL STATIC PRESSURE, INCHES WC									
		0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
PBLDALD08N040	HI	1182	1164	1136	1101	1063	1018	967	904	824	724
	MED	954	938	919	899	876	838	798	744	686	588
	LOW	650	643	634	620	602	577	542	494	440	335
PBLDBLD12N060	HI	1567	1552	1532	1517	1484	1441	1384	1315	1243	1166
	MED	1175	1173	1169	1159	1144	1126	1089	1039	985	910
	LOW	881	879	871	861	842	826	795	756	724	664
PBLDBLD12N080	HI	1603	1579	1558	1522	1485	1433	1380	1311	1233	1139
	MED	1250	1230	1210	1190	1160	1125	1083	1029	955	889
	LOW	925	904	891	873	845	829	793	761	685	618
PBLDCLD16N080	HI	2024	1960	1911	1855	1780	1698	1627	1540	1458	1387
	MED	1479	1471	1465	1452	1429	1393	1359	1300	1238	1163
	LOW	—	—	1210	1208	1198	1175	1149	1110	1052	982
PBLDCLD20N100	HI	2272	2200	2128	2061	1984	1890	1810	1710	1627	1519
	MED	1980	1933	1887	1838	1769	1701	1626	1535	1426	1328
	LOW	1573	1546	1526	1498	1464	1417	1359	1290	1222	1132
PBLDDLD20N120	HI	2281	2215	2144	2065	2002	1903	1820	1720	1618	1505
	MED	1945	1902	1849	1794	1738	1675	1604	1535	1426	1343
	LOW	1507	1485	1463	1433	1398	1358	1305	1249	1172	1095

Airflow expressed in standard cubic feet per minute.
NOTES: 1. Air filter installed. All filters must be high velocity, cleanable type.
2. Motor voltage at 115 V.

UNIT WIRING DIAGRAM



hoods and bathroom exhausts, so they shall operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.

4. Follow the lighting instructions. Place the appliance being inspected in operation. Adjust thermostat so the appliance shall operate continuously.
5. Test for draft hood equipped appliance spillage at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle.
6. After it has been determined that each appliance connected to the venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas burning appliance to their previous conditions of use.
7. If improper venting is observed during any of the above tests, the venting system must be corrected.
8. Any corrections to the common venting system must be in accordance with the National Fuel Gas Code Z223.1 or CAN1-B149.1 or .2 Installation Code (latest editions). If the common vent system must be resized, it should be resized to approach the minimum size as determined using the appropriate tables in Appendix G of the above codes.

SPECIFIC UNIT INFORMATION

NOMENCLATURE

P B LD A L D08 N 040

- 040 = Nominal Input 040 = 40 MBH
- N = Type Heat, N = Natural Gas
- D08 = Type Drive & CFM
  - D = Direct
  - 08 = 800 CFM
- L = Voltage Code
  - L = 115-1-60
- A = Cabinet Width
  - A = 14-1/2, B = 17-1/2
  - C = 21, D = 24-1/2
- LD = Product Identifier
  - LD = Downflow, (90+ AFUE)
- B = Product Generation
- P = Product Category
  - P = Furnace

LIMITATIONS & LOCATION

This furnace should be installed in accordance with all national and local building/safety codes and requirements, or in the absence of local codes, with the National Fuel Gas Code ANSI Z223.1 or CAN1-B149.1 or .2 Installation Code (latest editions), local plumbing or waste water codes, and other applicable codes.

A manufactured (mobile) home installation must conform with the Manufactured Home Construction and Safety Standard, Title 24 CFR, Part 3280, or when this standard is not applicable, the Standard for Manufactured Home Installations (Manufactured Home Sites, Communities and Set-Ups), ANSI A225.1, and/or CAN/CSA-Z240 MH Series, Mobile Homes.

CLEARANCES FOR ACCESS

Ample clearances should be provided to permit easy access to the unit. The following minimum clearances are recommended:

1. Twenty-four (24) inches between the front of the furnace and an adjacent wall or another appliance, when access is required for servicing and cleaning.
2. Eighteen (18) inches at the side where access is required for passage to the front when servicing or for inspection or replacement of flue/vent connections.

NOTE: *In all cases, accessibility clearances shall take precedence over clearances for combustible materials where accessibility clearances are greater.*

CAUTION: *Do not install the furnace in an unconditioned space or garage that could experience ambient temperatures of 32°F (0°C) or lower.*

CAUTION: *The furnace is not to be used for temporary heating of buildings or structures under construction.*

CAUTION: *This unit must be installed in a level (1/4") position side-to-side and front-to-back to provide proper condensate drainage.*

CAUTION: *Do not allow return air temperature to be below 55°F for extended periods. To do so may cause condensation to occur in the main fired heat exchanger.*

WARNING: *Furnaces shall not be installed directly on carpeting, tile or other combustible material other than wood flooring. An accessory combustible floor base is available to allow direct installation on combustible flooring.*

WARNING: *Furnace shall be installed so the electrical components are protected from water.*

The size of the unit should be based on an acceptable heat loss calculation for the structure.

Check the rating plate to make certain the unit is equipped for the type of gas supplied, and proper electrical characteristics are available.

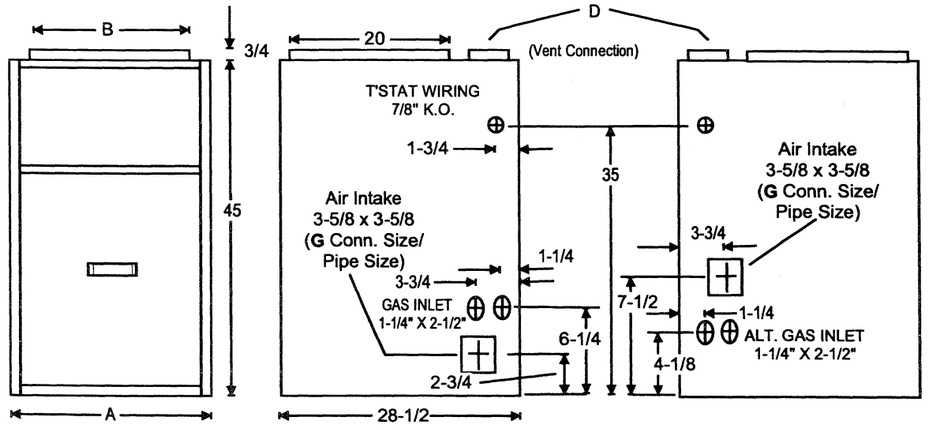
For installations above 2,000 feet, reduce input 4% for each 1,000 feet above sea level. Refer to Form 650.75-N2.1V for correct pressure switch/orifice information.

A furnace installed in a residential garage shall be located so that all burners and burner ignition devices are located not less that 18" above the garage floor, and located or protected to prevent damage by vehicles.

Allow clearances from combustible materials as listed under "Clearances to Combustibles", ensuring that service access is allowed for both the burners and blower.

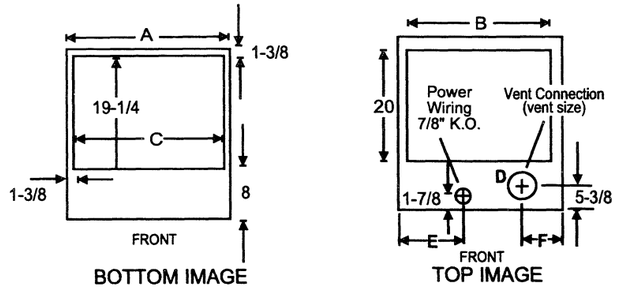
When the furnace is used in conjunction with a cooling coil, the furnace must be installed parallel with or on the upstream side of the cooling unit to avoid condensation in the primary heat exchanger. When a parallel flow arrangement is used, the dampers or other means used to control air flow shall be adequate to prevent chilled air from entering the furnace, and if manually operated, must be equipped with means to prevent operation of either unit unless the damper is in the full heat or cool position.

DIMENSIONS



Model	A	B	C	D	E	F	G
PBLDALD08N040	14-1/2	13-1/4	11-3/4	2	5-1/8	2-1/2	2
PBLDBLD12N060	17-1/2	16-1/4	14-3/4	2	6-5/8	2-1/4	2
PBLDBLD12N080	17-1/2	16-1/4	14-3/4	2	6-5/8	2-1/4	2
PBLDCLD16N080	21	19-3/4	18-1/4	2	8-3/8	2-1/4	2
PBLDCLD20N100	21	19-3/4	18-1/4	2	8-3/8	2-1/4	2
PBLDDLD20N120	24-1/2	23-1/4	21-3/4	2 (3)*	10-1/8	2-1/4	3

*Vent pipe must be increased to 3" on this model.



All dimensions are in inches, and are approximate.

TABLE 1 - RATINGS & PHYSICAL DATA

MODEL NUMBER	INPUT MBH	NOM. OUTPUT MBH	AFUE	AIR TEMP. RISE °F	CFM @ MEAN AIR TEMP. RISE	MAX. OUTLET AIR TEMP. °F	BLOWER			TOTAL UNIT AMPS	MAX.* OVER-CURRENT PROT.	MIN.* WIRE (AWG) @ 75'
							DIA.	WIDTH	HP			
PBLDADL08N040	40	37	91.0	25 - 55	856	155	10	6	1/4	9.0	20	14
PBLDBLD12N060	60	55	91.0	35 - 65	1018	165	11	8	1/2	9.0	20	14
PBLDBLD12N080	80	75	91.0	35 - 65	1370	165	11	8	1/2	9.0	20	14
PBLDCLD16N080	80	75	91.0	30 - 60	1563	160	11	8	3/4	12.0	20	14
PBLDCLD20N100	100	95	91.0	40 - 70	1582	170	11	10	1	12.0	20	14
PBLDDLD20N120	120	112	91.0	40 - 70	1885	170	11	10	1	12.0	20	14

* Wire size and overcurrent protection must comply with the National Electric Code.

NOTES: 1. For altitudes above 2000 ft. reduce capacity 4% for each 1000 ft. above sea level.
2. Wire size based on copper conductors, 60°C, 3% voltage drop.
3. Continuous return air temperature must not be below 55°F.

4 FLASH
This indicates the auxiliary limit switch has opened its normally closed contacts. With this fault code the control will operate the supply air blower and inducer. This condition may be caused by: dirty filter, improperly sized duct system, incorrect blower speed setting, incorrect firing rate or faulty blower motor.

5 FLASH
This fault is indicated if the normally closed contacts in the rollout switch opens. The rollout control is manually reset. If it has opened, check for proper combustion air, proper inducer operation, primary heat exchanger failure or burner problem. Be sure to reset the switch after correcting the failure condition.

6 FLASH
This indicates that after the unit was operating, the pressure switch opened 5 times during the call for heat. This could be caused by a number of problems; blocked vent or combustion air intake, high winds at vent terminal, faulty inducer, cracked pressure switch hose, or a blockage in the condensate drainage system.

7 FLASH
This fault code indicates that flame could not be established. This no-light condition occurred 3 times during the call for heat before locking out. This may be caused by low gas pressure, faulty gas valve, faulty hot surface ignitor or burner problem.

POWER SUPPLY POLARITY
If the power supply polarity is reversed, the following unit operation will occur. On a call for heat, the inducer will run, the HSI will glow and the gas valve will energize and the burners will ignite. The burners will immediately extinguish and the unit will recycle. This will occur 3 times and then the unit will lockout. A "7" flash code will be displayed. This code means the flame could not be established. This occurs because the control cannot sense flame with the power supply polarity reversed.

8 FLASH
This fault is indicated if the flame is lost 5 times during the heating cycle.This could be caused by low gas pressure or faulty gas valve.

LED ON CONSTANTLY
This indicated an internal fault in the furnace control discovered during its self-check procedure. Replace the control.

60 MINUTE AUTOMATIC RESET FROM LOCKOUT
This control includes a "watchdog" type circuit that will reset from a lockout condition after 60 minutes. Operational faults 6, 7 & 8 will be reset. This provides protection to an unoccupied structure if a temporary conditions exists causing a unit malfunction. An example would be a low incoming gas supply pressure condition preventing unit operation. When the gas pressure was restored, at some point the "watchdog" would restart the unit and provide heat for the house.

NOTE: *The control will blink one time when initially powered. This is normal and not an indication of any malfunction.*

RESET FROM LOCKOUT
To reset the control from any lockout condition break the line voltage supply *or* 24 volt signal from the thermostat for 30 seconds.

WARNING: *Do not try to repair controls. Replace defective controls with Source 1 Parts.*

WARNING: *Never adjust pressure switch to allow furnace operation.*

WARNING: *Never jump pressure switch or rewire in an attempt to allow furnace operation. To do so will allow furnace to operate under potentially hazardous conditions.*

3. Remove the upper access panel and remove the burner box cover.

4. Disconnect wires from flame sensor, rollout switch and HSI igniter. Remove igniter **carefully**, as it is easily broken.

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

5. Remove the screws that hold the burner box assembly to the vestibule panel and remove the assembly. The upper portion of the heat exchanger will now be exposed.

6. Remove the upper cover plate at the top of the furnace. Remove the internal baffle.

7. The upper portion of the heat exchanger is now exposed.

8. With a long flexible wire brush, clean inside each tube at both the top and bottom. The brush must pass around the rear heat exchanger tubes. Vacuum loose scale and dirt from each tube.

9. Clean - vacuum all burners.

10. Replace all components in reverse order. Reconnect all wiring.

11. Restore electrical power and gas supply to the furnace.

12. Check furnace operation.

Cleaning the Secondary Heat Exchanger

1. Follow steps 1 thru 10 under "Cleaning the Primary Heat Exchanger."

2. Remove the vent piping from the venter housing. Disconnect the drain lines from the venter and from the condensate drain pan. Remove the venter blower and the condensate pan. The turbulators can then be gently removed from the secondary heat exchanger.

3. With a stiff wire brush, brush out loose scale or soot.

4. Vacuum the secondary heat exchanger.

5. Finish the cleaning procedure by following steps 10 thru 12 under "Cleaning the Primary Heat Exchanger."

VENT/AIR INTAKE

Should it be necessary to service the vent/air intake system, the manufacturer recommends this service be conducted by a qualified service agency.

The operation of this appliance requires the reassembly and resealing of the vent/air intake system as specified on Page 10.

TROUBLESHOOTING

The following visual checks should be made before troubleshooting:

1. Check to see that the power to the furnace and the ignition control module is ON.

50A50-241 IGNITION CONTROL (P/N 031-01266-000)
Normal flame sense current is approximately.
2.0 microamps DC (µa)
Low flame signal control lockout point is
0.15 microamps DC (µa)

2. The manual shutoff valves in the gas line to the furnace must be open.

3. Make sure all wiring connections are secure.

4 Review the sequence of operation.

Start the system by setting the thermostat above the room temperature. Observe the system's response. Then use the troubleshooting section in this manual to check the system's operation.

FURNACE CONTROL DIAGNOSTICS

The furnace has built-in, self diagnostic capability. If a system problem occurs, a fault code is shown by a blinking LED. It is located behind a clear view port in the blower compartment door. DO NOT remove the furnace blower compartment panel OR turn off furnace power as either action will clear the control's memory of the fault.

The control continuously monitors its own operation and the operation of the system. If a failure occurs, the LED will indicate the failure code. If the failure is internal to the control, the light will stay on continuously. In this case, the entire control should be replaced as the control is not field repairable.

If the sensed failure is in the system (external to the control), the LED will flash in the following flash-pause sequences to indicate failure status.

Flash sequence codes 2 thru 8 are as follows. LED will turn "on" for 1/4 second and "off" for 1/4 second. This pattern will be repeated the number of times equal to the code. For example, six "on" flashes equals a number 6 fault code.

All flash code sequences are broken by a 2 second "off" period.

CONTINUOUS FLASHING (1 sec "on" - 1 sec "off")
This indicates that flame was sensed when there was not a call for heat. With this fault code the control will also turn on both the inducer motor and supply air blower. This fault would typically be caused by a gas valve that leaks through or is slow closing.

2 FLASH
This indicates that the normally open pressure switch contacts are stuck in the closed position. The control confirms these contacts are open at the beginning of each heat cycle. This would indicate a faulty pressure switch or mis-wiring.

3 FLASH
This indicates the normally open pressure switch contact did not close at the beginning of the heat cycle. This could be caused by a number of problems; faulty inducer, blocked vent pipe, high winds at vent terminal, broken pressure switch hose or faulty pressure switch.

The furnace shall be located:

1. Where a minimum amount of air intake/vent piping and elbows will be required.
2. As centralized with the air distribution as possible.
3. In an area where ventilation facilities provide for safe limits of ambient temperature under normal operating conditions. Ambient temperatures must not fall below 32°F (0° C).
4. Where it will not interfere with proper air circulation in the confined space.
5. Where the outdoor combustion air/vent terminal will not be blocked or restricted.
6. Where it will not interfere with the cleaning, servicing or removal of other appliances.

CLEARANCES TO COMBUSTIBLES

Minimum clearances from combustible construction are in inches:

Top	**1**
Front	**3**
Vent Piping	**0**
Rear	**0**
Sides	**0**
Floor	**1**

Special floor base or air conditioning coil is required for combustible floor application.

DUCTWORK

The duct system's design and installation must:

1. Handle an air volume appropriate for the served space and within the operating parameters of the furnace specifications.
2. Be installed in accordance with standards of NFPA (National Fire Protection Association) as outlined in NFPA pamphlets 90A and 90B (latest editions) or applicable national, provincial, local fire and safety codes.
3. Create a closed duct system. The supply duct system must be connected to the furnace outlet and the return duct system must be connected to the furnace inlet. Both supply and return duct systems must terminate outside the space containing the furnace.
4. Generally complete a path for heated or cooled air to circulate through the air conditioning and heating equipment and to and from the conditioned space.

SUPPLY AIR DUCTS

Installations on combustible floors must use a combustible floor base accessory (Shown in Figure 1 - Model 1CB0314, 17, 21 or 24) as specified on the rating plate or a matching cooling coil.

Follow the instructions supplied with the combustible floor base accessory.

If this base is replaced with a matching coiling coil, properly seal to prevent leaks. Follow the cooling coil instructions for installing the plenum. Be sure to comply with plenum duct clearances to combustible materials as required by NFPA 90A/90B and local codes.

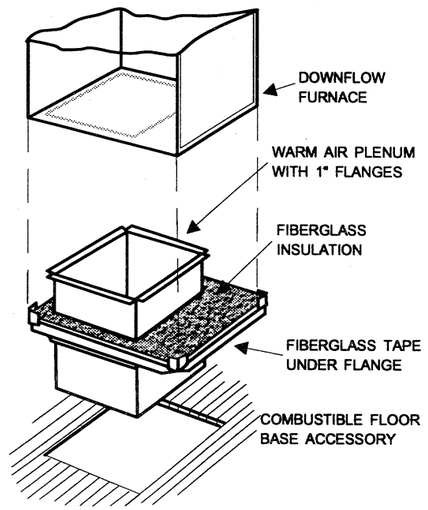


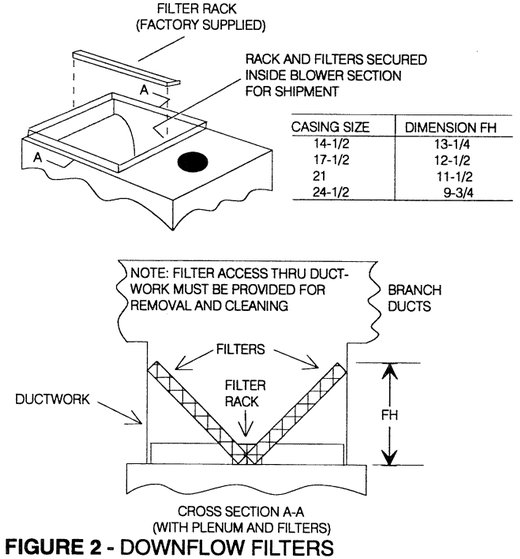
FIGURE 1 - COMBUSTIBLE FLOOR BASE ACCESS'Y

RETURN DUCT CONNECTION

Return air may enter the furnace only through the top. Be sure to see the "Filters" section of this instruction.

The return duct may be attached to the furnace by "S" cleat bend tabs or other approved methods. Be sure to seal the duct to the furnace to prevent air leakage.

Where the return duct system is not complete, the return connection must run full size to a location outside the room where the furnace is located. For further details, consult Section 5.3 (Air for Combustion and Ventilation) of the National Fuel Gas Code, ANSI Z223.1, or CAN/CGA B149.1 or .2, Installation Code - latest editions.



CASING SIZE	DIMENSION FH
14-1/2	13-1/4
17-1/2	12-1/2
21	11-1/2
24-1/2	9-3/4

FIGURE 2 - DOWNFLOW FILTERS

FILTERS

A top return filter rack is supplied with the furnace. Two 14" x 20" permanent washable filters are supplied with each unit. Downflow furnaces typically are installed with the filters located above the furnace, extending into the return air duct.

Any return duct must attach to the vertical plenum above the filter height (FH) in Figure 2. Refer to dimensions in Figure 2 for proper installation.

The filter rack (provided) should be secured to the center of the front and rear flanges at the furnace top. Drill a hole through the front and rear flanges into the filter rack and secure it with a sheet metal screw.

Refer to the unit rating plate for furnace model and then see the dimensions page of this instruction for return air plenum dimensions. Install the plenum following instructions under "Ductwork" in this instruction.

GAS PIPING

The gas supply must be installed in accordance with the current National Fuel Gas Code, ANSI Z223.1 (in the U.S.) or CAN-B149.1 or .2 (in Canada) installation codes and all applicable local and utility requirements. All pipe and fitting material, pipe size and installation procedures must comply with the appropriate code. Some utilities may require larger pipe sizes than shown in the code.

Gas piping may be connected from either side of the furnace. Each side of the unit has two gas pipe entry knockouts. Plan your combustion air piping before determining the correct gas pipe entry. Use 90 degree service elbow(s), or short nipples and conventional 90 degree elbow(s) to enter through the cabinet access holes.

NOTE: *An accessible manual shutoff valve must be installed upstream of the furnace gas controls and within 6 feet of the furnace.*

The installation of a ground joint union and drip leg are required. Refer to Figure 3. Maximum and minimum supply gas pressures are shown below.

INLET GAS PRESSURE	
	Natural Gas
Minimum	4.5 In. W.C
Maximum	13.9 In. W.C.

NOTE: *A 1/8" NPT plug is included in the inlet side of the gas valve for measuring incoming gas pressure.*

The furnace must be isolated from the gas supply piping system by closing its individual external manual shutoff valve during any pressure testing of the gas supply piping system at pressures equal to or less than 1/2 psig (3.48 kPa).

The furnace and its individual shutoff valve must be disconnected from the gas supply piping system during any pressure testing of that system at test pressures in excess of 1/2 psig (3.48 kPa).

⚠ ***WARNING:*** *Compounds used on threaded joints of gas piping must be resistant to the action of liquefied petroleum gases. After connections are made, leak-test all pipe connections.*

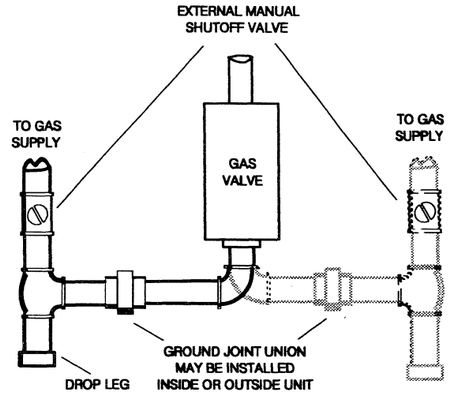


FIGURE 3 - GAS PIPING

⚠ ***WARNING:*** *After all gas piping connections are completed, leak test all joints, fittings and furnace connections with rich soap and water solution, commercially available bubble type leak detection fluid, or other approved means.*

⚠ ***WARNING:*** *Do not use an open flame or other source of ignition for leak testing.*

⚠ ***CAUTION:*** *Never apply a pipe wrench to the body of the combination automatic gas valve. A wrench must be placed on the projection or wrench boss of the valve when installing piping to it.*

ELECTRICAL POWER CONNECTION

Field wiring to the unit must conform to and be grounded in accordance with the provisions of the National Electrical Code ANSI/NFPA No. 70-latest edition, Canadian Electric Code C22.1 Part 1 - (latest edition) and/or local codes. Electric wires which are field installed shall conform with the temperature limitation for 63°F/35°C rise wire when installed in accordance with instructions. Specific electrical data is given for the furnace on its rating plate and in Table 1 of this instruction.

Provide a power supply separate from all other circuits. Install overcurrent protection and disconnect switch per local/national electrical codes. The switch should be close to the unit for convenience in servicing. With the disconnect switch in the OFF position, check all wiring against the unit wiring label. Also, see the wiring diagram in this instruction.

⚠ ***WARNING:*** *Use copper conductors only.*

NOTE: *The furnace's control system depends on correct polarity of the power supply and a proper ground connection. Refer to the the furnace control diagnostics section for symptoms of reversed power supply polarity.*

Connect the power supply as shown on the unit wiring label on the inside of the blower compartment door and Figures 4 & 5. The black furnace lead must be connected to the L1 (hot) wire from the power supply. The white furnace lead must be connected to neutral. Also, the green equipment ground wire must be connected to the power supply ground.

The control will repeat the ignition sequence for a total of two recycles if flame is lost within the first 10 seconds of establishment.

If flame is established for more than 10 seconds after ignition, the control will clear the ignition attempt (retry) counter. If flame is lost after 10 seconds, it will restart the ignition sequence. This can occur a maximum of five times.

During burner operation, a momentary loss of power of 50 milliseconds or longer will drop out the main gas valve. When the power is restored, the gas valve will remain deenergized and a restart of the ignition sequence will begin immediately.

Hot Surface Ignition System

⚠ ***WARNING:*** *Do not attempt to light this furnace by hand (with a match or any other means). There may be a potential shock hazard from the components of the hot surface ignition system. The furnace can only be lit automatically by its hot surface ignition system.*

MAINTENANCE

Air Filters

The filters must be checked periodically for dirt accumulation. Dirty filters greatly restrict the flow of air and may cause damage to the system.

Clean the filters at least every three months. On new construction, check the filters every week for the first four weeks. Inspect the filters every three weeks after that, especially if the system is running constantly.

All filters used with the furnace are the high-velocity, cleanable type. Clean these filters by washing in warm water. Make sure to shake all the water out of the filter and have it reasonably dry before installing it in the furnace. When replacing filters, be sure to use the same size and type as originally supplied.

Filter Removal

1. Turn off electrical power supply to the furnace at disconnect switch. Remove access doors.
2. Filters are installed in the plenum area above the blower assembly. Filters rest against the side of the plenum wall and are supported in the middle by a frame. Lift filter slightly to dislodge and remove for service.
3. Remove the filter and follow the cleaning instructions above. DO NOT remove the filter stiffener rods, if provided. ***When reinstalling the filter(s) be sure it completely covers the plenum opening.***

To reinstall the filters, simply reverse this procedure.

⚠ ***WARNING:*** *When replacing filters, DO NOT use a type with excessively high pressure drop. Some high efficiency filters available will cause the furnace to operate improperly and could result in a safety hazard.*

Lubrication

Blower motors in these furnaces are permanently lubricated and do not require periodic oiling.

BLOWER CARE

Even with good filters properly in place, blower wheels and motors will become dust laden after long months of operation. The entire blower assembly should be inspected annually. If the motor and wheel are heavily coated with dust, they can be brushed and cleaned with a vacuum cleaner.

The procedure for removing the direct drive blower assembly for cleaning is as follows:

1. Disconnect the electrical supply to the furnace and remove remove the access doors.
2. Remove the two wires leading to the auxiliary limit mounted on the side opposite the blower motor.
3. Remove four top panel screws and lift the top panel enough to disengage and remove the flue chase assembly.
4. Remove blower assembly mounting screws and slide the blower assembly out of the slots in the deck. If the two shipping screws were not previously removed, also remove and discard these two screws located on each front corner of the blower assembly.
5. Note the wire/terminal location and then remove the blower wiring from the furnace control. Remove the protective boot and disconnect run capacitor wires. Remove the screws securing the electrical panel to the blower housing. Pull blower assembly out of the unit. When cleaning or servicing the blower assembly, DO NOT remove or change the balance clips on the blower wheel.
6. To reassemble, reverse the procedure, restore power to the furnace and verify operation.

Burner Removal/Cleaning

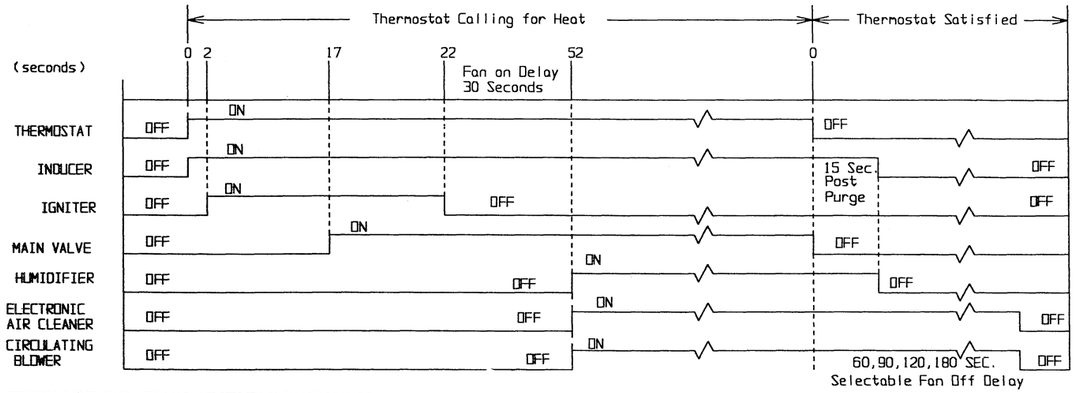
The main burners should be checked periodically for dirt accumulation.

If cleaning is required, follow this procedure:

1. Turn off the electrical power to the unit.
2. Turn off the gas supply at the external manual shutoff valve and loosen the ground union joint.
3. Remove the upper access panel and remove the burner box cover.
4. Remove the screws that hold the burner box assembly to the vest panel and remove the assembly.
5. Remove burners from the burner assembly.
6. Burners may be cleaned by rinsing in hot water.
7. Reassemble the burners in the reverse order.

Cleaning the Heat Exchanger

1. Turn off the main manual gas valve external to the furnace.
2. Turn off electrical power to the furnace.



FURNACE CONTROL EVENT SCHEDULE

ACCESSORY CONNECTIONS

The furnace control will allow power switching control of various accessories. See Figure 26 for connection details.

Electronic Air Cleaner Connection

Two 1/4" spade terminals (EAC and EAC N) for electronic air cleaner connections are located on the control board. The terminals provide 120 VAC (1.0 amp maximum) during circulating blower operation.

Humidifier Connection

Two 1/4" spade terminals (HUM and HUM N) for humidifier connections are located on the control board. The terminals provide 120 VAC (1.0 amp maximum) during heat speed operation of the circulating blower.

OPERATION AND MAINTENANCE

SEQUENCE OF OPERATION

The following describes the sequence of operation of the furnace. Refer to the schematic wiring diagram in the back of this manual for component location.

CONTINUOUS BLOWER

On cooling/heating thermostats with fan switch, when the fan switch is set in the "ON" position, a circuit is completed between terminals R and G of the thermostat. The blower motor is energized through the cool fan terminal and runs on the selected speed.

INTERMITTENT BLOWER - COOLING

On cooling/heating thermostats with fan switch, when the fan switch is set in the "auto" position and the thermostat calls for cooling, a circuit is completed between the R, Y and G terminals.

The motor is energized through the cool fan terminal and runs on the selected speed. The fan off setting is fixed at 60 seconds for SEER enhancement.

HEATING CYCLE

When the system switch is set on HEAT and the fan is set on AUTO, and the room thermostat calls for heat, a circuit is completed between terminals R and W of the thermostat. When the proper amount of combustion air is being provided, a pressure switch activates the ignition control

The ignition control provides a 17-second warm-up period. The gas valve then opens for seven seconds.

As gas starts to flow and ignition occurs, the flame sensor begins its sensing function. If a flame is detected within seven seconds after ignition, normal furnace operation continues until the thermostat circuit between R and W is opened. After flame is present for 30 seconds, the circulating blower is energized.

When the thermostat circuit opens, the gnition control is deenergized. With the ignition control deenergized, the gas flow stops and the burner flames are extinguished. The venter continues to operate for 15 seconds after the gas flow stops.

The blower motor continues to operate for the amount of time set by the fan-off delay switches located on the control board. The heating cycle is then complete, and the unit is ready for the start of the next heating cycle.

If flame is not detected within the seven second sensing period, the gas valve is deenergized. The control is equipped with a re-try option. This provides a 60 second wait following an unsuccessful ignition attempt (flame not detected).

After the 60 second wait, the ignition sequence is restarted with an additional 10 seconds of igniter warm-up time. If this ignition attempt is unsuccessful, one more re-try will be made before lockout.

A momentary loss of gas supply, flame blowout, or a shorted or open condition in the flame probe circuit will be sensed within 0.8 seconds.

The gas valve will deenergize and the control will restart the ignition sequence immediately. Recycles will begin and the burner will operate normally if the gas supply returns, or the fault condition is corrected prior to the last ignition attempt. Otherwise, the control will lockout.

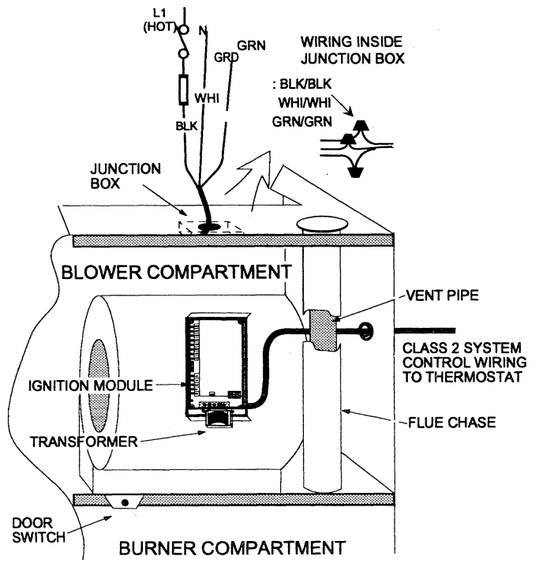


FIGURE 4 - DOWNFLOW MODELS - ELECTRICAL WIRING

Remove the screws retaining the wiring box cover. Route the power wiring through the unit top panel with a conduit connector or other proper connection. Make wiring connections as shown in Figure 5. Replace the wiring box cover and screws.

An alternate wiring method is to use a field provided 2 x 4 box and cover on the outside of the furnace. Route the furnace leads into the box using a protective bushing where the wires pass through the furnace panel.

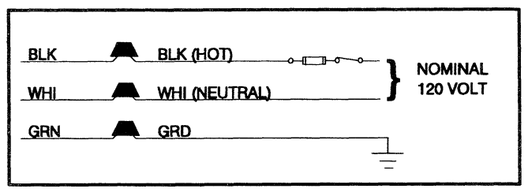


FIGURE 5 - POWER WIRING CONNECTIONS

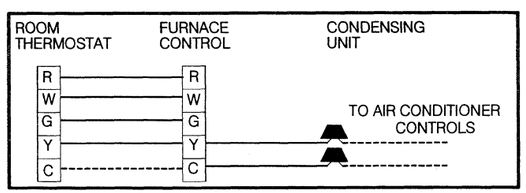


FIGURE 6 - TYPICAL HEATING AND COOLING

ELECTRICAL CONTROL CONNECTIONS

Install the field-supplied thermostat. The thermostat instructions for wiring are packed with the thermostat. With the thermostat set in the OFF position and the main electrical source disconnected, complete the low-voltage wiring from the thermostat to the terminal board on the ignition module. Connect Class 2 control wiring as shown in Figures 4 & 6. Electronic thermostats may require a "C" common connection as shown dashed in Figure 6.

Set the heat anticipator in the room thermostat to .45 amps. Setting it lower will cause short cycles. Setting it higher will cause the room temperature to exceed the setpoints.

NOTE: *Some electronic thermostats do not have adjustable heat anticipators. They may have other type cycle rate adjustments. Follow the thermostat manufacturer's instructions.*

The 24-volt, 40 VA transformer is sized for the furnace components only, and should not be connected to power auxiliary devices such as humidifiers, air cleaners, etc. The transformer may provide power for an air conditioning unit contactor.

COMBUSTION AIR AND VENT SYSTEM

This furnace is certified to be installed with one of three possible intake/vent configurations.

1. Two-pipe with a sealed combustion intake/vent system using outdoor combustion air.
2. Single pipe vent system using combustion air from the area surrounding the furnace.
3. Two-pipe intake/vent system using combustion air from a ventilated attic space and a vent pipe to the outside.

Be sure to follow the appropriate venting section details, related information and limitations for your type of installation.

COMBUSTION AIR INTAKE/VENT CONNECTIONS

	Furnace Intake / Vent Connection Size	
	40 - 100 MBH	120 MBH
Intake	2"	3"
Vent	2"	2" (See Note 1)

NOTE: 1. Vent must be increased to 3" on this model.
2. Any vent pipe size change must be made outside furnace casing in a vertical pipe section to allow proper drainage of condensate.
3. An offset using two 45 degree elbows will be required for plenum clearance when the vent is increased to 3".

METHOD ONE: TWO PIPE SEALED COMBUSTION AIR AND VENT SYSTEM

This type installation requires outdoor combustion air. Two separate, properly-sized pipes must be used. One bringing air from the outdoors to the furnace combustion air intake on the bottom of the burner box, and a second pipe from the furnace vent connection (top right of unit) back to the outdoors. See Figure 7.

The intake/vent should be located either through the wall (horizontal or side vent) or through the roof (vertical vent). Care should be taken to locate side vented systems where trees or shrubs will not block or restrict supply air from entering or combustion products from leaving the terminal.

TABLE 2 - INTAKE/VENT PIPING - 2 PIPE SYSTEM

Model	Pipe Size	Max. Elbows vs. One Way Vent Length (Ft.)			
		5-30	35	40	60
PBLDALD08N040	2"	6	5	4	N/A
PBLDBLD12N060					
PBLDBLD12N080					
PBLDCLD16N080					
PBLDCLD20N100					
PBLDALD08N040	3"	8	7	6	5
PBLDBLD12N060					
PBLDBLD12N080					
PBLDCLD16N080					
PBLDCLD20N100					
PBLDDLD20N120	3" Only	6	5	4	N/A

NOTE: Elbow count does not include (2) 90 ° elbows required to pipe intake into burner box or those for the termination. See Step 4 below

Also, the terminal assembly should be located as far as possible from a swimming pool or a location where swimming pool chemicals might be stored. Be sure the terminal assembly follows the outdoor clearances listed in Table 2 for U.S. installations: In Canada, refer to CAN/CGA-B149.1 or .2 Installation Code (latest edition -Venting Systems and Air Supply).

COMBUSTION AIR/VENT PIPE SIZING

Refer to Table 2 to select the proper size piping for combustion air intake and venting. The size will be determined by a combination of furnace model, total length of run, and the number of elbows required. The following rules must also be observed.

1. Long radius elbows are required for all units.
2. Elbows are assumed to be 90 degrees. Two 45 degree elbows count as one 90 degree elbow.
3. Elbow count refers to combustion air piping and vent piping separately. For example, if the table allows for 5 elbows, this will allow a maximum of 5 elbows in the combustion air piping and a maximum of 5 elbows in the vent piping.
4. Two 90° elbows for the intake pipe and three vent terminal elbows (two for vent pipe and one for air intake pipe) are already accounted for, and should not be counted in the allowable total indicated in the table. See section on vent terminal. These parts are shown shaded.
5. Combustion air and vent piping must be of the same diameter.
6. All combustion air/vent pipe and fittings must conform to American National Standards Institute (ANSI) standards and American Society for Testing and Materials (ASTM) standards D1785 (Schedule 40 PVC), D2665 (PVC-DWV), D2241 (SDR-21 and SDR-26 PVC), D2261 (ABS-DWV), or F628 (Schedule 40 ABS. Pipe cement and primer must conform to ASTM Standards D2564 (PVC) or D2235 (ABS).
7. The use of flexible connectors or no hub connectors in the vent system is not allowed. This type connection is allowed in the combustion air pipe near the furnace for air conditioning coil accessibility.

VENT TERMINATION (2-PIPE)

Side wall horizontal vent terminals and roof mounted vertical terminals may be field fabricated. Standard PVC/SRD fittings may be used. Terminal configuration must comply as detailed in this section.

NOTE: *Combustion air and vent pipes must terminate together in the same atmospheric zone, either through a roof or sidewall.*

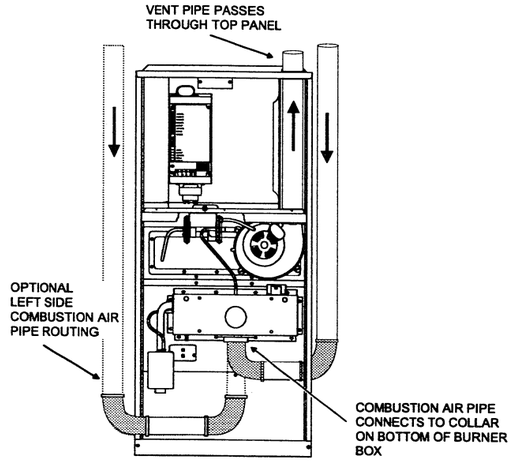


FIGURE 7 - AIR INTAKE/VENT LOCATIONS

NOTE: *Accessory concentric intake/vent terminations, models 1CT0302 and 1CT0303 are available and approved for use with these furnaces. Refer to Form 650.75-N2.4V for installation details.*

When selecting the location for combustion air/vent termination the following should be considered:

1. Comply with all clearance requirements as listed below.
2. Termination should be positioned where vent vapors will not damage plants or shrubs or air conditioning equipment.
3. Termination should be located where it will not be affected by wind gusts, light snow, airborne leaves or allow recirculation of flue gases.
4. Termination should be located where it will not be damaged or exposed to flying stones, balls, etc.
5. Termination should be positioned where vent vapors are not objectionable.

VENT CLEARANCES (2-PIPE) U.S. ONLY

Dryer Vent	3 ft.
Plumbing Vent Stack	3 ft.
Gas Appliance Vent Terminal	3 ft.*
From any mechanical fresh air intake	1 ft.
From any door, window or non-mechanical fresh air or combustion air intake	1 ft.
Above grade and anticipated snow depth	1 ft.
Above grade when adjacent to a public walkway	7 ft.
From electric, gas meters, regulators and relief equipment - min. horizontal distance	4 ft.

* Does not apply to multiple installations of this furnace model. Refer to multi-unit vent terminations on page 9.

In Canada, refer to CAN/CGA-B149.1 or .2 Installation Code (latest edition - Venting Systems and Air Supply)

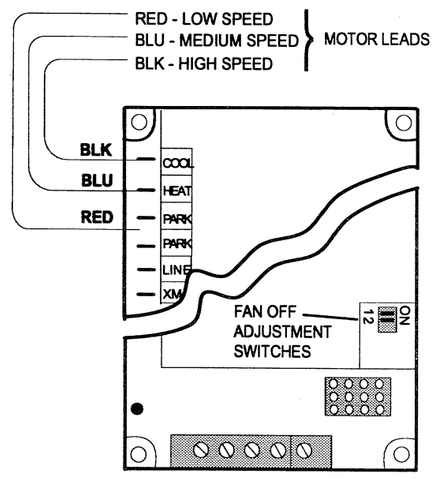


FIGURE 25 - TYPICAL HEAT/COOL SPEED TAP CONNECT & FAN OFF SETTING

If gas valve regulator is turned in, or clockwise, manifold pressure is increased. If screw is turned out, or counterclockwise, manifold pressure will decrease.

WARNING: *If manifold pressure is too high, an overfire condition exists which could cause heat exchanger failure. If the manifold pressure is too low, sooting and eventual clogging of the heat exchanger could occur.*

WARNING: *Once the correct gas pressure to the burners has been established, turn the gas valve knob to OFF and turn the electrical supply switch to OFF; then remove the pressure tap at the gas valve and re-install the plug, using a compound (on the threads) resistant to the action of LP gases. Replace the burner box front cover or the pressure reference hose.*

Turn the electrical and gas supplies back on, and with the burners in operation, check for gas leakage around the plug with a soap and water solution.

WARNING: *Be sure that gas valve regulator cap and burner box to gas valve pressure reference hose is reconnected.*

ADJUSTMENT OF TEMPERATURE RISE

The temperature rise, or temperature difference between the return air and the heated air from the furnace, must be within the range shown on the furnace rating plate and within the application limitations shown in Table 1. After the temperature rise has been determined, the cfm can be calculated.

After about 20 minutes of operation, determine the furnace temperature rise. Take readings of both the return air and the heated air in the ducts, about six feet from the furnace where they will not be affected by radiant heat.

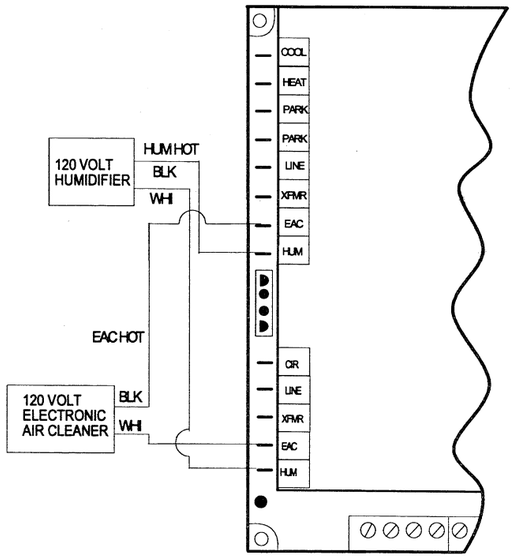


FIGURE 26 - ACCESSORY CONNECTIONS

Increase the blower speed to decrease the temperature rise; decrease the blower speed to increase the rise.

All direct-drive blowers have multi-speed motors. The blower motor speed taps are located in the control box in the blower compartment. Refer to Figure 25 and the unit wiring label to change the blower speed.

You may select a heating speed and a cooling speed. They may be the same speed or a different speed.

To use the same speed tap for heating and cooling, the "heat" terminal and "cool" terminal must be connected using a jumper wire and connected to the desired motor lead. Place all unused motor leads on "Park" terminals. Two are provided.

CAUTION: *Do not energize more than one motor speed at a time or damage to the motor will result.*

ADJUSTMENT OF FAN-OFF CONTROL SETTINGS

This furnace is equipped with a time-on / time-off heating fan control. The fan "on" is fixed at 30 seconds. The fan "off" is field adjustable from 60 to 180 seconds. The fan "off" is factory set to 60 seconds. Adjust the "off" time by repositioning the fan off switches as located in Figure 25.

The fan-off setting must be long enough to adequately cool the furnace, but not so long that cold air is blown into the heated space. The fan-off timing may be adjusted by setting the option switches located (refer to Figure 25) on the control board as follows:

To Delay Fan-Off By:	Set Switch 1	Set Switch 2
60 Sec.	ON	ON
90 Sec.	OFF	ON
120 Sec.	ON	OFF
180 Sec.	OFF	OFF

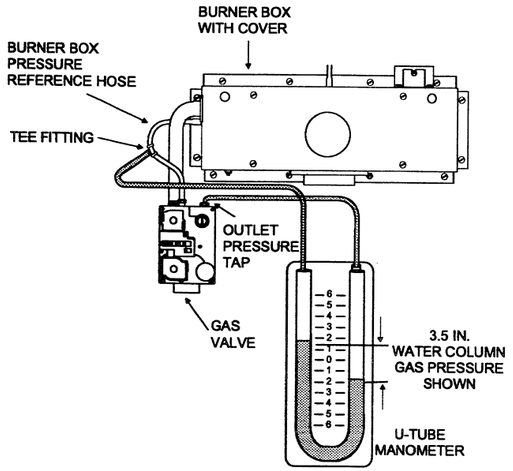


FIGURE 23 - READING GAS PRESSURE WITH BURNER BOX COVER IN PLACE

Temperatures under 60° F will slow it and make it read low. The barometric pressure above 30.0" will slow the meter and below 30.0" speed up the meter. At some conditions the meter may be off significantly. an error of ± 5% is not uncommon. The gas meter correction factor is calculated as follows:

$$\frac{\text{(Barometric Pressure) x 520}}{\text{(Temperature ° F + 460) x 30}} = \text{Meter Correction Factor}$$

Example 1: 28.9" Barometric Pressure, 80° F

$$\frac{(28.9) \times 520}{(80 + 460) \times 30} = \frac{15028}{16200} = .928 \text{ Correction Factor}$$

Contact your gas supplier for actual BTU content of the gas.

EXAMPLE - CHECKING GAS INPUT

It is found by measurement that it takes 26 seconds for the hand on the 1 cubic foot dial to make a revolution with only a 120,000 Btuh furnace running. Using this information, locate 26 seconds in the first column of Table 5. Read across to the column headed "1 cubic foot" where you will see that 138 cubic feet of gas per hour are consumed by the furnace at that rate.

With the barometer at 28.9" and a 70° F temperature, the correction factor will be .945. If the local gas heating value is 935 BTU per cubic foot the calculations will be as follows:

138 cu. ft/hr x .945 correction factor x 935 BTU/cu. ft. = 121,933 BTU/Hr.

The calculated firing rate of 121,933 BTU per hour is within the ± 2% tolerance of our nominal 120,000 furnace.

If the actual input is not within 2% of the furnace rating, with allowance being made for the permissible range of the regulator setting (0.3 inches W.C.), replace the orifice spuds with spud of the proper size.

CAUTION: *Be sure to relight any gas appliance that were turned off at the start of this input check.*

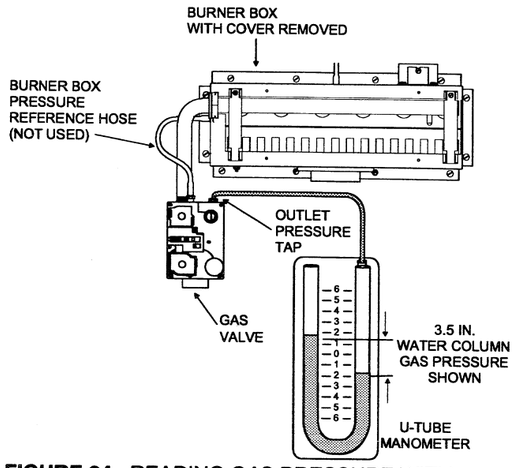


FIGURE 24 - READING GAS PRESSURE WITH BURNER BOX COVER REMOVED

ADJUSTMENT OF MANIFOLD GAS PRESSURE

Manifold gas pressure may be measured by two different procedures. It may be measured with the burner box cover in place or it may be measured with the burner box cover removed. Follow the appropriate section, 2a or 2b in the instructions below.

1. Turn gas off at main gas valve. Remove 1/8" Allen socket head pipe plug from the manifold end of the main gas valve. Install the proper manometer tube adapter into this opening.
2. Read the inlet gas pressure using either of the two methods below.
   a. Reading the gas pressure with the burner box cover in place - Disconnect the pressure reference hose from the right side of the burner box. Using a tee fitting and a short piece of hose, connect the negative side of the manometer to the burner box pressure reference port as shown in Figure 23. Connect the positive side of the manometer to the adapter previously installed in the gas valve as shown in Figure 23.
   b. Reading the gas pressure with the burner box cover removed - Remove the screws securing the burner box front cover plate. Remove the cover. It is gasketed and may stick in place. Connect the positive side of the manometer to the adapter previously installed in the gas valve as shown in Figure 24. There will be no second connection to the manometer as it will reference atmospheric pressure.

NOTE: *The screw-off cap for the pressure regulator must be removed entirely to gain access to the adjustment screw. Loosening or tightening the cap does not adjust the flow of gas.*

3. Refer to Figure 22 for location of pressure regulator adjustment cap and screw on main gas valve.
4. Turn gas and electrical supplies ON. Start furnace and observe manifold pressure on manometer.
5. Adjust manifold pressure by adjusting gas valve regulator screw: for natural gas, set at 3.5" W.C.

Natural Gas	3.5" W.C.

NOTE: *Consideration must be given for degradation of building materials by flue gases.*

NOTE: *Shaded components of the combustion air/vent system shown in the following figures are considered to be part of the vent terminal. These components should not be counted when determining piping limitations. Refer to Figures 8 - 11. Sidewall termination may require sealing or shielding of building surfaces with a corrosive resistance material to protect against combustion product corrosion.*

VENTING MULTIPLE UNITS

Each unit must have its own intake/vent piping and termination. Do not use common pipes for combustion air or venting. The vent terminals must be located as shown in Figures 12 & 13.

PIPING ASSEMBLY

The final assembly procedure for the vent/combustion air piping is as follows:

1. Cut piping to the proper length, beginning at the furnace.
2. Deburr the piping inside and outside.
3. Chamfer the outer edges of the piping.
4. Dry-fit the entire vent/combustion air piping assembly.
5. Disassemble the piping and apply cement primer and cement per the cement manufacturer's instructions. Primer and cement must conform to ASTM D2564 for PVC, or ASTM D2235 for ABS piping.

WARNING: *Solvent cements are flammable and must be used in well-ventilated areas only. Keep them away from heat, sparks and open flames (including pilots). Do not breathe vapors and avoid contact with skin and eyes.*

6. All joints must be made to provide a permanent, air-tight, water-tight seal.
7. Support the combustion air and vent piping such that it is angled 1/4" per linear foot so that condensate will flow back toward the furnace. Piping should be supported with pipe hangers to prevent sagging. Maximum spacing between hangers is five (5) feet, except SDR-PVC piping, where maximum spacing is three (3) feet.
8. Seal around the openings where the combustion air and vent piping pass through the roof of side wall.

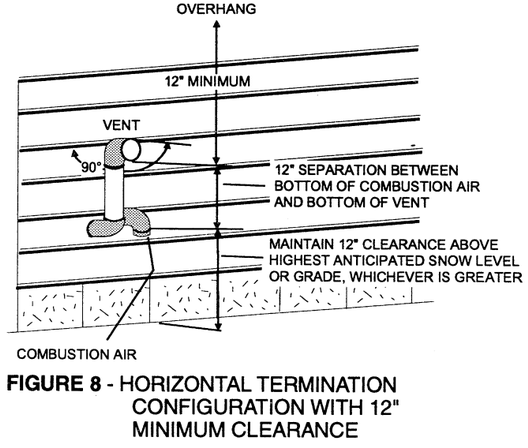


FIGURE 8 - HORIZONTAL TERMINATION CONFIGURATION WITH 12" MINIMUM CLEARANCE

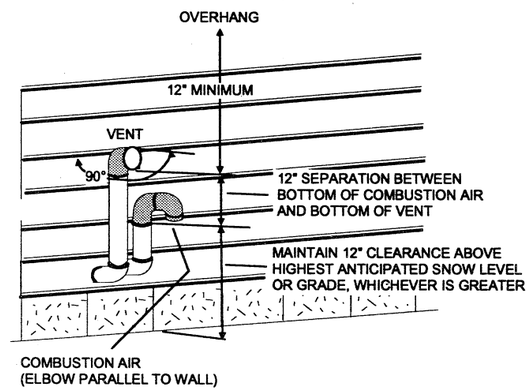


FIGURE 9 - HORIZONTAL TERMINATION RAISED CONFIGURATION FOR ADDITIONAL CLEARANCE

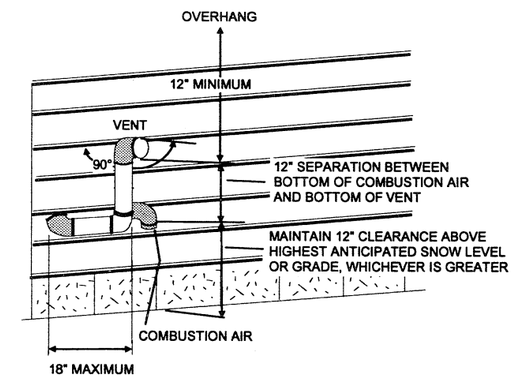


FIGURE 10 - HORIZONTAL TERMINATION CONFIGURATION WITH HORZ. EXTENS.

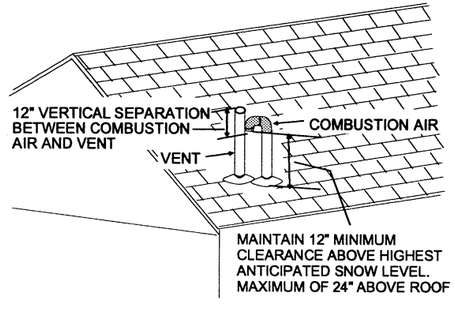


FIGURE 11 - VERTICAL TERMINATION

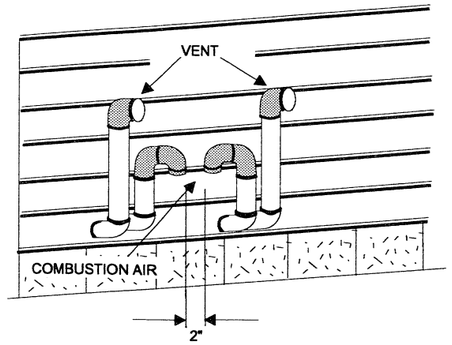


FIGURE 12 - DOUBLE SIDEWALL TERMINATION

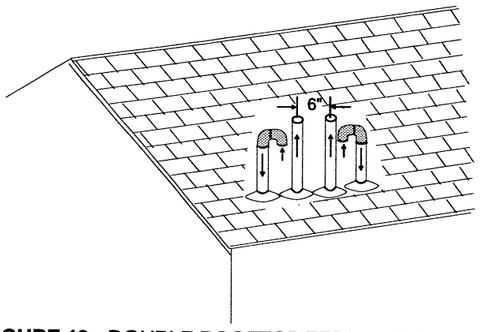


FIGURE 13 - DOUBLE ROOFTOP TERMINATION

CAUTION: *Vent piping must be insulated with 1/2" Armaflex insulation if it will be subjected to freezing temperatures such as routing through unheated areas or through an unused chimney.*

CAUTION: *When combustion air pipe is installed above a suspended ceiling, the pipe must be insulated with 1/2" Armaflex type insulation. The combustion air pipe should also be insulated when it passes through a warm, humid space.*

NOTE: *Vent pipe must be sloped 1/4" per foot to allow condensate to flow back to the furnace.*

METHOD TWO: ONE PIPE SYSTEM

This type installation will use combustion air from within the space surrounding the furnace. This may be from within the space in a non-confined location or it may be brought into the furnace area from outdoors. It is not directly ducted into the furnace. A single, properly sized pipe from the furnace vent connector to the outdoors must be provided.

Combustion air is brought into the furnace through the unit side panel openings. Remove a minimum of two gas piping knockouts for combustion air access. It is not necessary to install a pipe into the intake collar on bottom of the burner box. For details, refer to Figure 14.

COMBUSTION AIR

All installations must comply with Section 5.3, Air for Combustion and Ventilation of the National Fuel Gas Code, ANSI Z223.1 or Sections 7.2, 7.3 or 7.4 of CAN/CGA B149.1 or .2 Installation Code - latest editions.

An unconfined space is not less than 50 cubic feet per 1000 Btu/hr input rating for all appliances installed in that area.

Rooms communicating directly with the space containing the appliances are considered part of the unconfined space, if openings are not furnished with doors.

A confined space is an area with less than 50 cubic feet per 1000 Btu/hr input rating for all appliances installed in that area.

The following must be considered to obtain proper air for combustion and ventilation in confined spaces.

Air Source from Inside the Building -
Two permanent openings, one within 12 inches of the top of the confined space and one within 12 inches of the bottom, shall each have a free area of not less than one square inch per 1,000 Btuh of total input rating of all appliances located in the space. The openings shall communicate freely with interior areas having adequate infiltration from the outside.

NOTE: *At least 100 square inches free area shall be used for each opening.*

Air Source from Outdoors -

1. Two permanent openings, one within 12 inches of the top of the confined space and one within 12 inches of the bottom, shall communicate directly, or by means of ducts, with the outdoors or to such crawl or attic spaces that freely communicate with the outdoors.

   a. Vertical Ducts - Each opening must have a free area of not less than one square inch per 4,000 Btuh of total input of all appliances located in the space.

EXAMPLE:

$$\frac{\text{Total Input of All Appliances}}{4000} = \text{Square Inches Free Area}$$

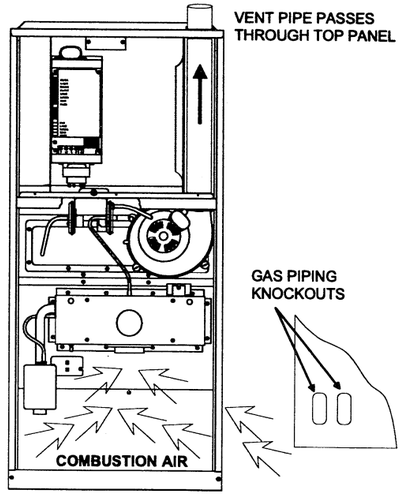


FIGURE 14 - VENT PIPE CONNECTION

START-UP AND ADJUSTMENTS

The initial start-up of the furnace requires the following additional procedures:

1. When the gas supply is initially connected to the furnace, the gas piping may be full of air. In order to purge this air, it is recommended that the ground union be loosened until the odor of gas is detected. When gas is detected, immediately retighten the union and check for leaks. Allow five minutes for any gas to dissipate before continuing with the start-up procedure.

WARNING: *Be sure proper ventilation is available to dilute and carry away any vented gas.*

2. The condensate trap must be filled with water before putting the furnace into operation. The recommended procedure is as follows:
   a Disconnect the condensate drain hose from the induced draft blower discharge.
   b. Elevate this hose and fill with water using a funnel.
   c. Replace the condensate drain hose and clamps.
3. All electrical connections made in the field and in the factory should be checked for proper tightness.

IGNITION SYSTEM SEQUENCE

1. Turn the gas supply ON at external valve and main gas valve.
2. Set the thermostat above room temperature to call for heat.
3. System start-up will occur as follows:
   a. The induced draft blower motor will start and come up to speed. Shortly after venter start-up, the hot surface igniter will glow for about 17 seconds.
   b. The ignition module will energize (open) the main gas valve for seven seconds.
   c. After flame is established, the supply air blower will start in about 30 seconds.

NOTE: *Burner ignition may not be satisfactory on first start-up due to residual air in line.*

4. With furnace in operation, paint the pipe joints and valve gasket lines with a rich soap and water solution, Bubbles indicate a gas leak. Take appropriate steps to stop the leak. If the leak persists, replace the component.

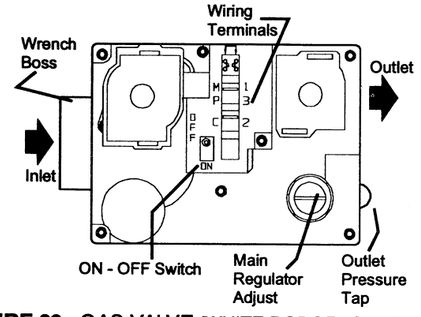


FIGURE 22 - GAS VALVE (WHITE RODGERS 36E24)

TABLE 5 - GAS RATE (CUBIC FEET PER HOUR)

Seconds for one Revol.	Size of Test Dial	
	1/2 cu. ft.	1 cu. ft.
10	180	360
12	150	300
14	129	257
16	113	225
18	100	200
20	90	180
22	82	164
24	75	150
26	69	138
28	64	129
30	60	120
32	56	113
34	53	106
36	50	100
38	47	95
40	45	90
42	43	86
44	41	82
46	39	78
48	37	75
50	36	72
52	35	69
54	34	67
56	32	64
58	31	62
60	30	60

WARNING: *DO NOT omit this test! Never use a flame to check for gas leaks.*

CHECKING GAS INPUT (NATURAL GAS)

NOTE: *Front door of burner box must be secured when checking gas input.*

1. Turn off all other gas appliances connected to the gas meter.
2. With the furnace turned on, measure the time needed for one revolution of the hand on the smallest dial on the meter. A typical domestic gas meter usually has a 1/2 or 1 cubic foot test dial.
3. Using the number of seconds for each revolution and the size of the test dial increment, find the cubic feet of gas consumed per hour from Table 4.

To find the BTUH input use the following formula:

Cu. Ft. Gas x meter correction factor x Gas BTU Content = BTU Per Hour Input

The gas meter is affected by both the temperature and also the barometric pressure. The meter should be correct at 60° F, and 30.0" barometric pressure. At all other conditions it will be inaccurate, although the correction factor is easily calculated. Higher temperatures (over 60° F) will speed up the meter and make it read high.

CONDENSATE PIPING

The condensate drain connection is shipped in the blower compartment. It consists of a formed hose with a 1/2" NPT male connection. A 1/2" FM x 3/4" PVC slip coupling is provided.

This drain hose may be installed to allow left or right side condensate drain connection. Refer to Figure 20. Cut the hose to allow for proper fit for left or right exit.

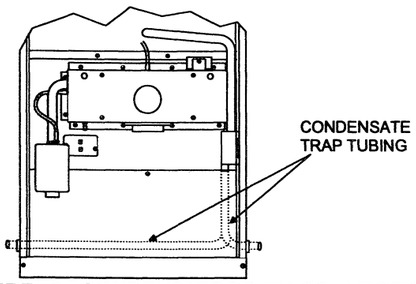


FIGURE 20 - CONDENSATE DRAIN CONNECTION

To install the drain hose assembly, remove the 7/8" knockout in the side panel. Remove the conduit nut from the 1/2" male fitting. Push the male fitting through the hole and reinstall the nut. The use of the 3/4" PVC coupling is optional.

The installation procedure for condensate piping is as follows:

Drain Connection

1. It is recommended that either 1/2" or 3/4" PVC or equivalent pipe be field installed as drain pipe. The condensate piping may be tied together with the air conditioning condensate drain if the air conditioning condensate drain line is trapped upstream of the tie-in and the combined drains are constructed of the same material.
2. All pipe joints must be cleaned, de-burred and cemented using PVC primer and cement.
3. The furnace contains an internal trap. Therefore, no external trap should be used.
4. If a condensate pump is used, it must be suitable for use with acidic water.
5. Where required, a field-supplied neutralizer can be installed in the drain line, external to the furnace.

NOTE: *The condensate drain from the furnace may be connected in common with the drain from an air conditioning coil if allowed by local code. Follow the instructions with the coil for trapping the drain.*

SAFETY CONTROLS

Control Circuit Fuse

A 3 amp. fuse is provided to protect the 24 volt transformer from overload caused by control circuit wiring errors. This is an ATO 3, automotive type fuse and is located in the unit wiring harness between the control transformer and the furnace control.

Blower Door Safety Switch

This unit is equipped with an Electrical Interlock Switch mounted in the blower compartment. This switch interrupts all power at the unit when the panel covering the blower compartment is removed.

WARNING: *Blower and burner must never be operated without the blower panel in place.*

Electrical supply to this unit is dependent upon the panel that covers the blower compartment being in place and properly positioned.

CAUTION: *Main power to the unit must still be interrupted at the main power disconnect switch before any service or repair work is to be done to the unit. Do not rely upon the interlock switch as a main power disconnect.*

Rollout Switch Controls

This control is mounted on the burner box assembly. If the temperature in the burner compartment exceeds its set point, the igniter control and the gas valve are deenergized. The operation of this control indicates a malfunction in the combustion air blower, heat exchanger or a blocked vent pipe connection. Corrective action is required. This is a manual reset control and must be reset before operation can continue.

Pressure Switches

This furnace is supplied with pressure switches which monitor the flow through the combustion air/vent piping system. These switches de-energize the ignition control module and the gas valve if any of the following conditions are present. Refer to Figure 21 for tubing connections

1. Blockage of combustion air piping or terminal. (1LP)
2. Blockage of vent piping or terminal (1LP).
3. Failure of combustion air blower motor (1LP).
4. Blockage of condensate drain piping (2LP).

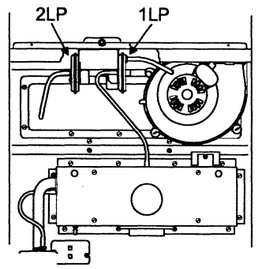


FIGURE 21 - PRESSURE SWITCH TUBING ROUTING

Limit Control

There is a high temperature limit control located on the furnace vestibule panel near the gas valve. This is an automatic reset control and provides over temperature protection due to reduced airflow, such as a dirty filter.

Auxiliary Limit Controls

Downflow units have a single limit switch mounted on the blower assembly. This is a manual reset control and gives high temperature protection in the event of a blower motor failure.

b. Horizontal Ducts - Each opening must have a free area of not less than one square inch per 2,000 Btuh of total input of all appliances located in the space.

NOTE: *Ducts must have the same cross-sectional area as the free area in the opening to which they are connected. The minimum dimension of rectangular ducts shall be three inches.*

2. One permanent opening, commencing within 12 inches of the top of the enclosure shall be permitted where the equipment has clearances of at least 1 inch from the sides and back and 6 inches from the front of the appliance. The opening 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:

   a. 1 sq. in. per 3000 Btu per hr of the total input rating of all equipment located in the enclosure.

   b. Not less than the sum of the areas of all vent connectors in the confined space.

3. **Louvers, Grilles and Screens**

   a. In calculating free area, consideration must be given to the blocking effects of louvers, grilles and screens.

   b. If the free area of a specific louver or grille is not known, refer to Table 3 to estimate free area.

TABLE 3 - ESTIMATED FREE AREA

ESTIMATED FREE AREA	
Wood or Metal Louvers or Grilles	Wood 20 - 25%* Metal 60 - 70%*
Screens**	1/4" mesh or larger 100%

* Do not use less than 1/4" mesh

** Free area or louvers and grilles varies widely. Installer should follow louver or grillle manufacturer's instructions.

NOTE: *If mechanically operated louvers are used, a means to prevent main burner ignition and operation must be provided should louvers close during startup or operation.*

Special Combustion and Ventilation Considerations

Operation of a mechanical exhaust, such as an exhaust fan, kitchen ventilation system, clothes dryer or fireplace may create conditions requiring special attention to avoid unsatisfactory operation of gas appliances.

Specially Engineered Installations

The above requirements shall be permitted to be waived where special engineering, approved by the authority having jurisdiction, provides an adequate supply of air for combustion, ventilation and dilution of flue gases.

Combustion Air Quality

The recommended source of combustion air is to use the outdoor air supply. Excessive exposure to contaminated combustion air will result in safety and performance related problems. However, the use of indoor air in most applications is acceptable, except as follows:

1. If the furnace is installed in a confined space it is recommended that the necessary combustion air come from the outdoors by way of attic, crawl space, air duct or direct opening.
2. If outdoor combustion air is used, there must be no exposure to the installations or substances listed in "3" below.
3. The following types of installations may require OUTDOOR AIR for combustion, due to chemical exposure.

   a) Commercial buildings
   b) Buildings with indoor pools
   c) Furnaces installed in laundry rooms
   d) Furnaces installed in hobby or craft rooms
   e) Furnaces installed near chemical storage areas

Exposure to the following substances in the combustion air supply may also require OUTDOOR AIR for combustion.

   f) Permanent wave solutions
   g) Chorinated waxes and cleaners
   h) Chorine based swimming pool chemicals
   i) Water softening chemicals
   j) De-icing salts or chemicals
   k) Carbon tetrachloride
   l) Halogen type refrigerants
   m) Cleaning solvents (such as perchloroethylene)
   n) Printing inks, paint removers, varnishes, etc.
   o) Hydrochloric acids
   p) Cements and glues
   q) Antistatic fabric softeners for clothes dryers
   r) Masonry acid washing chemicals

VENT PIPE SIZING (1-PIPE SYSTEM)

Refer to Table 4 to select the proper size piping for venting. The size will be determined by a combination of furnace model, total length of run, and the number of elbows required. The following rules must also be observed.

NOTE: *Furnace vent pipe connections are sized for 2-in. pipe. Any pipe size change must be made outside the furnace casing in a vertical pipe section to allow proper drainage of vent connections.*

NOTE: *An offset using two 45 degree elbows may be required for plenum clearance when the vent is increased to 3".*

1. Long radius elbows are required for all units.

TABLE 4 - VENT PIPING - 1 PIPE SYSTEM

Model	Pipe Size	Max. Elbows vs. One Way Vent Length (Ft.)			
		5-40	45	50	75
PBLDALD08N040 PBLDBLD12N060 PBLDBLD12N080 PBLDCLD16N080 PBLDCLD20N100	2"	6	5	4	N/A
PBLDALD08N040 PBLDBLD12N060 PBLDBLD12N080 PBLDCLD16N080 PBLDCLD20N100	3"	8	7	6	5
PBLDDLD20N120	3" Only	6	5	4	N/A

2. Elbows are assumed to be 90 degrees. Two 45 degree elbows count as one 90 degree elbow.
3. One Vent terminal elbow is already accounted for and should not be counted in the allowable total indicated in the table. Refer to the section of this manual on vent terminal. This part is shown shaded.
4. All vent pipe and fittings must conform to American National Standards Institute (ANSI) standards and American Society for Testing and Materials (ASTM) standards D1785 (Schedule 40 PVC), D2665 (PVC-DWV), D2241 (SDR-21 and SDR-26 PVC), D2261 (ABS-DWV), or F628 (Schedule 40 ABS. Pipe cement and primer must conform to ASTM Standards D2564 (PVC) or D2235 (ABS).
5. The use of flexible connectors or no hub connectors in the vent system is not allowed.

VENT TERMINATION (1-PIPE SYSTEM)

Side wall horizontal vent terminals and roof mounted vertical terminals may be field fabricated. Standard PVC/SRD fittings may be used. Terminal configuration must comply as detailed in this section.

When selecting the locations for vent termination, the following should be considered:

1. Comply with all clearance requirements as shown in Figure 15.
2. Termination should be positioned where vent vapors will not damage plants or shrubs or air conditioning equipment.
3. Termination should be located where it will not be affected by wind gusts, light snow, airborne leaves or allow recirculation of flue gases.
4. Termination should be located where it will not be damaged or exposed to flying stones, balls, etc.
5. Termination should be positioned where vent vapors are not objectionable.

VENT TERMINAL LOCATION CLEARANCES

The vent must be installed with the following minimum clearances (Figure 15), and complying with local codes or utility requirements or other authority having jurisdiction.

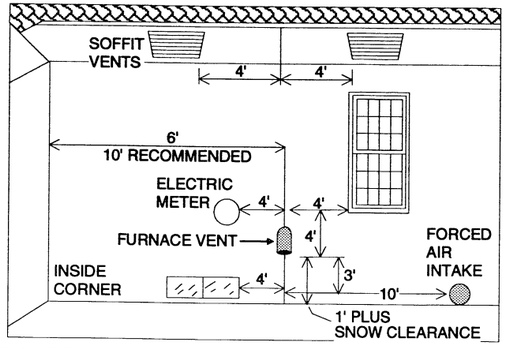


FIGURE 15 - VENT TERMINAL CLEARANCES (1-PIPE SYSTEM) - U.S. ONLY

In Canada, refer to CAN/CGA-B149.1 or .2 Installation Code (latest edition - Venting Systems and Air Supply)

1. 1 foot above grade and above normal snow levels.
2. Not above any walkway.
3. 4 feet below, 4 feet horizontally from, or 1 foot above any door/window or gravity air inlet to the building, or from gas or electric meters.

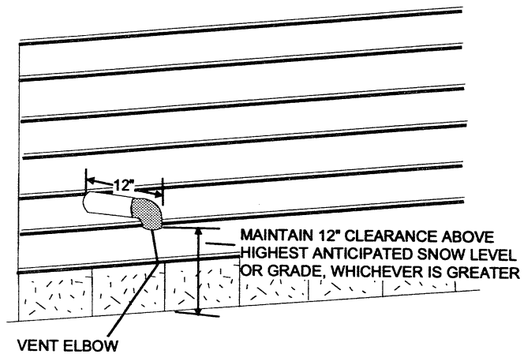


FIGURE 16 - HORIZONTAL TERMINATION CONFIGURATION WITH 12" MINIMUM CLEARANCE

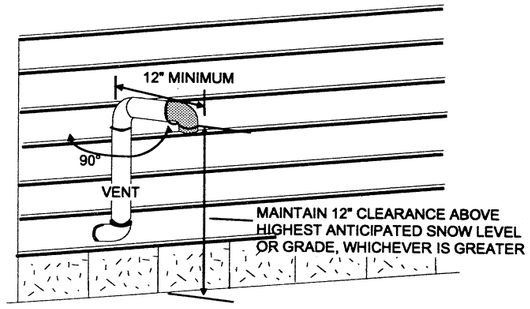


FIGURE 17 - HORIZONTAL TERMINATION RAISED CONFIGURATION FOR ADDITIONAL CLEARANCE

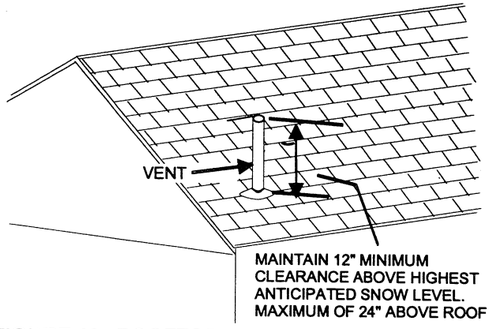


FIGURE 18 - ROOFTOP TERMINATION

4. 6 feet from any inside corner formed by two exterior walls. 10 feet is recommended where possible.
5. At least 4 feet horizontally from any soffit or undereave vent.
6. 10 feet from any forced air inlet to the building. Any fresh air or make up inlet as for a dryer or furnace area is considered to be a forced air inlet.
7. Avoid areas where condensate drippage may cause problems such as above planters, patios, or adjacent to windows where steam may cause fogging.

NOTE: *Consideration must be given for degradation of building materials by flue gases.*

NOTE: *Shaded components of the vent system shown in the following Figures 16-18 are considered to be termination. These components should not be counted when determining pipe diameter. Sidewall termination may require sealing or shielding of building surfaces with a corrosive resistant material due to vent system corrosive combustion products.*

PIPING ASSEMBLY

The final assembly procedure for the vent piping is as follows:

1. Cut piping to the proper length, beginning at the furnace.
2. Deburr the piping inside and outside.
3. Chamfer the outer edges of the piping.
4. Dry-fit the entire vent piping system.
5. Disassemble the piping and apply cement primer and cement per the cement manufacturer's instructions. Primer and cement must conform to ASTM D2564 for PVC, or ASTM D2235 forABS piping.

⚠ ***WARNING:*** *Solvent cements are flammable and must be used in well-ventilated areas only. Keep them away from heat, sparks and open flames (including pilots). Do not breathe vapors and avoid contact with skin and eyes.*

6. All joints must be made to provide a permanent, air tight. water tight seal.
7. Support the vent piping such that it is angled 1/4" per linear foot so that condensate will flow back towards the furnace. Piping should be supported with pipe hangers to prevent sagging. Maximum spacing between hangers is 5 feet, except SDR-PVC piping, where maximum spacing is 3 feet.

NOTE: *Vent pipe must be sloped 1/4" per foot to allow condensate to flow back to the furnace.*

8. Seal around the openings where the vent piping passes through the roof or side wall.

⚠ ***CAUTION;*** *Vent piping must be insulated with 1/2" Armaflex insulation if it will be subjected to freezing temperatures such as routing through unheated areas or through an unused chimney.*

METHOD THREE: TWO PIPE SYSTEM USING COMBUSTION AIR FROM A VENTILATED ATTIC SPACE

This type installation requires two properly sized pipes. One brings combustion air from a properly ventilated attic space and a second pipe from the furnace vent connection (top right of unit) exits to the outdoors.

COMBUSTION AIR INTAKE

Refer to Table 2 on page 8 for intake pipe sizing, allowable length and elbow usage. Follow all notes, procedures and required materials in the Two-Pipe Sealed Combustion section (Method 1) when installing the combustion air pipe within the unit and into the ventilated attic space.

COMBUSTION AIR TERMINATION

Refer to Figure 19 for required termination method and configuration for the intake pipe. For attic termination, use two 90 elbows with the open end in a downward position. Be sure to maintain 12" clearance above any insulation, flooring or other material. Be sure to instruct the owner not to block this intake pipe.

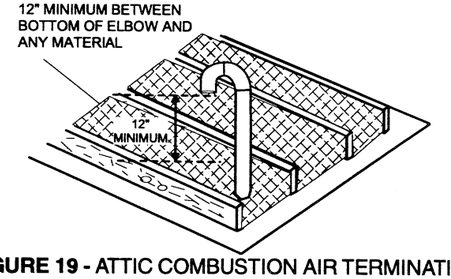


FIGURE 19 - ATTIC COMBUSTION AIR TERMINATION

COMBUSTION AIR REQUIREMENTS

The ventilated attic space from which the combustion air is taken must comply with the requirements shown on pages 10 & 11 in this instruction or in Section 5.3, Air for Combustion and Ventilation of the National Fuel Gas Code, ANSI Z223.1 (current edition).

In Canada, refer to CAN/CGA-B149.1 or .2 Installation Code (latest edition - Venting Systems and Air Supply)

VENT PIPE

Refer to Table 2 on page 8 for vent pipe sizing, allowable length and elbow usage. Follow all notes, installation procedures and required materials in the One-Pipe System (Method 2), page 10 to install the vent pipe from the unit to the outdoors.

VENT TERMINATION

The vent pipe termination must be installed within the allowable locations shown in Figure 15 and Section 7.8 in the National Fuel Gas Code, ANSI Z223.1 (current edition). Follow all local agency and utility requirements if more restrictive than those shown. Vent termination must be as shown in Figures 16-18.

In Canada, refer to CAN/CGA-B149.1 or .2 Installation Code (latest edition - Venting Systems and Air Supply)