

INSTALLATION INSTRUCTIONS AND SERVICE MANUAL
SEPARATED COMBUSTION
 GAS-FIRED INDOOR DUCT FURNACE

ATTENTION: READ THIS MANUAL AND ALL LABELS ATTACHED TO THE UNIT CAREFULLY BEFORE ATTEMPTING TO INSTALL, OPERATE OR SERVICE THESE UNITS! RECORD THE UNIT MODEL AND SERIAL No.(s) IN THE SPACE PROVIDED. RETAIN FOR FUTURE REFERENCE.

Model No. _____ Serial No. _____

FOR YOUR SAFETY

The use and storage of gasoline or other flammable vapors and liquids in open containers in the vicinity of this appliance is hazardous.



FOR YOUR SAFETY

If you smell gas:

1. Open windows.
2. Don't touch electrical switches.
3. Extinguish any open flame.
4. Immediately contact your gas supplier.



▲ WARNING Improper installation, adjustment, alteration, service, or maintenance can cause property damage, injury, or death. Read the installation, operating, and maintenance instruction thoroughly before installing or servicing this equipment.

▲ WARNING Install, operate, and maintain unit in accordance with the manufacturer's instructions to avoid exposure to fuel substances, or substances from incomplete combustion, which can cause death or serious illness. The state of California has determined that these substances may cause cancer, birth defects, or other reproductive harm.

▲ WARNING INSTALLER'S RESPONSIBILITY

Installer Please Note: This equipment has been test fired and inspected. It has been shipped free from defects from our factory. However, shipment and installation problems such as loose wires, leaks, or loose fasteners may occur. **It is the installer's responsibility to inspect and correct any problem that may be found.**

RECEIVING INSTRUCTIONS

Inspect shipment immediately when received to determine if any damage has occurred to the unit during shipment. After the unit has been uncrated, check for any visible damage to the unit. If any damage is found, the consignee should sign the bill of lading indicating such damage and immediately file claim for damage with the transportation company.

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GENERAL SAFETY INFORMATION

The duct furnace design is certified by the American Gas Association and the Canadian Gas Association for use with natural and LP (propane) gases. ANSI and NFPA Standards as well as Canadian installation codes referred to in this manual are the ones that were applicable at the time that the design was certified. In addition, the duct furnace may be installed on the downstream side of a cooling coil, without need of a bypass duct.

If the unit is to be installed at altitudes exceeding 2,000 feet (610m) above sea level, derate the input by 4% for each 1,000 feet (305m) rise above sea level. Special orifices are required for installations above 2,000 feet.

When units are installed in Canada, any reference to derations at altitudes in excess of 2,000 feet (610m) are to be ignored. At altitudes of 2,000 to 4,500 feet (610 to 1372m), the units must be orificed for 90% of normal altitude rating, and be so marked in accordance with C.G.A. certification.

The following terms are used throughout this manual, in addition to the AGA/CGA requirements to bring attention to the presence of potential hazards, or to important information concerning the product:

▲ DANGER Indicates an imminently hazardous situation which, if not avoided, will result in death, serious injury, or substantial property damage.

▲ WARNING Indicates an imminently hazardous situation which, if not avoided, could result in death, serious injury, or substantial property damage.

▲ CAUTION Indicates an imminently hazardous situation which, if not avoided, may result in minor injury or property damage.

NOTICE: Used to notify of special instructions on installation, operation, or maintenance which are important to equipment but not related to personal injury.

GENERAL SAFETY INFORMATION

▲ WARNING Failure to comply with the general safety information may result in extensive property damage, severe personal injury, or death!

Installation must be in accordance with local codes, or in absence of local codes, with ANSI Standard Z223-1996. (N.F.P.A. No. 54) National Fuel Gas Code. All of the ANSI and NFPA Standards referred to in these installation instructions are those that were applicable at the time the design of this appliance was certified. The ANSI Standards are available from the American Gas Association, 1515 Wilson Boulevard, Arlington, Virginia 22209. The NFPA Standards are available from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269. These duct furnaces are designed for use in airplane hangars when installed in accordance with ANSI/NFPA No. 409, and in public garages when installed in accordance with NFPA No. 88A and NFPA No. 88B.

If installed in Canada, the installation must conform with local building codes, or in the absence of local building codes, with CGA-B149.1 "Installation Codes for Natural Gas Burning Appliances and Equipment" or CGA-B149.2 "Installation Codes for Propane Gas Burning Appliances and Equipment." These duct furnaces have been designed and certified to comply with CGA 2.6. Also see sections on installation in AIRCRAFT HANGARS and PUBLIC GARAGES.

▲ WARNING Do not alter the duct furnace in any way, or damage to the unit and/or severe personal injury or death may occur!

▲ WARNING Never service any component without first disconnecting all electrical and gas supplies to the unit, or severe personal injury or death may occur!

▲ CAUTION Insure that all power sources conform to the requirements of the duct furnace, or damage to the unit will result!

Follow installation instructions CAREFULLY to avoid creating unsafe conditions. All wiring should be done and checked by a qualified electrician, using copper wire only. All external wiring must conform to applicable local codes, and to the National Electric Code, ANSI/NFPA No. 70-1996 (or the latest edition of). All gas connections should be made and leak-tested by a suitably qualified individual, per instructions in this manual.

Also follow procedures listed on the "Gas Equipment Start-Up" sheet located in this manual.

Use only the fuel for which the duct furnace is designed (see rating plate). Using LP gas in a heater that requires natural gas, or vice versa, will create risk of gas leaks, carbon monoxide poisoning, and explosion.

▲ WARNING Do not attempt to convert furnace for use with a fuel other than the one intended. Such conversion is dangerous, as it will create the risks previously listed.

Make certain that the power source conforms to the electrical requirements of the furnace.

▲ WARNING Do not depend upon a thermostat or other switch as sole means of disconnecting power when installing or servicing duct furnace. Always disconnect power at main circuit breaker as described above. Failure to do so could result in electrical shock.

Special attention must be given to any grounding information pertaining to this duct furnace. To prevent the risk of electrocution, the furnace must be securely and adequately grounded. This should be accomplished by connecting a ground conductor between the service panel and the furnace. To ensure a proper ground, the grounding means must be tested by a qualified electrician.

Do not insert fingers or foreign objects into furnace or its air moving device. Do not block or tamper with the heater in any manner while in operation, or just after it has been turned off, as some parts maybe hot enough to cause injury.

This furnace is intended for general heating applications ONLY. It must NOT be used in potentially dangerous locations such as flammable, explosive, chemical-laden, or wet atmospheres.

In cases in which property damage may result from malfunction of the furnace, a back-up system or temperature sensitive alarm should be used.

▲ CAUTION The open end of piping systems being purged shall not discharge into areas where there are sources of ignition or into confined spaces UNLESS precautions are taken as follows: (1) by ventilation of the space, (2) control of the purging rate, (3) elimination of all hazardous conditions. All precautions must be taken to perform this operation in a safe manner!

Unless otherwise specified, the following conversions may be used for calculating SI unit measurements:

1 foot = 0.305 m	1000 BTU/cu. ft. = 37.5 MJ/m ³
1 inch = 25.4 mm	1000 BTU per hour = 0.293 kW
1 gallon = 3.785 L	1 inch water column = 0.249 kPa
1 pound = 0.453kg	liter/second = CFM x 0.472
1 psig = 6.894 kPa	meter/second = FPM ÷ 196.8
1 cubic foot = 0.028m ³	

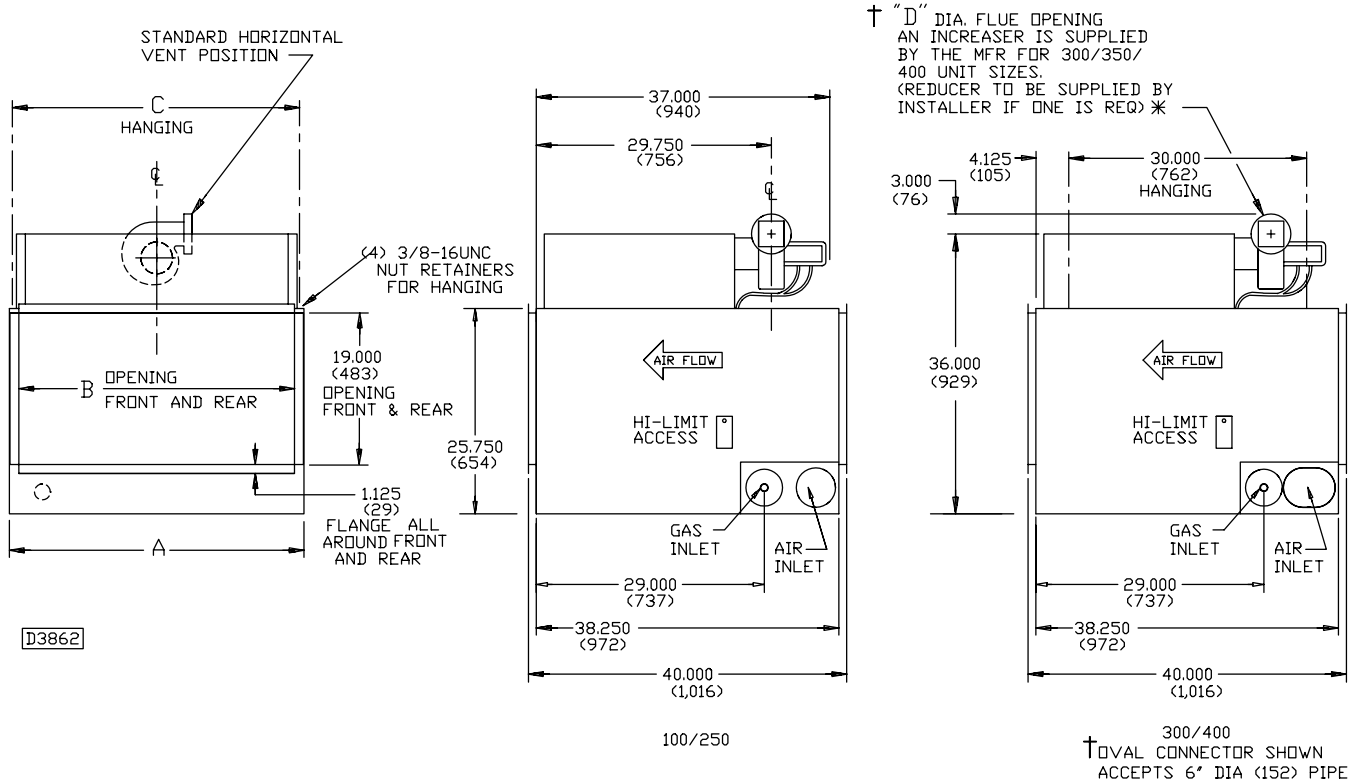
SPECIFICATIONS

Table 1

Unit Size	A	B	C	D (Dia)*†	Gas Inlet in.		Weight lb. (kg)
	in. (mm)	in. (mm)	in. (mm)	in. (mm)	Nat.	LP	
100	17-7/8 (454)	15-1/2 (394)	17-1/8 (435)	4 (102)	1/2	1/2	161 (73)
125	20-5/8 (524)	18-1/4 (464)	19-7/8 (505)	4 (102)	1/2	1/2	180 (82)
150	20-5/8 (524)	18-1/4 (464)	19-7/8 (505)	4 (102)	1/2	1/2	188 (85)
175	23-3/8 (594)	21 (533)	22-5/8 (575)	4 (102)	1/2	1/2	207 (93)
200	26-1/8 (664)	23-3/4 (603)	25-3/8 (645)	5 (127)	1/2	1/2	227 (103)
225	28-7/8 (733)	26-1/2 (673)	28-1/8 (714)	5 (127)	3/4	1/2 or 3/4	246 (116)
250	31-5/8 (803)	29-1/4 (743)	30-7/8 (784)	5 (127)	3/4	1/2 or 3/4	266 (121)
300	37-1/8 (943)	34-3/4 (883)	36-3/8 (924)	6 (152)	3/4	1/2 or 3/4	305 (138)
350	42-5/8 (1083)	40-1/4 (1022)	41-7/8 (1064)	6 (152)	3/4	1/2 or 3/4	344 (156)
400	48-1/8 (1222)	45-3/4 (1162)	47-3/8 (1203)	6 (152)	3/4	1/2 or 3/4	383 (174)

†NOTE: "D" dia. equals the air inlet opening and the flue discharge opening.

Figure 1 - Separated Combustion Duct Furnace



*CANADIAN UNITS INCLUDE VENT CAPS AND REDUCER (IF REQ'D)
DIMENSIONS XXX STANDARD UNITS
DIMENSIONS IN PARENTHESIS (XXX) MILLIMETERS

PERFORMANCE DATA

Table 2

Unit Size	Input		Output MBH (kW)	Min. CFM (cu. m/s)	Temp. Rise Deg. F. (Deg. C.)	P.D. in. of W.C. (kPa)	Max. CFM (cu. m/s)	Temp. Rise Deg. F. (Deg. C.)	P.D. in. of W.C. (kPa)
	(Max.) MBH (kW)	(Min.) MBH (kW)							
100	100 (29.3)	50 (14.6)	80 (23.4)	822 (0.388)	90 (50)	0.10 (0.02)	3,700 (1.746)	20 (11)	2.03 (0.51)
125	125 (36.6)	62.5 (18.3)	100 (29.3)	1,028 (0.485)	90 (50)	0.09 (0.02)	4,625 (2.183)	20 (11)	1.92 (0.48)
150	150 (43.9)	75 (22.0)	120 (35.1)	1,233 (0.582)	90 (50)	0.09 (0.02)	5,550 (2.620)	20 (11)	1.81 (0.45)
175	175 (51.2)	87.5 (25.6)	140 (41.0)	1,439 (0.679)	90 (50)	0.09 (0.02)	6,475 (3.056)	20 (11)	1.86 (0.46)
200	200 (58.6)	100 (29.3)	160 (46.9)	1,645 (0.776)	90 (50)	0.09 (0.02)	7,401 (3.493)	20 (11)	1.90 (0.47)
225	225 (65.9)	112.5 (32.9)	180 (52.7)	1,850 (0.873)	90 (50)	0.09 (0.02)	8,326 (3.930)	20 (11)	1.93 (0.48)
250	250 (73.2)	125 (36.6)	200 (58.6)	2,056 (0.970)	90 (50)	0.09 (0.02)	9,251 (4.366)	20 (11)	1.96 (0.49)
300	300 (87.8)	150 (43.9)	240 (70.3)	2,467 (1.164)	90 (50)	0.10 (0.02)	11,101 (5.240)	20 (11)	2.00 (0.50)
350	350 (102.5)	175 (51.2)	280 (82.0)	2,878 (1.358)	90 (50)	0.10 (0.02)	12,951 (6.113)	20 (11)	2.02 (0.50)
400	400 (117.1)	200 (58.6)	320 (93.7)	3,289 (1.552)	90 (50)	0.10 (0.02)	14,801 (6.986)	20 (11)	2.05 (0.51)

NOTE:

Ratings are shown for elevations up to 2,000 feet (610M) above sea level. Above 2,000 feet (610M), input must be derated 4% for each 1,000 feet (305M) above sea level. When units are installed in Canada, any reference to derations at altitudes in excess of 2,000 feet (610M) are to be ignored. At altitudes of 2,000 to 4,500 feet (610 to 1372M), the units must be orificed to 90% of the normal altitude rating, and be so marked in accordance with the CGA certification.

TEMPERATURE RISE AND PRESSURE DROP-GRAPH #1

CLEARANCES

▲ WARNING Under no circumstances should combustible material be located within the clearances specified in Table 3. Failure to provide proper clearance could result in personal injury or equipment damage from fire.

Maintain adequate clearances around air openings into the combustion chamber:

Table 3 - Minimum Clearances

Sides	18" (457mm)
Top	6" (152mm)
Bottom	25" (635mm)
Flue	6" (152mm)

* When clearances required for accessibility are greater than the minimum required safety clearances, the accessibility clearances take precedence.

NOTICE: Increasing the clearance distances may be necessary if there is a possibility of distortion or discoloration of adjacent materials.

Atmospheres containing commercial solvents or chlorinated hydrocarbons will produce corrosive acids when coming in contact with the flames. This will greatly reduce the life of the duct furnace, and may void the warranty. Avoid such areas.

NOTICE: If the gas duct furnace is to be used in a building classified as having a hazardous atmosphere, the installation must comply with the standards set by the National Board of Fire Underwriters. Consult the authorities having jurisdiction before starting the job.

The Separated Combustion Duct Furnace must be installed on the positive pressure side of the air circulation blower.

INSTALLATION

NOTICE: Furnace sizing should be based on heat loss calculations where the furnace output equals or exceeds heat loss.

▲ CAUTION Do not install duct furnace in corrosive or flammable atmosphere! Premature failure of, or severe damage to the unit will result!

▲ CAUTION Duct furnaces must not be installed in locations where air for combustion would contain chlorinated, halogenated, or acidic vapors. If located in such an environment, premature failure of the unit will occur!

ACCESSIBILITY: The Separated Combustion Duct Furnace is a bottom service access type. Allow a minimum of 25 inches (635mm) at the bottom of the unit to facilitate servicing the burners and pilot. Provision should be made to assure accessibility for recurrent maintenance purposes.

AIRCRAFT HANGARS: Separated Combustion Duct Furnaces must be installed in aircraft hangars as follows: Duct furnaces must be at least 10 feet (3.05m) above the upper surface of wings or engine enclosures of the highest aircraft to be stored in the hangar, and 8 feet (2.44m) above the floor in shops, offices, and other sections of the hangar where aircraft are not stored or housed. In Canada, installation is suitable in aircraft hangars when acceptable to the enforcing authorities.

PUBLIC GARAGES: In parking structures, Separated Combustion Duct Furnaces must be installed a minimum of 25 inches (635mm) to facilitate servicing the burners

and pilot. Refer to NFPA 88A, Parking Structures. In repair garages, duct furnaces must be installed in a detached building or room separated from repair areas as specified in NFPA 88B, Repair Garages. In Canada, installation must be in accordance with current CGA B149 "Installation Codes for Gas Burning Appliances and Equipment."

Separated Combustion Duct Furnaces should not be installed to maintain low temperatures and/or freeze protection of buildings. A minimum of 50°F (10°C) thermostat setting must be maintained. If duct furnaces are operated to maintain lower than 50°F (10°C), hot flue gases are cooled inside the heat exchanger to the point where water condenses onto the heat exchanger walls. The result is a mildly corrosive acid which prematurely corrodes the aluminized heat exchanger, and can actually drip water down from the duct furnace onto the floor surface. Additional duct furnaces should be installed if a minimum of 50°F (10°C) thermostat setting cannot be maintained.

DUCTWORK: Properly designed and installed ductwork, providing a uniformly distributed flow of air across the surfaces of the heat exchanger, is essential to satisfactory unit performance and life of the equipment.

All duct flanges/seams must be sealed to prevent air leaks. Sealant/tape must be suitable for temperatures of 250°F (121°C) minimum.

▲ WARNING Any attempt to straighten the 90° duct connection flanges on the duct furnace will affect the operation of the furnace and void the warranty.

INSTALLATION (Continued)

If uniform air distribution is not obtained, install additional baffles and/or turning vanes in the ductwork.

Access panels large enough to observe smoke and reflected light, and to detect the presence of leaks in the heating equipment, are required both upstream and downstream from the gas duct furnace. These panels must be sealed to prevent air leaks. If allowed by local regulations, install canvas connectors between the ductwork and fan discharge opening to eliminate the transmission of sound.

Figures 2 & 3 illustrate recommended ductwork designs for both the straight-through and elbowed air inlet arrangements.

AIR FLOW: The installation is to be adjusted to obtain an air throughput within the range specified on the appliance rating plate.

Figure 2 - Recommended Design for Field Installation of Ductwork for Straight-through Arrangement

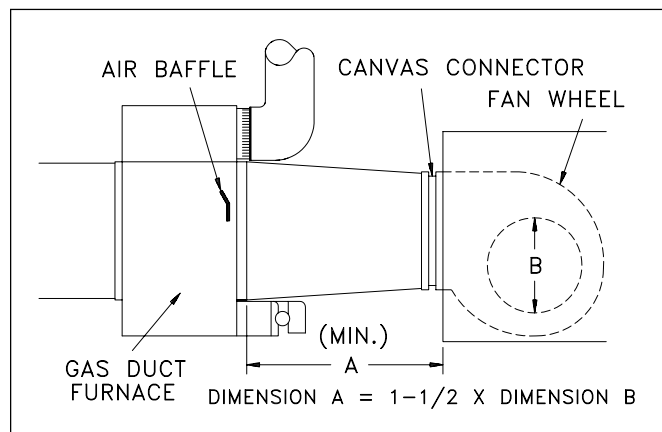
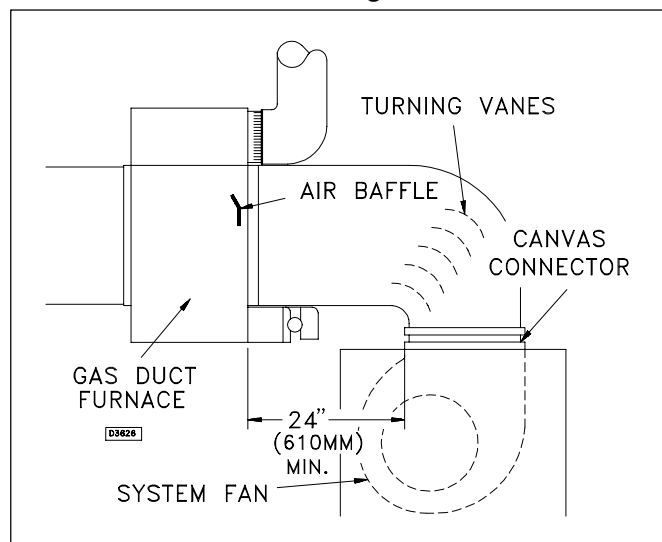


Figure 3 - Recommended Ductwork Design for Elbowed Arrangement

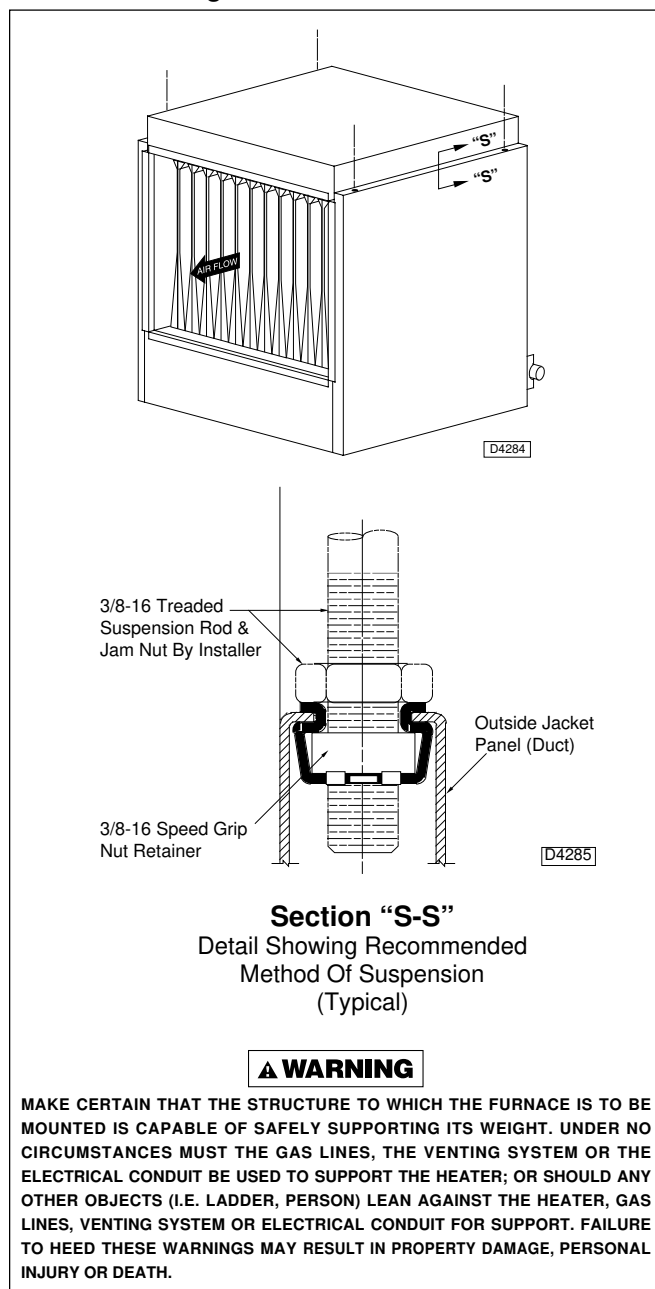


SUSPENSION: Refer to Figure 4 for typical suspension arrangements.

CAUTION The Separated Combustion Duct Furnace must be hung level from side to side, and from front to back, from four suspension points provided at the top of the unit. Failure to do so will result in poor performance and or premature failure of the unit.

WARNING Insure that all hardware used in the suspension or for duct furnace is more than adequate for the job. Failure to do so may result in extensive property damage, severe personal injury or death!

Figure 4 - Typical (4) Point Duct Suspending Arrangement



INSTALLATION (Continued)

ELECTRICAL CONNECTIONS



▲ WARNING

HAZARDOUS VOLTAGE! disconnect ALL ELECTRIC POWER INCLUDING REMOTE DISCONNECTS BEFORE SERVICING. Failure to disconnect power before servicing can cause severe personal injury or death.

Standard units are shipped for use on 115 volt, 60 hertz, single phase electric power. The motor name-plate and electrical rating of the transformer should be checked before energizing the duct furnace electrical system. All external wiring must conform to the latest edition of ANSI/NFPA No. 70-1996, National Electrical Code, and applicable local codes; in Canada, to the Canadian Electrical Code, Part 1, CSA Standard C22.1

▲ CAUTION Do not use any tools (i.e. screwdriver, pliers, etc.) across the terminals to check for power. Use a voltmeter.

▲ CAUTION USE COPPER CONDUCTORS ONLY! UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT OTHER TYPES OF CONDUCTORS. Failure to do so may cause damage to the equipment

It is recommended that the electrical power supply to each duct furnace be provided by a separate, fused, and permanently live electrical circuit. A disconnect switch of suitable electrical rating should be located as close to the gas valve as possible. Each duct furnace must be electrically grounded in accordance with the latest edition of the National Electrical Code, ANSI/NFPA No. 70-1996, or CSA Standard C22.1 Sample wiring diagrams are shown in Figures 6, 7, and 8.

THERMOSTAT WIRING AND LOCATION

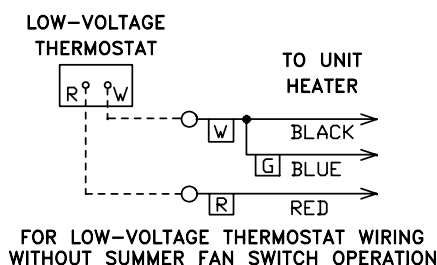
NOTICE: The thermostat must be mounted on a vertical, vibration-free surface, free from air currents, and in accordance with the furnished instructions.

Mount the thermostat approximately 5 feet (1.5m) above the floor, in an area where it will be exposed to a free circulation of average temperature air. Always refer to the thermostat instructions, as well as our unit wiring diagram, and wire accordingly. Avoid mounting the thermostat in the following locations:

1. Cold Areas- Outside walls or areas where drafts may affect the operation of the control.
2. Hot Areas- Areas where the sun's rays, radiation, or warm air currents may affect the operation of the control.
3. Dead Areas- Areas where the air cannot circulate freely, such as behind doors or in corners.

NOTICE: Thermostat wires tagged "W" and "G" must be connected together except when using a general purpose "SPDT" 24VAC relay and standard thermostat with a subbase, or when using a Honeywell T834H-1009 or T834H-1017 thermostat. Also refer to Figure 5 for other wiring connections.

Figure 5 - C1267G



THERMOSTAT HEAT ANTICIPATOR ADJUSTMENTS

The initial heat anticipator setpoint should equal the thermostat's current amperage draw when the unit is firing. This setpoint should be measured for the best results. Use the recommended ranges for a guide. If further information is needed, consult your thermostat manufacturer's instructions.

Recommended heat anticipator setting ranges:	
25 ft. (7.6m) T'stat wiring	50 ft. T'stat wiring
0.85 to 0.90 A	0.90 to 1.1 A Max. setting on t'stat

Figure 6 - Standard Wiring Diagram for Unit with Honeywell Ignition System.

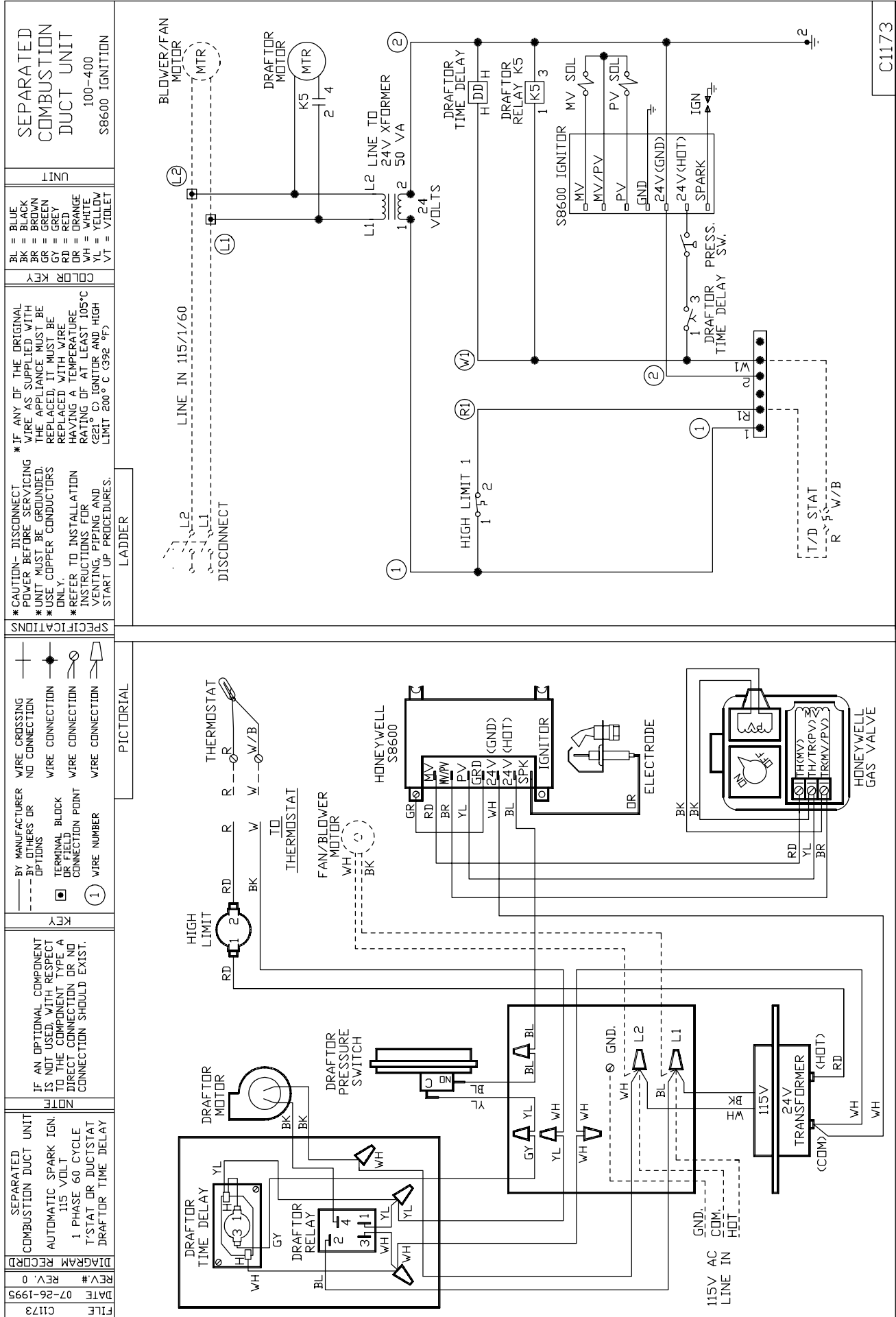
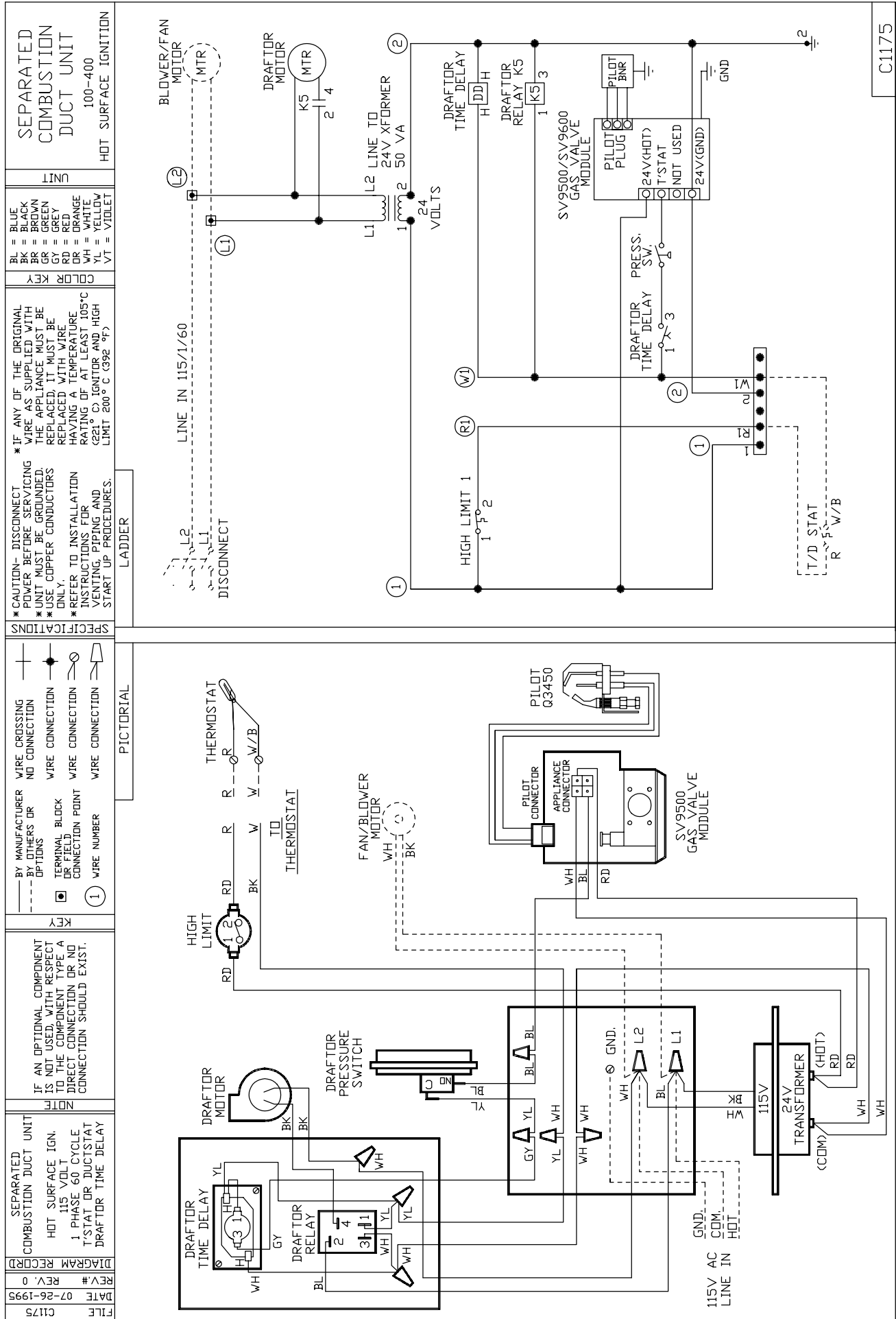


Figure 8 - Standard Wiring Diagram for Unit with Hot Surface Ignition System



INSTALLATION (Continued)

FAN TIME DELAY CONTROL (OPTIONAL)

Leads from the fan time delay control are factory wired to the junction box (when ordered as an optional component). The fan time delay control is a time delay relay (approximately 45 seconds ON, 65 seconds OFF). The fan time delay control is rated at 17 amps.

NOTICE: The start-up fan delay should not exceed 90 seconds from a cold start.

IMPORTANT: For all wiring connections, refer to the wiring diagram shipped with your unit (either affixed to the side jacket or enclosed in the installation instructions envelope). Should any original wire supplied with the heater have to be replaced, it must be replaced with wiring material having a temperature rating of at least 105°C.

Should any high limit wires have to be replaced, they must be replaced with wiring material having a temperature rating of 200°C minimum.

COMBUSTION AIR PIPING

▲ WARNING Never operate duct furnaces without combustion air and flue gas piping in place, or severe personal injury or death may occur!

1. The combustion air system installation must be in accordance with the latest edition of National Fuel Gas Code-NFPA 54, ANSI Z223.1 National Fuel Gas Code. In Canada, installation must be in accordance with CGA-B149.1 "Installation Code for Natural Gas Burning Appliances and Equipment" or CGA-B149.2 "Installation Code for Propane Burning Appliances and Equipment".
2. A Breidert Type L or Fields inlet cap furnished by the customer, must be installed at the termination point of the combustion air system, Figures 9 & 10. (Canadian duct furnaces include inlet caps.)

NOTICE: The top of the cap is to be no less than 12 inches from the top of the exhaust vent cap. See Figures 9 & 10.

3. Each duct furnace MUST have its own combustion air system. It MUST NOT be connected to other air intake systems.
4. Use single wall pipe constructed of 24 gauge galvanized steel, or material of equivalent durability and corrosion resistance for the combustion air system.

▲ WARNING Never use a pipe of a diameter other than that specified in Table 1, ("D" dia. flue opening)! Never use pvc or other non-metallic pipe for venting! To do so may result in serious damage to the unit, or severe personal injury or death!

5. Long runs of single wall combustion air piping passing through an unheated space may require insulating if condensation becomes noticeable.
6. The combustion air system must be installed to prevent collection of condensate. Pitch horizontal pipes downward 1/4 inch per foot (21mm/m) toward the inlet cap to facilitate drainage. Vertical combustion air pipes should be arranged as depicted in Figure 9.
7. The equivalent length of the combustion air system must not be less than 5 feet (1.5m) and must not exceed 50 feet (15.2m). Equivalent length is the total length of straight sections PLUS 15 feet (4.6m) for each 90 elbow and 5 feet (1.5m) for each 45 elbow.

NOTICE: For optimum performance, keep the combustion air system as straight as possible.

8. Each slip joint must be secured with at least three corrosion resistant screws. Two full turns of 3M #425 Aluminum Foil Tape or its equivalent must be used to seal each joint. General Electric RTV-108, Dow-Corning RTV-732, or an equivalent, may be used instead of the tape.
9. For horizontal combustion air systems longer than 5 feet (1.5m), the system must be supported from overhead building structures at 3 foot (1m) intervals.

EXHAUST VENTING

▲ WARNING Never operate duct furnaces without combustion air and flue gas piping in place, or severe personal injury or death may occur!

1. Vent system installation must be in accordance with the latest edition of National Fuel Gas Code-NFPA 54, ANSI Z223.1 National Fuel Gas Code. In Canada, installation must be in accordance with CGA-B149.1 "Installation Code for Natural Gas Burning Appliances and Equipment" or CGA-B149.2 "Installation Code for Propane Burning Appliances and Equipment".
2. A Breidert Type L or Fields vent cap furnished by the customer, must be installed at the termination point of the vent system, Figures 9 & 10. Canadian duct furnaces include inlet caps and a reducer/increaser (if required).
3. Each unit MUST have its own vent system. It MUST NOT be connected to other vent systems or to a chimney.

INSTALLATION (Continued)

- Use single wall pipe constructed of 24 gauge galvanized steel or material of equivalent durability and corrosion resistance for the vent system. For installation in Canada, use pipe constructed from 0.025 inch thick aluminum or 0.018 inch thick stainless steel.

▲ WARNING Never use a pipe of a diameter other than that specified in Table 1, (“D” dia. flue opening)! Never use pvc or other non-metallic pipe for venting! To do so may result in serious damage to the unit or severe personal injury or death!

- Any run of single wall vent pipe passing through an unheated space must be insulated with an insulation suitable to 550°F.
- The combustion and exhaust vent air systems must be installed to prevent collection of condensate. Pitch horizontal pipes downward 1/4 inch per foot (21mm/m) toward the terminal caps to facilitate drainage (see Figure 9A). Vertical vent pipes should be arranged as depicted in Figure 9.
- The equivalent length of the vent system must not be less than 5 feet (1.5m) and must not exceed 50 feet (15.2m). Equivalent length is the total length of straight sections PLUS 15 feet (4.6m) for each 90° elbow and 5 feet (1.5m) for each 45° elbow.
- Each slip joint must be secured with at least three corrosion resistant screws. Two full turns of 3M #425 Aluminum Foil Tape or its equivalent must be used to seal each joint. General Electric RTV-108, Dow-Corning RTV-732, or an equivalent, may be used instead of the tape.
- For horizontal vent systems longer than 5 feet (1.5m), the system must be supported from overhead building structures at 3 foot (1m) intervals.
- The exhaust vent system must remain at a minimum of 6 inches (152mm) from all combustible materials. Any part of the vent system that passes through a combustible material must be properly insulated.

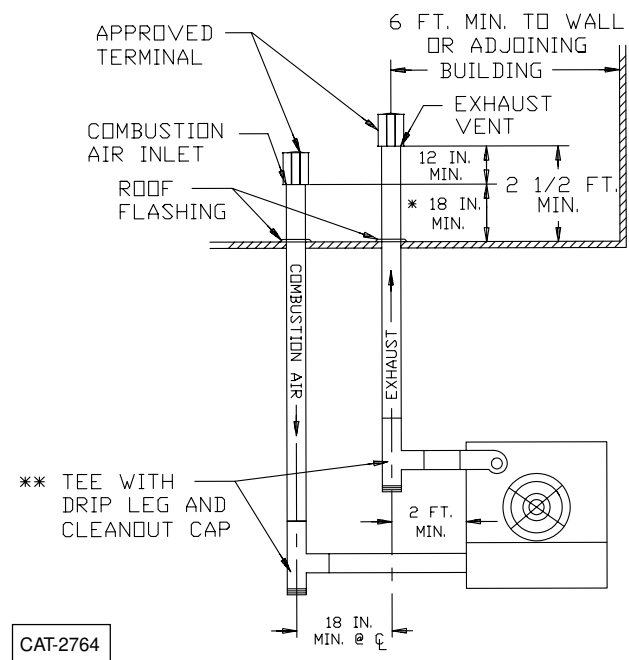
NOTICE: Increasing the clearance distance may be necessary if there is a possibility of distortion or discoloration of adjacent materials.

For a VERTICAL vent pipe section that passes through a floor or roof, an opening 4 inches (102mm) greater in diameter is required. The opening must be insulated and flashed in accordance with applicable installation codes.

A HORIZONTAL section of an exhaust vent system that passes through a combustible wall must be constructed and insulated as shown in Figure 10A.

- The top of a VERTICALLY VENTED exhaust system must extend at least 3 feet (1m) above the roof surface that it passes through. The point of termination for a HORIZONTALLY VENTED exhaust system must be at least 12 inches (305mm) from the exterior wall that it passes through. In addition, the termination point must be at least 3 feet (1m) above grade or above snow line, more than 6 feet (2m) from the combustion air inlet of another appliance, more than 3 feet (1m) from any building opening, and more than 4 feet (1.3m) from, and not directly above any electric meter, gas meter, regulator, or relief equipment. See Vent/Intake Installations in Figures 9 & 10.

Figure 9. Vertical Intake/Vent Installation



- * Size according to expected snow depths.
- ** If excessive condensation develops, a drip leg with a condensate drain may be required. Insulating pipes may eliminate the problem.

Figure 9A. Horizontal Intake/Vent Locations

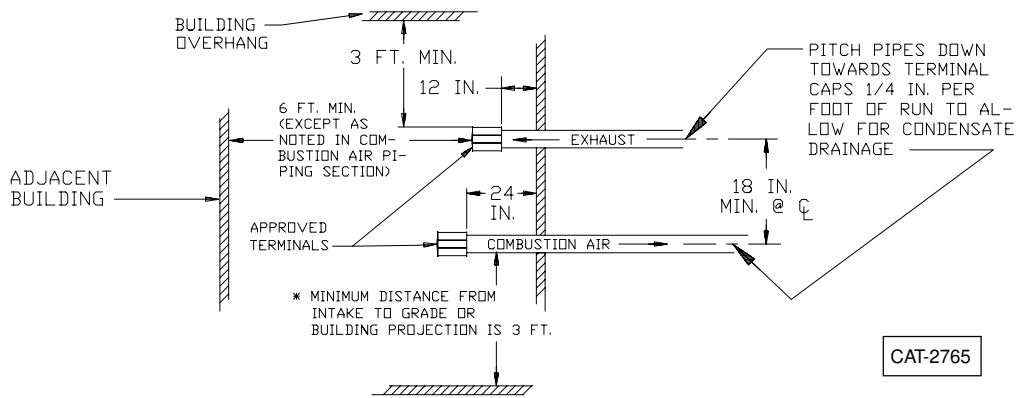


Figure 10. Vertical Vent Installation

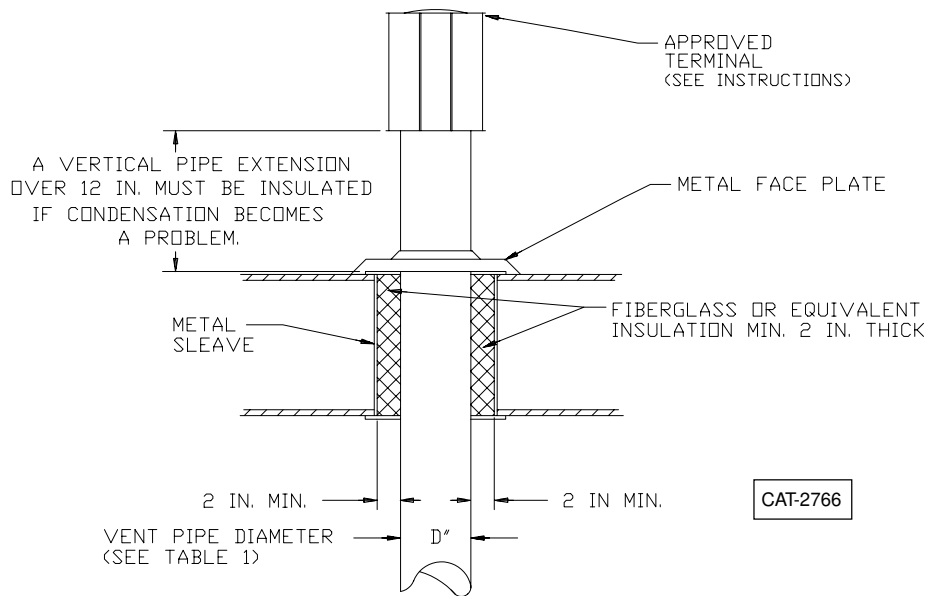
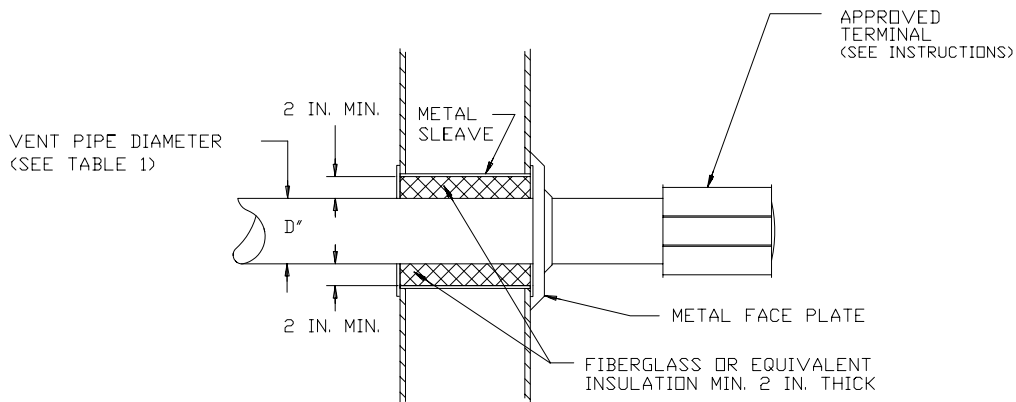


Figure 10A. Horizontal Vent Installation



NOTE: DO NOT TERMINATE HORIZONTAL VENT WHERE CONDENSATE COULD CREATE A NUISANCE OR HAZARD OR COULD CAUSE BUILDING OR EQUIPMENT DAMAGE.

GAS PIPING

▲ WARNING To avoid damage or possible personal injury, do not connect gas piping to this unit until a supply line pressure/leak test has been completed. Connecting the unit before completing the pressure/leak test may damage the gas valve and result in fire hazard.

▲ WARNING Do not rely on a shut-off valve to isolate the unit while conducting gas pressure/leak tests. These valves may not be completely shut off, exposing the gas valve to excessive pressure and damages.

PIPE SIZING

To provide adequate gas pressure to the gas duct furnace, size the gas piping as follows:

- Find cu. ft./hr. by using the following formula:

$$\text{Cu. ft./hr.} = \frac{\text{Input}}{\text{BTU/Cu. ft.}}$$
- Refer to table 4. Match "Length of Pipe in Feet" with appropriate "Gas Input - Cu. Ft./Hr." figure. This figure can then be matched to the pipe size at the top of the column.

Example:

It is determined that a 67 foot (20.4m) run of gas pipe is required to connect a 200 MBTU gas duct furnace to a 1,000 BTU/cu. ft. (0.29kW) natural gas supply.

$$\frac{200,000 \text{ BTU/Hr}}{1,000 \text{ BTU/Cu. ft.}} = 200 \text{ Cu. ft./hr.}$$

Using Table 4, a 1 inch pipe is needed.

NOTICE: See General Safety Information section for English/Metric unit conversion factors.

NOTICE: If more than one duct furnace is to be served by the same piping arrangement, the total cu. ft./hr. input and length of pipe must be considered.

NOTICE: If the duct furnace is to be fired with LP gas, consult your local LP gas dealer for pipe size information.

Heater installation for use with propane (bottled) gas must be made by a qualified LP gas dealer or installer. He will insure that proper joint compounds are used for making pipe connections; that air is purged from lines; that a thorough test is made for leaks before operating the heater; and that it is properly connected to the propane gas supply system.

Before any connection is made to the existing line supplying other gas appliances, contact the local gas company to make sure that the existing line is of adequate size to handle the combined load.

Table 4 - Gas Pipe Size

Maximum Capacity of Pipe in Cubic Feet of Gas per Hour (Cubic Meters per Hour) for Gas Pressures of 0.5 psig (3.5 kPa) or Less, and a Pressure Drop of 0.5 Inch Water Column (124.4 Pa)
(Based on a 0.60 Specific Gravity Gas)

Nominal Iron Pipe Size	Internal Dia.	Length of Pipe, Feet (meters)													
		10 (3.0)	20 (6.1)	30 (9.1)	40 (12.2)	50 (15.2)	60 (18.3)	70 (21.3)	80 (24.4)	90 (27.4)	100 (30.5)	125 (38.1)	150 (45.7)	175 (53.3)	200 (61.0)
1/2	0.622	175 (4.96)	120 (3.40)	97 (2.75)	82 (2.32)	73 (2.07)	66 (1.87)	61 (1.73)	57 (1.61)	53 (1.50)	50 (1.42)	44 (1.25)	40 (1.13)	37 (1.05)	35 (0.99)
3/4	0.824	360 (10.2)	250 (7.08)	200 (5.66)	170 (4.81)	151 (4.28)	138 (3.91)	125 (3.54)	118 (3.34)	110 (3.11)	103 (2.92)	93 (2.63)	84 (2.38)	77 (2.18)	72 (2.04)
1	1.049	680 (19.3)	465 (13.2)	375 (10.6)	320 (9.06)	285 (8.07)	260 (7.36)	240 (6.80)	220 (6.23)	205 (5.80)	195 (5.52)	175 (4.96)	160 (4.53)	145 (4.11)	135 (3.82)
1 1/4	1.380	1400 (39.6)	950 (26.9)	770 (21.8)	660 (18.7)	580 (16.4)	530 (15.0)	490 (13.9)	460 (13.0)	430 (12.2)	400 (11.3)	360 (10.2)	325 (9.20)	300 (8.50)	280 (7.93)
1 1/2	1.610	2100 (59.5)	1460 (41.3)	1180 (33.4)	990 (28.0)	900 (25.5)	810 (22.9)	750 (21.2)	690 (19.5)	650 (18.4)	620 (17.6)	550 (15.6)	500 (14.2)	460 (13.0)	430 (12.2)
2	2.067	3950 (112)	2750 (77.9)	2200 (62.3)	1900 (53.8)	1680 (47.6)	1520 (43.0)	1400 (39.6)	1300 (36.8)	1220 (34.5)	1150 (32.6)	1020 (28.9)	950 (26.9)	850 (24.1)	800 (22.7)
2 1/2	2.469	6300 (178)	4350 (123)	3520 (99.7)	3000 (85.0)	2650 (75.0)	2400 (68.0)	2250 (63.7)	2050 (58.0)	1950 (55.2)	1850 (52.4)	1650 (46.7)	1500 (42.5)	1370 (38.8)	1280 (36.2)
3	3.068	11000 (311)	7700 (218)	6250 (177)	5300 (150)	4750 (135)	4300 (122)	3900 (110)	3700 (105)	3450 (97.7)	3250 (92.0)	2950 (83.5)	2650 (75.0)	2450 (69.4)	2280 (64.6)
4	4.026	23000 (651)	15800 (447)	12800 (362)	10900 (309)	9700 (275)	8800 (249)	8100 (229)	7500 (212)	7200 (204)	6700 (190)	6000 (170)	5500 (156)	5000 (142)	4600 (130)

1. Determine the required Cu. Ft. / Hr. by dividing the rated heater input by 1000. For SI / Metric measurements: Convert unit Btu. / Hr. to kilowatts. Multiply the units input (kW) by 0.0965 to determine Cubic Meters / Hour. 2. FOR NATURAL GAS: Select the pipe size directly from the table. 3. FOR PROPANE GAS: Multiply the Cu. Ft. / Hr. (Cubic Meters per Hour) value by 0.633; then use the table. 4. Refer to the metric conversion factors listed in General Safety section for more SI unit measurements/conversions.

PIPE INSTALLATION

1. Install the gas piping in accordance with applicable local codes.
2. Check gas supply pressure. Each duct furnace must be connected to a manifold pressure and a gas supply capable of supplying its full rated capacity as specified in Table 5. A field LP tank regulator must be used to limit the supply pressure to a maximum of 14" W.C. (3.5 kPa). All piping should be sized in accordance with ANSI Standard Z223.1-1996, (or the latest edition) National Fuel Gas Code; in Canada, according to CGA B149. See Tables 1, 4 & 5 (of this manual) for correct gas piping size. If gas pressure is excessive on natural gas applications, install a pressure regulating valve in the line upstream from the main shutoff valve.
3. Adequately support the piping to prevent strain on the gas manifold and controls.
4. To prevent the mixing of moisture with gas, run the take-off piping from the top, or side, of the main.
5. Duct furnaces are shipped with a combination valve which includes:
 - a. Manual "A" valve
 - b. Manual "B" valve
 - c. Solenoid valve
 - d. Pilot safety
 - e. Pressure regulator

Pipe directly into the combination valve (see Figure 11).

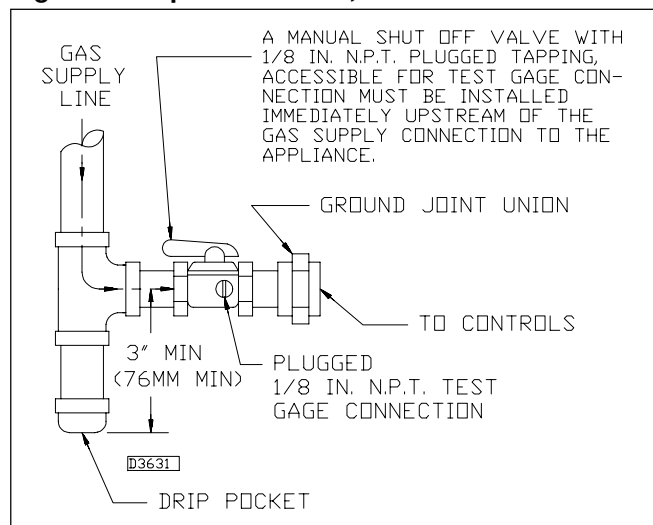
6. A 1/8" N.P.T. plugged tapping, accessible for test gauge connection, must be installed immediately upstream of the gas supply connection to the appliance.
7. Provide a drip leg in the gas piping near the gas duct furnace. A ground joint union and a manual gas shutoff valve should be installed ahead of the unit heater controls to permit servicing. The manual shutoff valve must be located external to the jacket (See Figure 11).
8. Make certain that all connections have been adequately doped and tightened.

▲ CAUTION Do not over tighten the inlet gas piping into the valve. This may cause stresses that will crack the valve!

NOTICE: Use pipe joint sealant resistant to the action of liquefied petroleum gases regardless of gas conducted.

▲ WARNING Check all pipe joints for leakage using a soap solution or other approved method. Never use an open flame or severe personal injury or death may occur!

Figure 11- Pipe Installation, Standard Controls



▲ DANGER Never use an open flame to detect gas leaks. Explosive conditions may exist which will result in personal injury or death.

The appliance and its individual shutoff valve must be disconnected from the gas supply piping system during any pressure testing of that system in excess of 1/2 psig (3.5 kPa).

The appliance must be isolated from the gas supply piping system by closing its individual manual shutoff valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 psig (3.5 kPa).

Table 5 - Gas Requirements*

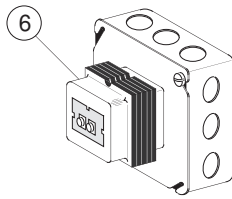
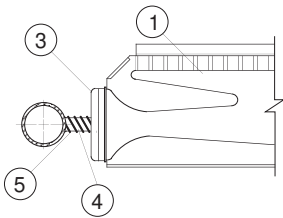
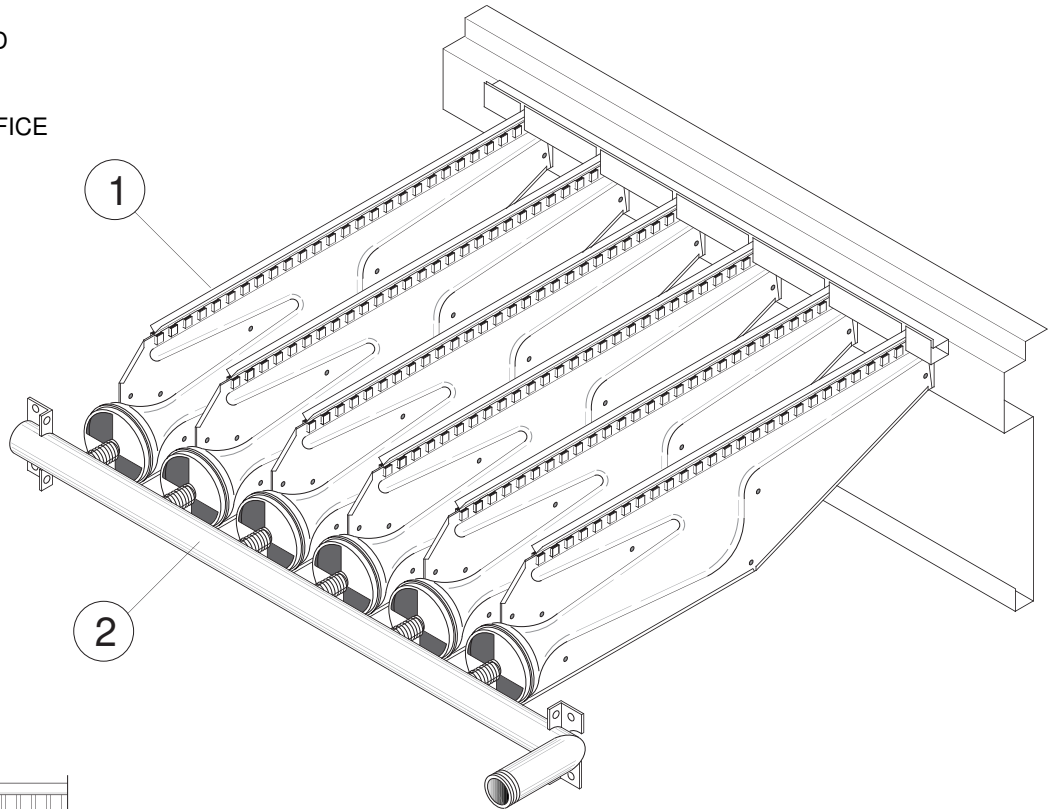
Gas Type	Natural Gas	Propane (LP) Gas
Manifold Pressure	3.5 in. W.C. (0.9 kPa)	10.5 in. W.C. (2.6 kPa)
Supply Inlet Pressure	14 in. W.C. Max. (3.5 kPa)	14 in. W.C. Max. (3.5 kPa)
	5.5 in W.C. Min. (1.4 kPa)	13.0 in W.C. Min. (3.2 kPa)

*For single stage applications only at normal altitudes.

Figure 12 - Burner Components – Intermittent Pilot Ignition

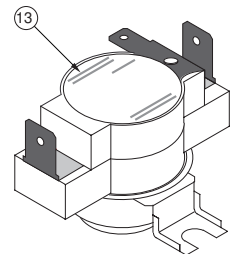
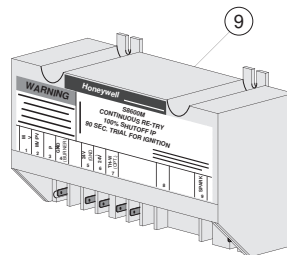
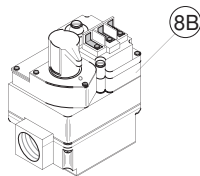
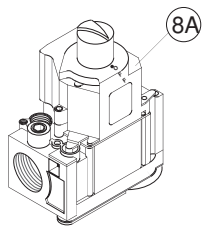
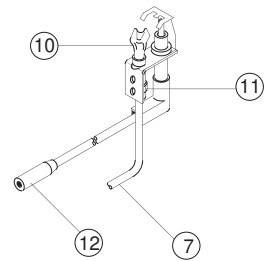
BURNER DRAWER COMMON PARTS:

1. MAIN BURNERS
2. BURNER MANIFOLD
3. AIR SHUTTERS
4. BURNER SPRINGS
5. MAIN BURNER ORIFICE
6. TRANSFORMER
7. PILOT TUBING



CONTROLS:

- 8A. MAIN GAS VALVE (HONEYWELL)
- 8B. MAIN GAS VALVE (WHITE RODGERS)
9. HONEYWELL IGNITOR
10. HONEYWELL PILOT BURNER
11. HONEYWELL PILOT ORIFICE
12. HONEYWELL ELECTRODE/SENSOR LEAD
13. HIGH LIMIT
(LOCATED ON THE REAR HEADER PLATE OF THE HEAT EXCHANGER - AIR INLET SIDE).



GAS INPUT RATE

▲ CAUTION Never overfire the duct furnace, as this may cause unsatisfactory operation, or shorten the life of the heater.

Check the gas input rate as follows (Refer to General Safety Information section for metric conversions).

1. Turn off all gas appliances that use gas through the same meter as the unit heater.
2. Turn the gas on to the unit heater.
3. Clock the time in seconds required to burn 1 cubic foot of gas by checking the gas meter.
4. Insert the time required to burn one cubic foot of gas into the following formula and compute the input rate

$$\frac{3600 \text{ (Sec. per Hr.)} \times \text{BTU/Cu./Ft.}}{\text{Time (Sec.)}} = \text{Input Rate}$$

For example, assume the BTU content of one cubic foot of gas is 1000, and that it takes 18 seconds to burn one cubic foot of gas.

$$\frac{3600 \times 1000}{18} = 200,000$$

NOTICE: If the computation exceeds, or is less than 95% of the gas BTU/hr. input rating (see Table 2), adjust the gas pressure.

Adjust the gas pressure as follows:

1. **NATURAL GAS:** Best results are obtained when the duct furnace is operating at its full rated input with the manifold pressure of 3.5 inches W.C. (0.9 kPa). Adjustment of the pressure regulator is not normally necessary since it is preset at the factory. However, field adjustment may be made as follows:
 - a. Attach manometer at the pressure tap plug below the control outlet.
 - b. Remove the regulator adjustment screw cap, located on the combination gas valve.
 - c. With a small screwdriver, rotate the adjustment screw clockwise to increase pressure.
 - d. Replace regulator adjustment screw cap.
2. **PROPANE GAS:** An exact manifold pressure of 10.0 inches W.C. (2.5 kPa) must be maintained for proper operation of the duct furnace. If the unit is equipped with a pressure regulator on the combination gas valve, follow steps "a" through "d" above. If the unit is not so equipped, the propane gas supply system pressure must be regulated to attain this manifold operating pressure.

Table 6 - Main Burner Orifice Schedule*

* INPUT IN 1000 BTU	TYPE OF GAS	NATURAL	PROPANE	NO. OF BURNER ORIFICES
	HEATING VALUE	1075 BTU/Ft ³ (40.1 MJ/m ³)	2500 BTU/Ft ³ (93.1 MJ/m ³)	
	MANIFOLD PRESSURE	3.5" W.C. (0.9 kPa)	10.5" W.C. (2.6 kPa)	
100	FT ³ /HR ORIFICE DRILL	96 41	40 54	4
125	FT ³ /HR ORIFICE DRILL	120 41	50 54	5
150	FT ³ /HR ORIFICE DRILL	140 41	60 54	6
175	FT ³ /HR ORIFICE DRILL	163 41	70 54	7
200	FT ³ /HR ORIFICE DRILL	186 41	80 54	8
225	FT ³ /HR ORIFICE DRILL	210 41	90 54	9
250	FT ³ /HR ORIFICE DRILL	233 41	100 54	10
300	FT ³ /HR ORIFICE DRILL	280 41	120 54	12
350	FT ³ /HR ORIFICE DRILL	326 41	140 54	14
400	FT ³ /HR ORIFICE DRILL	372 41	160 54	16

* This schedule is for units operating at normal altitudes of 2000 ft. (610m) or less. Special orifices are required for installations above 2000 feet (610m).

When installed in Canada, any references to deration at altitudes in excess of 2000 feet (610m) are to be ignored. At altitudes of 2000 to 4500 feet (610 to 1372m), the unit heaters must be orificed to 90% of the normal altitude rating, and be so marked in accordance with the C.G.A. certification.

PILOT ADJUSTMENT

1. Remove the PILOT ADJUSTMENT CAP.
2. Adjust the pilot screw to provide a properly sized flame.
3. A proper flame is a soft, steady flame that envelops ³/₈ to ¹/₂ inch (9.5 to 12.7mm) of the flame sensor.
4. Replace the pilot adjustment cap.

MANIFOLD PRESSURE ADJUSTMENT

If the manifold pressure requires adjustment, remove the cap from the pressure regulator and turn the adjustment screw clockwise to increase the pressure, and counterclockwise to decrease the pressure. The adjusted manifold pressure should not vary more than 10% from the pressures specified in Table 6.

OPERATION

▲ CAUTION Never operate the unit beyond the specified limits or severe damage to, and/or premature failure of, the unit will result!

EXPLANATION OF CONTROLS

1. Each Separated Combustion Duct Furnace comes equipped with a power vent system that consists of a power ventor motor and blower, pressure switch, and sealed flue collector. (See Figure 16)

▲ CAUTION The addition of external draft hoods or power ventors is not permitted. Addition of such devices may cause serious unit malfunction or failure.

2. The power ventor is energized by the room thermostat when a demand for heat is sensed. The pressure switch measures the differential pressure between the air inlet and the exhaust vent systems. If the differential is correct, the indirect spark ignition system is energized.

▲ WARNING Under no circumstances is the unit to be fired if the power ventor is not operable, or severe personal injury or death may occur!

3. The indirect spark ignition system consists of an ignition module, a dual combination gas valve, and a spark-ignited pilot burner. When the pressure switch is closed, the pilot valve opens as a spark is generated to light the pilot. When the flame is sensed by the flame sensing circuit, the spark ceases, and the main gas valve opens to supply gas to the main burners. Once the thermostat is satisfied, the vent system and gas valve are simultaneously de-energized, stopping all gas flow to the unit.
4. The high limit switch interrupts the flow of electrical current to the main gas valve if the duct furnace becomes overheated.
5. The optional fan switch delays the operation of the fan for approximately 45 seconds once the thermostat is closed, and continues fan operation for approximately 65 seconds after the thermostat opens. The start-up fan delay must not exceed 90 seconds from a cold start.
6. The wall thermostat, supplied optionally, is a temperature sensitive switch that operates the vent and ignition systems to control the temperature of the space being heated.

NOTICE: The thermostat must be mounted on a vertical, vibration-free surface, free from air currents, and in accordance with the furnished instructions.

INITIAL LIGHTING

1. Open the manual gas valve, in the gas supply line to the duct furnace. Loosen the union in the gas supply line to purge it of air. Tighten the union, and check for leaks.

NOTICE: Check all pipe joints for leakage using a soap solution or other approved method.

▲ DANGER Never use an open flame to detect gas leaks. Explosive conditions may exist which could result in property damage, personal injury or death.

▲ WARNING Before attempting to light or relight the pilot, wait 5 minutes to allow gas which may have accumulated in the burner compartment to escape. Failure to heed this warning could result in property damage, personal injury or death!

2. Turn on electrical power. The duct furnace should now be under the control of the thermostat. Set the thermostat to it's highest setting, the power ventor motor should start, and burner ignition occur. Turn the thermostat to the lowest setting. The burners and power ventor should stop operating immediately. Reset the thermostat to the desired operational setting.

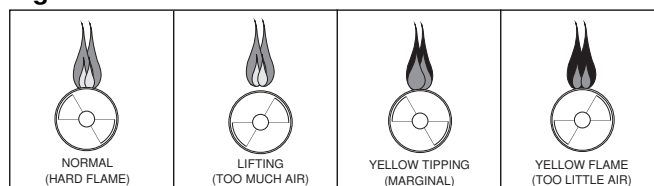
PRIMARY AIR SHUTTER ADJUSTMENT

After the unit has been operating for at least 15 minutes, adjust the primary air flow to the burners. Turn the friction-locked, manually-rotated air shutters clockwise to close, and counterclockwise to open.

For correct air adjustment, close the shutter until yellow tips in the flame appear. Then, open the air shutter to the point just beyond where the yellow tipping disappears. Refer to Figure 12.

NOTICE: There may be momentary and spasmodic orange flashes in the flame. This is caused by the burning of airborne dust particles, and should not be confused with yellow tipping, which is a stable, or permanent, situation when there is insufficient primary air.

Figure 13 - Main Burner Flames



SHUT DOWN

1. Turn the valve selector knob to the "OFF" position.
2. Turn off the electricity.
3. To relight, follow "Initial Lighting" instructions.

MAINTENANCE

PERIODIC SERVICE

▲ WARNING Open all disconnect switches and secure in that position before servicing unit. Failure to do so may result in personal injury or death from electrical shock!

NOTICE: The heater and vent system should be checked once a year by a qualified technician.

Should maintenance be required, perform the following inspection and service routine:

1. Inspect the area near the unit to be sure that there is no combustible material located within the minimum clearance requirements listed in Table 3.

▲ WARNING Under no circumstances should combustible material be located within the clearances specified in Table 3. Failure to provide proper clearances could result in personal injury or equipment damage from fire!

2. Turn off the manual gas valve and electrical power to the duct furnace.
3. To clean or replace the main burners, open the bottom panel and compress the spring by moving the burner toward the manifold. Slide the opposite end of the burner downward from the locating slot while retaining spring is still compressed. Pull the burners away from the heater.

4. With the burners removed, wire brush the inside surfaces of the heat exchanger.
5. Remove any dirt, dust, or other foreign matter from the burners using a wire brush and/or compressed air. Ensure that all parts are unobstructed. Inspect and clean the pilot burner if necessary.
6. Reassemble the gas duct furnace by replacing all parts in reverse order.
7. Complete the appropriate unit start-up procedure as given in the "Operation" section of this manual (see unit lighting instruction plate and the unit nameplate).
8. Check the burner adjustment. See "Primary Air Shutter Adjustment" section in this manual.
9. Check all gas control valves and pipe connections for leaks.
10. Check the operation of the automatic gas valve by lowering the setting of the thermostat, stopping the operation of the gas duct furnace. The gas valve should close tightly, completely extinguishing the flame on the main burners.
11. Inspect and service the blower section of the system.
12. Check and test the operational functions of all safety devices supplied with your unit.

Figure 14 - Combustion Chamber

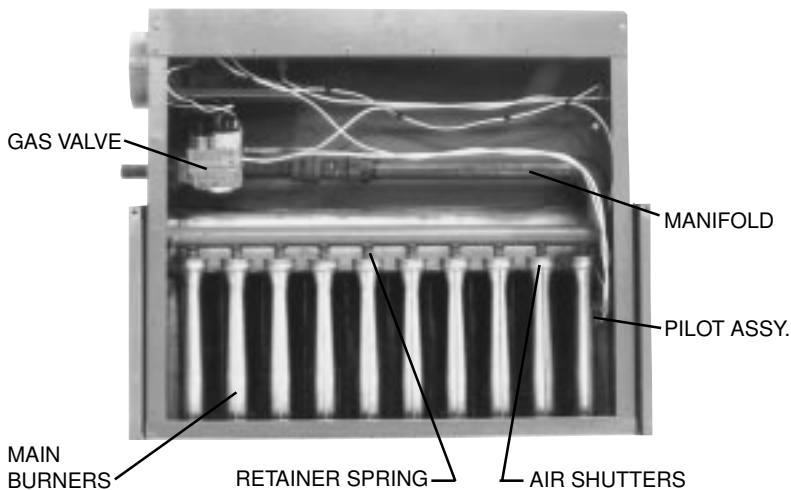


Figure 15 - Internal Furnace Assembly

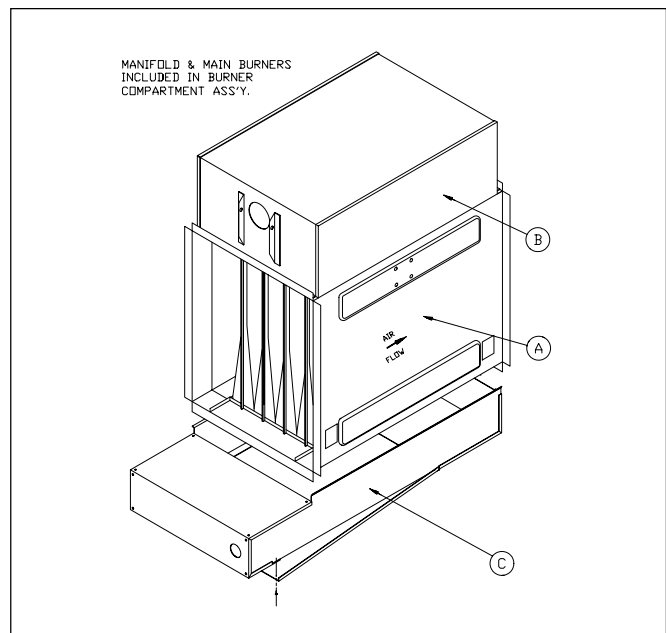
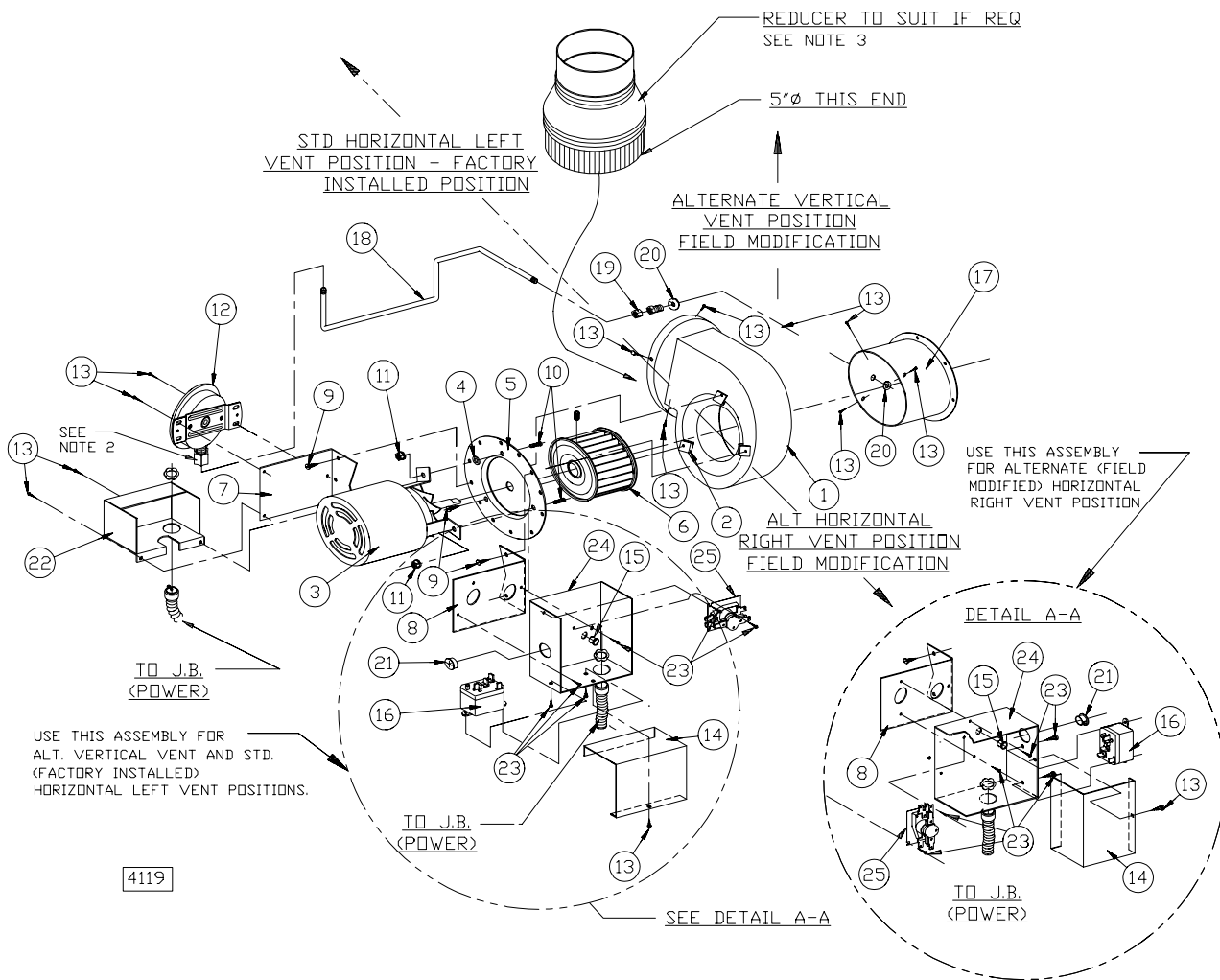


Figure 16 - Power Venter Assembly



REF. NO.	DESCRIPTION
1	Blower Housing Assembly
2	Speed Nut
3	Motor
4	Washer, Plain
5	Plate Adapter
6	Blower Wheel
7	Mounting Bracket (Pressure Switch)
8	Mounting Bracket (Junction Box)
9	Screw, S.T.
10	Screw, Machine (L = 3/4")
11	Nut, Keps (Ext. Lock Washer)
12	Air Pressure Switch*
13	Drill Screw

REF. NO.	DESCRIPTION
14	Junction Box Cover
15	Snap Bushing
16	Relay (Motor)
17	Draftor Stack Assembly
18	Tubing (Aluminum) Formation
19	Male Connector
20	Locknut
21	Hole Plug
22	Pressure Switch Cover
23	Drill Screw
24	Junction Box Base
25	Relay (Purge)

NOTES:

- *1) For item No. 6 use counter-clockwise rotation.
- 2) **DO NOT OVERTIGHTEN CELCON NUT! HAND TIGHTEN ONLY! DO NOT USE TOOLS!**
Approximate 1/3 turn maximum or 8 inch pounds is sufficient from the point where the tube does not slip in or out.
- 3) Flue Sizes:
 100/175 units: 4" dia. flue outlet Reducer required – To be supplied by installer.
 200/250 units: 5" dia. flue outlet (no adaptor required on flue).
 300/400 units: 6" dia. flue outlet Increaser required – To be supplied by manufacturer.
 Exception: "CGA" requires manufacturer to supply Canadian units with flue reducers or increasers.

Table 7 - Trouble Shooting Guide

SYMPTOMS	POSSIBLE CAUSE(S)	CORRECTIVE ACTION
A. Flame lifting from burner ports.	<ol style="list-style-type: none"> 1. Pressure regulator set too high. 2. Defective regulator. 3. Burner orifice too large. 	<ol style="list-style-type: none"> 1. Reset manifold Pressure. Refer to "Operation". 2. Replace regulator section of combination gas valve or complete valve. 3. Check with local gas supplier for proper orifice size, and replace. Refer to "Operation".
B. Flame pops back.	<ol style="list-style-type: none"> 1. Excessive primary air. 2. Burner orifice too small. 	<ol style="list-style-type: none"> 1. Close air shutter. Refer to "Operation". 2. Check with local gas supplier for proper orifice size and replace. Refer to "Operation".
C. Noisy flame.	<ol style="list-style-type: none"> 1. Too much primary air. 2. Noisy pilot. 3. Irregular orifice causing whistle or resonance. 4. Excessive gas input. 	<ol style="list-style-type: none"> 1. Close air shutter. 2. Reduce pilot gas. Refer to "Operation". 3. Replace orifice. 4. Reset manifold pressure. Refer to "Operation": Replace regulator section of combination gas valve or complete valve; or Check with local gas supplier for proper orifice size, and replace. Refer to "Operation".
D. Yellow tip flame (some yellow tipping on propane gas is permissible).	<ol style="list-style-type: none"> 1. Insufficient primary air. 2. Clogged burner ports. 3. Misaligned orifices. 4. Clogged draft hood. 5. Air shutter. 6. Insufficient combustion air. 	<ol style="list-style-type: none"> 1. Open air shutter. Refer to "Operation". 2. Clean main burner ports. 3. Replace manifold assembly. 4. Clean draft hood. 5. Check for dust or lint at air mixer opening and around air shutter. 6. Check for obstruction in combustion air inlet cap and piping. See "Installation".
E. Floating flame.	<ol style="list-style-type: none"> 1. Blocked Venting. 2. Insufficient combustion air. 3. Blocked heat exchanger 4. Air leak into combustion chamber or draft hood. 	<ol style="list-style-type: none"> 1. Clean flue. Refer to "Installation". 2. Check for obstruction in combustion air inlet cap and piping. See "Installation". 3. Clean heater. 4. Determine cause and repair accordingly.
F. Gas odor.	<ol style="list-style-type: none"> 1. Shut off gas immediately. 2. Blocked heat exchanger/venting. 3. Drafts around heater. 4. Negative pressure in building. 5. Blocked draft hood. 	<ol style="list-style-type: none"> 1. Inspect all gas piping and repair. 2. Clean heat exchanger/flue. 3. Eliminate drafts. Refer to "Installation". 4. See "Installation". 5. Clean draft hood.

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SYMPTOMS	POSSIBLE CAUSE(S)	CORRECTIVE ACTION
G. Delayed ignition.	<ol style="list-style-type: none"> 1. Excessive primary air. 2. Main burner ports clogged near pilot. 3. Pressure regulator set too low. 4. Pilot decreases in size when main burners come on. 5. Pilot flame too small. 6. Drafts around ventor. 7. Improper venting. 	<ol style="list-style-type: none"> 1. Close air shutter. Refer to "Operation". 2. Clean main burner ports. 3. Reset manifold pressure. Refer to "Operation". 4. Supply piping is inadequately sized. Refer to "Installation". 5. Clean pilot orifice. Refer to "Operation". 6. Eliminate drafts. Refer to "Installation". 7. Refer to "Installation".
H. Failure to ignite.	<ol style="list-style-type: none"> 1. Main gas valve off. 2. Lack of power at unit. 3. Thermostat not calling for heat. 4. Defective limit switch. 5. Improper thermostat or transformer wiring at gas valve. 6. Defective gas valve. 7. Defective thermostat. 8. Defective transformer. 9. Loose wiring. 10. Defective ignition control. 	<ol style="list-style-type: none"> 1. Open all manual gas valves. 2. Replace fuse or turn on power supply. 3. Turn up thermostat. 4. Check limit switch with continuity tester. If open, replace high limit. 5. Check wiring per wiring diagrams. 6. Replace gas valve. 7. Check thermostat and replace if defective. 8. Be sure 115 volts is supplied to the transformer primary, then check for 24 volts at secondary terminal before replacing. 9. Check and tighten all wiring connections per diagrams. 10. Replace, if necessary. Also see W, X, & Y symptoms.
J. Condensation of water vapor.	<ol style="list-style-type: none"> 1. Condensation of water vapor. 	<ol style="list-style-type: none"> 1. Refer to "Installation, Venting".
K. Burner won't turn off.	<ol style="list-style-type: none"> 1. Poor thermostat location. 2. Defective thermostat. 3. Improper thermostat or transformer wiring at gas valve. 4. Short circuit. 5. Defective or sticking gas valve. 6. Excessive gas supply pressure. 	<ol style="list-style-type: none"> 1. Relocate thermostat away from drafts. 2. Replace thermostat. 3. Check wiring diagrams. 4. Check operation at valve. Look for short (such as staples piercing thermostat wiring) and correct. 5. Replace gas valve. 6. Refer to "Operation".

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SYMPTOMS	POSSIBLE CAUSE(S)	CORRECTIVE ACTION
L. Rapid burner cycling.	<ol style="list-style-type: none"> 1. Loose wire connections at gas valve or thermostat. 2. Excessive thermostat heat anticipator. 3. Unit cycling on high limit. 4. Poor thermostat location. 5. Draft on pilot. 6. Defective ignitor control. 7. Defective high limit. 	<ol style="list-style-type: none"> 1. Tighten all connections. 2. Adjust thermostat for longer cycles. Refer to "Operation". 3. Check for proper air supply across heat exchanger. 4. Relocate thermostat (do not mount thermostat on unit). 5. Eliminate drafts. Refer to "Installation". 6. Replace ignitor. 7. Jumper high limit switch terminals 1 and 2. If burner operates normally, replace switch.
M. Noisy power ventor.	<ol style="list-style-type: none"> 1. Power ventor wheel loose. 2. Power ventor wheel dirty. 3. Power ventor wheel rubbing housing. 4. Bearings are dry. 	<ol style="list-style-type: none"> 1. Replace or tighten. 2. Clean power ventor wheel. 3. Realign power ventor wheel. 4. Oil bearings on power ventor motor. Refer to label on motor.
N. Pilot will not light or will not stay lit.	<ol style="list-style-type: none"> 1. Main gas valve off. 2. Pilot adjustment screw turned too low on combination main gas valve. 3. Air in gas line. 4. Incorrect lighting procedure. 5. Dirt in pilot orifice. 6. Extremely high or low gas pressure. 7. Drafts around unit. 8. Pilot valve not opening (faulty wiring). 9. No spark (faulty wiring). 10. Defective gas valve. 	<ol style="list-style-type: none"> 1. Open all manual gas valves. 2. Refer to "Operation". 3. Purge air from gas line. 4. Follow lighting instruction label adjacent to gas valve. 5. Remove pilot orifice. Clean with compressed air or solvent. Do not ream. 6. Refer to "Operation". 7. Eliminate drafts. Refer to "Installation". 8. Inspect and correct wiring. 9. Inspect and correct ignition system wiring. See symptoms W, X & Y. 10. Replace gas valve.

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SYMPTOMS	POSSIBLE CAUSE(S)	CORRECTIVE ACTION
O. Power ventor will not run.	<ol style="list-style-type: none"> 1. Loose wiring. 2. Defective motor overload protector or defective motor. 3. Defective power ventor relay. 	<ol style="list-style-type: none"> 1. Check and tighten all wiring connections per diagrams. Thermostat wires tagged "W" and "G" must be connected together (unless special thermostats are used; if so, see thermostat wiring diagram). See "Electrical Connections". 2. Replace motor. 3. Check 24V across 1 and 3 terminals on fan relay. If 24V is present, jumper terminals numbered 2 and 4. If motor runs, the relay is defective and must be replaced. If 24V in not present, check wiring per wiring diagrams.
P. Power ventor motor turns on and off while burners are operating.	<ol style="list-style-type: none"> 1. Fan relay heater element improperly wired. 2. Defective ventor relay switch. 3. Motor protector cycling on and off. 4. Motor not properly oiled. 	<ol style="list-style-type: none"> 1. Be sure ventor relay heater terminals are connected per diagrams. 2. Replace ventor motor. 3. Check motor amps against motor name plate rating, check voltage, replace power ventor motor if defective. 4. Refer to label on motor.
Q. Power ventor motor will not stop.	<ol style="list-style-type: none"> 1. Improperly wired ventor relay. 2. Main burners not lighting while thermostat calls for heat. 3. Defective ventor relay. 	<ol style="list-style-type: none"> 1. Check all wiring. 2. Refer to H & N Symptoms. 3. Replace ventor relay.
R. Not enough heat.	<ol style="list-style-type: none"> 1. Incorrect gas input. 2. Heater undersized. 3. Thermostat malfunction. 4. Heater cycling on high limit. 5. Check outside dampers if used. 	<ol style="list-style-type: none"> 1. Refer to "Operation". 2. This is especially true when heated space is enlarged. Have heat loss calculated and compare to heater output (80% of input). Your gas supplier or installer can furnish this information. If heater is undersized, add additional heaters. 3. Replace thermostat. 4. Check air movement through heat exchanger. Check voltage to fan motor. Clean power ventor motor. 5. Adjust dampers accordingly.
T. Too much heat.	<ol style="list-style-type: none"> 1. Thermostat malfunction. 2. Heater runs continuously. 	<ol style="list-style-type: none"> 1. Replace thermostat. 2. Check wiring diagrams; Check operation at valve. Look for short (such as staples piercing thermostat wiring) and correct: Replace gas valve; Refer to "Operation".
U. Cold air is delivered on start-up	<ol style="list-style-type: none"> 1. Fan relay heater element improperly wired. 	<ol style="list-style-type: none"> 1. Be sure fan relay heater terminal are connected per diagrams.

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SYMPTOMS	POSSIBLE CAUSE(S)	CORRECTIVE ACTION
V. Cold air is delivered during heater operation.	<ol style="list-style-type: none"> 1. Incorrect manifold pressure or input. 2. Voltage to unit too high. 3. Air through put too high. 	<ol style="list-style-type: none"> 1. Refer to "Operation". 2. Check motor voltage with fan running. Should be 115 volts AC. 3. Refer to "Operation".
W. No spark.	<ol style="list-style-type: none"> 1. Thermostat not calling for heat. 2. No low voltage. 3. Spark gap closed or too wide. 4. Broken or cracked ceramic on spark electrode. 	<ol style="list-style-type: none"> 1. Close thermostat contacts. 2. Check for 24V across 24V terminals of S8600. 3. Set gap to 0.1". 4. Replace pilot assembly.
X. Spark present but pilot does not light.	<ol style="list-style-type: none"> 1. Loose S8600 connections. 2. Improper gas pressure. 3. Is spark in pilot gas stream? 4. No pilot gas — do not use match to test - presence of gas is easily detected by the odor. 	<ol style="list-style-type: none"> 1. Check all connections, term. PV feeds 24V to pilot valve. 2. Check pressure — pressure that is either too high or too low may cause a problem. 3. Spark should arc from electrode. 4. Check pilot line for kinks. Insure there are no drafts.
Y. Pilot lights — Main valve does not energize.	<ol style="list-style-type: none"> 1. Loose S8600 connections. 2. Cracked or broken sensor ceramic. 3. Check sensor/spark lead for continuity. 4. Measure 24 volts from term. MV to term. MV/PV. 	<ol style="list-style-type: none"> 1. Check connections-term. MV feeds main valve. 2. Replace pilot assembly. 3. Replace if needed. 4. If present, replace main valve; if not, replace S8600 Igniter.
Z. Hi-Limit switch tripping.	<ol style="list-style-type: none"> 1. Unit is overfiring. 2. Air flow too low 3. Defective switch. 	<ol style="list-style-type: none"> 1. Manifold pressure too high; adjust Burner orifices may be too large: verify/replace if req'd. 2. Increase air flow; check fan size. Check for proper voltage. 3. Replace.

HOW TO ORDER REPLACEMENT PARTS

Please send the following information to your local representative; If further assistance is needed, contact the manufacturer's customer service department.

- Model number
- Serial Number (if any)
- Part description and Number as shown in the Replacement Parts Catalog.

LIMITED WARRANTY

SEPARATED COMBUSTION DUCT FURNACE

1. The "Manufacturer" warrants to the original owner at original installation site that our Separated Combustion Duct Furnace ("the Product") will be free from defects in material or workmanship for one (1) year from the date of shipment from the factory. If upon examination by the Manufacturer the Product is shown to have a defect in material or workmanship during the warranty period, the Manufacturer will repair or replace, at its option, that part of the Product which is shown to be defective.
2. This limited warranty does not apply:
 - (a) if the Product has been subjected to misuse or neglect, has been accidentally or intentionally damaged, has not been installed, maintained or operated in accordance with the furnished written instructions, or has been altered or modified in any way by any unauthorized person.
 - (b) to any expenses, including labor or material, incurred during removal or reinstallation of the Product.
 - (c) to any damage due to corrosion by chemicals, including halogenated hydrocarbons, precipitated in the air.
 - (d) to any workmanship of the installer of the Product.
3. This limited warranty is conditional upon:
 - (a) advising the installing contractor, who will in turn notify the distributor or manufacturer.
 - (b) shipment to the Manufacturer of that part of the Product thought to be defective . Goods can only be returned with prior written approval of the Manufacturer. All returns must be freight prepaid.
 - (c) determination in the reasonable opinion of the Manufacturer that there exists a defect in material or workmanship.
4. Repair or replacement of any part under this Limited Warranty shall not extend the duration of the warranty with respect to such repaired or replaced part beyond the stated warranty period.
5. **THIS LIMITED WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EITHER EXPRESS OR IMPLIED, AND ALL SUCH OTHER WARRANTIES, INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARE HEREBY DISCLAIMED AND EXCLUDED FROM THIS LIMITED WARRANTY. IN NO EVENT SHALL THE MANUFACTURER BE LIABLE IN ANY WAY FOR ANY CONSEQUENTIAL, SPECIAL, OR INCIDENTAL DAMAGES OF ANY NATURE WHATSOEVER, OR FOR ANY AMOUNTS IN EXCESS OF THE SELLING PRICE OF THE PRODUCT OR ANY PARTS THEREOF FOUND TO BE DEFECTIVE. THIS LIMITED WARRANTY GIVES THE ORIGINAL OWNER OF THE PRODUCT SPECIFIC LEGAL RIGHTS. YOU MAY ALSO HAVE OTHER RIGHTS WHICH MAY VARY BY EACH JURISDICTION.**

In the interest of product improvement, we reserve the right to make changes without notice.

