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INSTALLATION AND SERVICE MANUAL

gas-fired indoor separated combustion duct furnaces

model DFS



FOR YOUR SAFETY

IF YOU SMELL GAS:

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

! WARNING

Improper installation, adjustment, alteration, service or maintenance can cause property damage, injury or death, and could cause exposure to substances which have been determined by various state agencies to cause cancer, birth defects or other reproductive harm. Read the installation, operating and maintenance instructions thoroughly before installing or servicing this equipment.

! CAUTION

To prevent premature heat exchanger failure do not locate ANY gas-fired units in areas where chlorinated, halogenated, or acid vapors are present in the atmosphere.

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.

IMPORTANT

The use of this manual is specifically intended for a qualified installation and service agency. A qualified installation and service agency must perform all installation and service of these appliances.

Inspection on Arrival

1. Inspect unit upon arrival. In case of damage, report it immediately to transportation company and your local factory sales representative.
2. Check rating plate on unit to verify that power supply meets available electric power at the point of installation.
3. Inspect unit upon arrival for conformance with description of product ordered (including specifications where applicable).

SPECIAL PRECAUTIONS / TABLE OF CONTENTS

SPECIAL PRECAUTIONS

THE INSTALLATION AND MAINTENANCE INSTRUCTIONS IN THIS MANUAL MUST BE FOLLOWED TO PROVIDE SAFE, EFFICIENT AND TROUBLE-FREE OPERATION. IN ADDITION, PARTICULAR CARE MUST BE EXERCISED REGARDING THE SPECIAL PRECAUTIONS LISTED BELOW. FAILURE TO PROPERLY ADDRESS THESE CRITICAL AREAS COULD RESULT IN PROPERTY DAMAGE OR LOSS, PERSONAL INJURY, OR DEATH. THESE INSTRUCTIONS ARE SUBJECT TO ANY MORE RESTRICTIVE LOCAL OR NATIONAL CODES.

HAZARD INTENSITY LEVELS

1. **DANGER:** Indicates an imminently hazardous situation which, if not avoided, WILL result in death or serious injury.
2. **WARNING:** Indicates a potentially hazardous situation which, if not avoided, COULD result in death or serious injury.
3. **CAUTION:** Indicates a potentially hazardous situation which, if not avoided, MAY result in minor or moderate injury.
4. **IMPORTANT:** Indicates a situation which, if not avoided, MAY result in a potential safety concern.

DANGER

Appliances must not be installed where they may be exposed to a potentially explosive or flammable atmosphere.

WARNING

1. This gas fired heating equipment must be vented - do not operate unvented.
2. A built-in power exhauster is provided - additional external power exhausters are not required or permitted.
3. If you are replacing an existing heater, it may be necessary to resize the venting systems. Improperly sized venting systems can result in vent gas leakage or the formation of condensate. Refer to the National Fuel Gas Code ANSI Z223.1 or CSA B149.1 latest edition. Failure to follow these instructions can result in injury or death.
4. Under no circumstances should two sections of double wall vent pipe be joined together within one horizontal vent system due to the inability to verify complete seal of inner pipes.
5. All field gas piping must be pressure/leak tested prior to operation. Never use an open flame. Use a soap solution or equivalent for testing.
6. Gas pressure to appliance controls must never exceed 14" W.C. (1/2 psi).
7. Disconnect power supply before making wiring connections to prevent electrical shock and equipment damage.
8. All appliances must be wired strictly in accordance with wiring diagram furnished with the appliance. Any wiring different from the wiring diagram could result in a hazard to persons and property.
9. Any original factory wiring that requires replacement must be replaced with wiring material having a temperature rating of at least 105°C.
10. To reduce the opportunity for condensation, the minimum sea level input to the appliance, as indicated on the serial plate, must not be less than 5% below the rated input, or 5% below the minimum rated input of dual rated units.
11. Ensure that the supply voltage to the appliance, as indicated on the serial plate, is not 5% greater than the rated voltage.
12. When servicing or repairing this equipment, use only factory-approved service replacement parts. A complete replacement parts list may be obtained by contacting Modine Manufacturing Company. Refer to the rating plate on the appliance for complete appliance model number, serial number, and company address. Any substitution of parts or controls not approved by the factory will be at the owner's risk.

CAUTION

1. Installation must conform with local building codes or in the absence of local codes, with Part 7, Venting of Equipment, of the National Fuel Gas Code, ANSI Z223.1 (NFPA 54) - latest edition. In Canada installation must be in accordance with CSA B149.1.
2. Purging of air from gas supply line should be performed as described in ANSI Z223.1 - latest edition "National Fuel Gas Code", or in Canada in CAN/CGA-B149 codes.
3. Do not attempt to reuse any mechanical or electrical controller which has been wet. Replace defective controller.
4. Ensure that the supply voltage to the appliance is not 5% less than the rated voltage.

IMPORTANT

1. To prevent premature heat exchanger failure, do not locate NY gas-fired appliances in areas where corrosive vapors (i.e. chlorinated, halogenated or acid) are present in the atmosphere.
2. To prevent premature heat exchanger failure, the input to the appliance, as indicated on the serial plate, must not exceed the rated input by more than 5%.
3. To prevent premature heat exchanger failure, observe heat exchanger tubes by looking at the heat exchanger through field installed access openings in connecting ductwork. If the tubes become red while blower and duct furnace are in operation, additional baffles must be inserted between blower and duct furnace to assure uniform air flow across the heat exchanger.
4. To prevent premature heat exchanger failure, with all control systems, a blower starting mechanism must be provided so that the blower is running or energized within 45 seconds of the gas control operation.
5. Start-up and adjustment procedures should be performed by a qualified service agency.
6. To check most of the Possible Remedies in the troubleshooting guide listed in Table 24.1, refer to the applicable sections of the manual.

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SI (METRIC) CONVERSION FACTORS / UNIT LOCATION

SI (METRIC) CONVERSION FACTORS

Table 3.1

To Convert	Multiply By	To Obtain	To Convert	Multiply By	To Obtain
"W.C.	0.24	kPa	CFH	1.699	m ³ /min
psig	6.893	kPa	Btu/ft ³	0.0374	mJ/m ³
°F	(°F-32) x 0.555	°C	pound	0.453	kg
inches	25.4	mm	Btu/hr	0.000293	kW/hr
feet	0.305	meters	gallons	3.785	liters
CFM	0.028	m ³ /min	psig	27.7	"W.C.

UNIT LOCATION

DANGER

Appliances must not be installed where they may be exposed to a potentially explosive or flammable atmosphere.

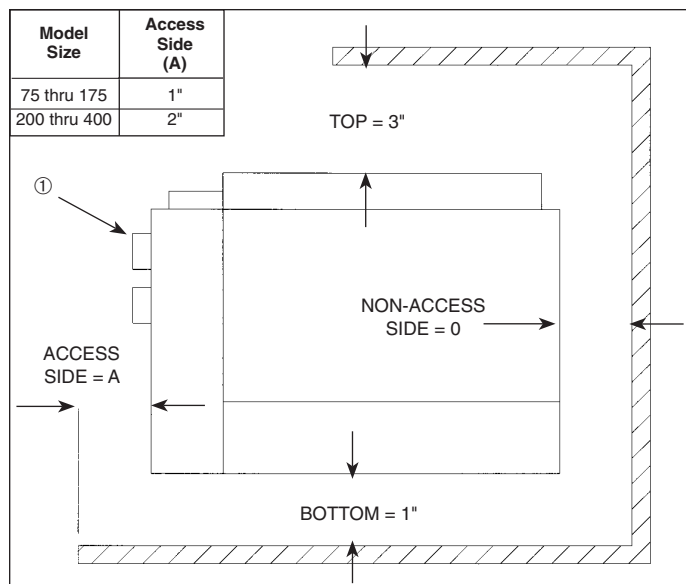
IMPORTANT

To prevent premature heat exchanger failure, do not locate ANY gas-fired appliances in areas where corrosive vapors (i.e. chlorinated, halogenated or acid) are present in the atmosphere.

Location Recommendations

- When locating the furnace, consider general space and heating requirements, availability of gas and electrical supply, and proximity to vent locations.
- Unit must be installed on the positive pressure side of the circulating blower.
- Be sure the structural support at the unit location site is adequate to support the weight of the unit. For proper operation the unit must be installed in a level horizontal position.
- Do not install units in locations where the flue products can be drawn into the adjacent building openings such as windows, fresh air intakes, etc.
- Be sure that the minimum clearances to combustible materials and recommended service clearances are maintained. Units are designed for installation on non-combustible surfaces with the minimum clearances shown in Figure 3.1 and Table 3.2.
- Units installed downstream of refrigeration systems, or exposed to inlet air temperatures of 40°F or less, may experience condensation. Therefore, provisions should be made for disposal of condensate. Means have been provided in the bottom pan of the unit to accommodate a condensate drain line connection flange.
- When locating units, it is important to consider that the combustion air and exhaust vent piping must be connected to the outside atmosphere, vent terminals should be located adjacent to one another. The maximum equivalent lengths are listed in Table 6.1 on page 6.
- In garages or other sections of aircraft hangars such as offices and shops that communicate with areas used for servicing or storage, keep the bottom of the unit at least 7' above the floor unless the unit is properly guarded to provide user protection from moving parts. In parking garages, the unit must be installed in accordance with the standard for parking structures ANSI/NFPA 88A, and in repair garages the standard for repair garages NFPA #88B. In Canada, installation of unit heaters in airplane hangars must be in accordance with the requirements of the enforcing authority, and in public garages in accordance with the current CAN/CGA-B149 codes.
- Do not install units in locations where gas ignition system is exposed to water spray, rain, or dripping water.

Figure 3.1 - Combustible Material and Service Clearances



① A 3" minimum clearance to combustible material is required from the vent collar.

Table 3.2 - Service Clearances

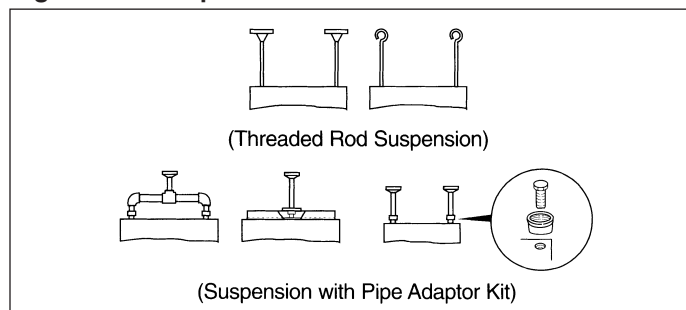
Model Size	Recommended Service Clearance			
	Access Side	Non-Access	Top	Bottom
75	18"	6"	10"	0"
100/125	20"	6"	10"	0"
150/175	25"	6"	10"	0"
200/225	27"	6"	10"	0"
250/300	30"	6"	10"	0"
350/400	41"	6"	10"	0"

UNIT SUSPENSION

Be sure the means of suspension is adequate to support the weight of the unit (see Dimensional Data for unit weights). For proper operation, the unit must be installed in a level horizontal position. Combustible material and service clearances as specified in Figure 3.1 and Table 3.2 must be strictly maintained.

- Four 1/2" - 13NC tapped holes in top of furnace are provided to accept ceiling hangers. To assure that flames are directed into the center of the heat exchanger tubes, the furnace must be supported in a vertical position. Use a spirit level to ensure that unit is suspended correctly.
- NOTE: A pipe hanger adapter kit, shown in Figure 3.2, is available as an accessory from the factory. One kit consists of two drilled 3/4" IPS pipe caps and two 1/2" - 13 x 1-3/4" capscrews to facilitate threaded pipe suspension. Two kits are required for mounting all duct furnace models.

Figure 3.2 - Suspension Methods



INSTALLATION

Direction of Airflow

Select proper direction of airflow. For models in which the 10th digit of the model number is an “L” for Low Temperature Rise, the airflow direction is fully reversible without modification to the duct furnace. See Airflow Reversal Note.

If the unit is provided with an air distribution baffle (models in which the 10th digit of the model number is an “H” for High Temperature Rise), the air baffle must face the air inlet direction as shown in Figure 4.1. If it is necessary to reverse the airflow direction, remove the four screws securing the air distribution baffle, reverse the air distribution baffle to the air inlet side and replace the screws. See Airflow Reversal Note.

Figure 4.1 - Air Distribution Baffle Location



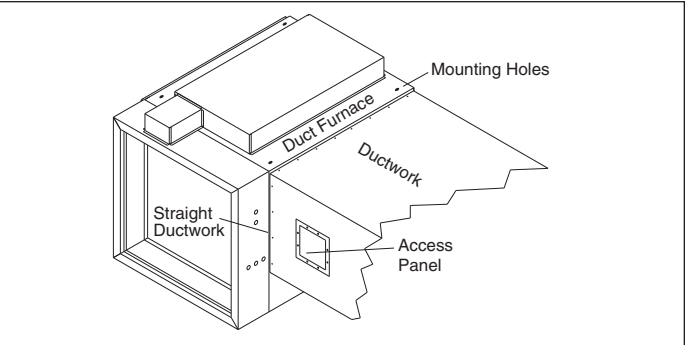
Airflow Reversal Note: If factory installed discharge air options (thermostat, freeze protection, etc.) were provided, these options would have to be relocated to the discharge air side of the duct furnace.

Duct Installation (refer to Figure 4.2)

- 1. The furnace is designed to accept straight ductwork. All connections between the ductwork and the furnace MUST be airtight to prevent air leakage. Seams with cracks in ductwork should be caulked and/or taped and be of permanent type.
- 2. Provide removable access panels on both the upstream and downstream sides of the ductwork. These openings should be large enough to view smoke or reflect light inside the casing to indicate leaks in the heat exchanger and to

check for hot spots on heat exchangers due to poor air distribution or lack of sufficient air (CFM).

Figure 4.2 - Duct Connections



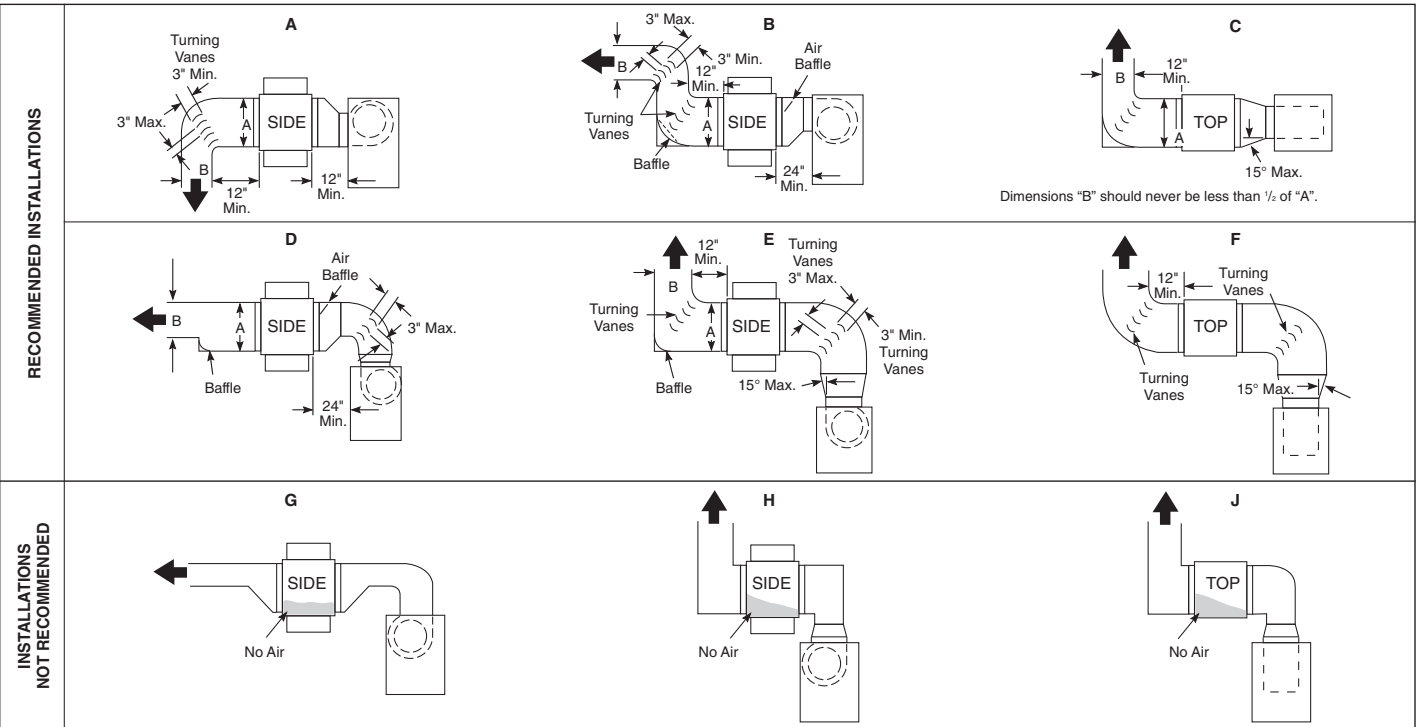
Airflow Distribution

IMPORTANT

To prevent premature heat exchanger failure, observe heat exchanger tubes by looking at the heat exchanger through field installed access openings in connecting ductwork. If the tubes become red while blower and duct furnace are in operation, additional baffles must be inserted between blower and duct furnace to assure uniform air flow across the heat exchanger.

- 1. Provide uniform air distribution over the heat exchanger. Use turning vanes where required (see Figure 4.3) to obtain uniform air distribution. Avoid installing as in “G”, “H” & “J” of Figure 4.3.
- 2. A bottom, horizontal discharge type blower should be installed at least 12" from the furnace (See “A”, Figure 4.3).
- 3. A top, horizontal discharge type blower should be installed at least 24" from the furnace (See “B”, Figure 4.3). Provide air baffle at top of duct to deflect air down to the bottom of heat exchanger.

Figure 4.3 - Typical Duct & Airflow Installation



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INSTALLATION - VENTING

⚠ WARNING

1. Gas fired heating equipment must be vented - do not operate unvented.
2. A built-in power exhauster is provided - additional external power exhausters are not required or permitted.
3. If you are replacing an existing heater, it may be necessary to resize the venting systems. Improperly sized venting systems can result in vent gas leakage or the formation of condensate. Refer to the National Fuel Gas Code ANSI Z223.1 or CSA B149.1 latest edition. Failure to follow these instructions can result in serious injury or death.
4. Under no circumstances should two sections of double wall vent pipe be joined together within one horizontal vent system due to the inability to verify complete seal of inner pipes.

⚠ CAUTION

Installation must conform with local building codes or in the absence of local codes, with Part 7, Venting of Equipment, of the National Fuel Gas Code, ANSI Z223.1 (NFPA 54) - latest edition. In Canada installation must be in accordance with CSA B149.1.

Model DFS duct furnaces must be vented with the proper passageway as described in these instructions to convey flue gases from the unit or the vent connector to the outside atmosphere. The heaters must also have a separate combustion air intake pipe to bring in fresh air for combustion from the outside atmosphere.

The venting instructions are organized in sections, based on installation type. The sections are identified as follows:

Section	Installation Instructions by Vent System Type
A	General Instructions for ALL installations
B	VERTICAL 2-PIPE vent systems ①
C	HORIZONTAL 2-PIPE vent systems ①
D	HORIZONTAL AND VERTICAL CONCENTRIC vent systems ①

① The differences between Vertical and Horizontal vent systems in 2-Pipe or Concentric Vent configurations will be identified in "Section A - General Instructions – All Units".

Section A - General Instructions - All Units

- A1. If the heater being installed is replacing existing equipment and using the existing vent system from that equipment, inspect the venting system for proper size and horizontal pitch, as required in the National Fuel Gas Code ANSI Z223.1 or CSA B149.1 Installation Code-latest edition and these instructions. Determine that there is no blockage or restriction, leakage, corrosion and other deficiencies, which could cause an unsafe condition.
- A2. The combustion air and vent pipes should be galvanized steel or other suitable corrosion resistant material. Follow the National Fuel Gas Code for minimum thickness of vent material. The minimum thickness for connectors varies depending on the pipe diameter. Do not vent unit with PVC or other forms of plastic venting material.

- A3. All heaters come with factory installed vent and combustion air adapters for attaching the pipe to the heater. The pipe diameters are 4" for model sizes 75-175 and 6" for model sizes 200-400. All units are classified as Category III vented appliances, which defined by ANSI is positive pressure, non-condensing, and requires the vent system to be gastight. Attach the vent pipe to the adapter with 3 corrosion resistant screws. (Drill pilot holes through the vent pipe and adapter prior to screwing in place). Vent pipe must not be smaller than the connector size.
- A4. Limit the total equivalent vent pipe length to a minimum of 5' and a maximum as shown in Table 6.1, making the vent system as straight as possible. Total equivalent vent pipe length must include elbows. The equivalent length of a 4" elbow is 5' and for a 6" elbow is 7'.

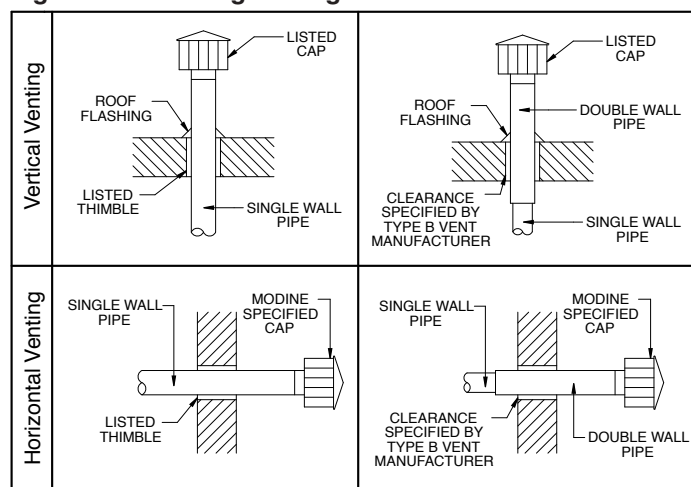
Table 6.1 - Individual Total Equivalent Lengths for Combustion Air and Exhaust Vent Pipes

Model Size	Minimum (ft)	Maximum (ft)
75	5	48
100, 125, 150, 175	5	55
200, 225	5	70
250, 300	5	63
350, 400	5	70

- A5. A minimum of 12" straight pipe is recommended from the flue outlet before turns in the vent pipe.
- A6. Horizontal sections of vent and combustion air pipes are to be installed with a minimum downward slope from the appliance of 1/4 inch per foot and suspended securely from overhead structures at points not greater than 3' apart.
- A7. Fasten individual lengths of vent together with at least three corrosion resistant sheet metal screws.
- A8. Keep single wall vent pipe at least 6" from combustible materials. For double wall vent pipe, follow the vent pipe manufacturer's clearances to combustibles. The minimum distance from combustible materials is based on the combustible material surface not exceeding 160°F. Clearance from the vent pipe (or the top of the unit) may be required to be greater than 6" if heat damage other than fire could result (such as material distortion or discoloration).
- A9. Avoid venting through unheated space when possible. When venting does pass through an unheated space or if the unit is installed in an environment that promotes condensation, insulate runs greater than 5' to minimize condensation. Inspect for leakage prior to insulating and use insulation that is noncombustible with a rating of not less than 400°F. Install a tee fitting at the low point of the vent system and provide a drip leg with a clean out cap as shown in Figure 8.1.
- A10. When the vent passes through a combustible INTERIOR wall or floor, a metal thimble 4" greater than the vent diameter is necessary. If there is 6' or more of vent pipe in the open space between the appliance and where the vent pipe passes through the wall or floor, the thimble need only be 2" greater than the diameter of the vent pipe. If a thimble is not used, all combustible material must be cut away to provide 6" of clearance. Where authorities have jurisdiction type B vent may be used for the last section of vent pipe to maintain clearance to combustibles while passing through wall or floor. See Figure 7.1. Any material used to close the opening must be noncombustible.

INSTALLATION - VENTING

Figure 7.1 - Venting Through Combustible Roof or Wall



① See Instruction A12 for attaching single wall pipe to double wall pipe

A11. All seams and joints of the single wall pipe must be sealed with metallic tape or silastic suitable for temperatures up to 400°F. Wrap the tape two full turns around the vent pipe. One continuous section of double wall vent pipe may be used within the vent system. Refer to instruction A12 in “Section A – General Instructions – All Units” for attaching double wall pipe to single wall pipe.

A12. The following are General Instructions for Double Wall (Type B) Terminal Pipe Installation:

How to attach a single wall vent terminal to double wall (type B) vent pipe:

1. Look for the “flow” arrow on the vent pipe.
2. Slide the vent terminal inside the exhaust end of the double wall vent pipe.
3. Drill (3) holes through the pipe and the vent terminal. Using 3/4" long sheet metal screws, attach the cap to the pipe. Do not over tighten.

How to connect a single wall vent system to a double wall (type B) vent pipe:

1. Slide the single wall pipe inside the inner wall of the double wall pipe.
2. Drill (3) holes through both walls of the single and double wall vent pipes. Using 3/4" sheet metal screws, attach the two pieces of pipe. Do not over tighten.
3. The gap between the single and double wall pipe must be sealed but it is not necessary to fill the full volume of the annular area. To seal, run a large bead of 400°F silastic around the gap.

A13 Do NOT vent this appliance into a masonry chimney.

A14. Do NOT use dampers or other devices in the vent or combustion air pipes.

A15. The venting system must be exclusive to a single appliance, and no other appliance is allowed to be vented into it.

A16. Precautions must be taken to prevent degradation of building materials by flue products.

A17. Single wall vent pipe must not pass through any unoccupied attic, inside wall, concealed space, or floor.

A18. Uninsulated single wall vent pipe must not be used outdoors for venting appliances in regions where the 99% winter design temperature is below 32°F.

A19. Long runs of horizontal or vertical combustion air pipes may require insulation in very cold climates to prevent the buildup of condensation on the outside of the pipe where the pipe passes through conditioned spaces.

A20. Vent termination clearances must be maintained:

Table 7.1 - Vent Termination Clearances

Structure	Minimum Clearances for Vent Terminal Location
Forced air inlet within 10 feet	3 feet above
Combustion air inlet of another appliance	6 feet all directions
Door, window, gravity air inlet, or any building opening	4 feet horizontal and below 1 foot above
Electric meter, gas meter, gas regulator, and relief equipment ①	4 feet horizontal (U.S.) 6 feet horizontal (Canada)
Gas regulator ①	3 feet horizontal (U.S.) 6 feet horizontal (Canada)
Adjoining building or parapet wall	6 feet all directions
Adjacent public walkways	7 feet all directions
Grade (ground level)	3 feet above ②

① Do not terminate the vent directly above a gas meter or regulator.

② The vent must be at least 6" higher than anticipated snow depth.

A21. Vertical combustion air pipes should be fitted with a tee with a drip leg and a clean out cap to prevent against the possibility of any moisture in the combustion air pipe from entering the unit. The drip leg should be inspected and cleaned out periodically during the heating season.

A22. In addition to following these General Instructions, specific instructions for Vertical and Horizontal vent systems in 2-Pipe or Concentric Vent configurations must also be followed. The following outlines the differences:

Vertical Vent System Determination

- Vertical vent systems terminate vertically (up) (an example is shown in Figure 8.1).
- Determine the venting configuration as follows:
 - > For two building penetrations through the wall or roof (one for the combustion air inlet pipe and one for the vent pipe), proceed to “Section B - Vertical 2-Pipe Venting”.
 - > For a single larger building penetration through the wall or roof, through which both the combustion air inlet and vent pipes will pass, proceed to “Section D - Horizontal and Vertical Concentric Venting”.
 - > For all other cases, proceed to the next section for Horizontal Vent System Determination.

Horizontal Vent System Determination

- Horizontal vent systems terminate horizontally (sideways) (an example is shown in Figure 9.1).
- Determine the venting configuration as follows:
 - > For two building penetrations through the wall or roof (one for the combustion air inlet pipe and one for the vent pipe), proceed to “Section C - Horizontal 2-Pipe Venting”.
 - > For a single larger building penetration through the wall or roof, through which both the combustion air inlet and vent pipes will pass, proceed to “Section D - Horizontal and Vertical Concentric Venting”.

INSTALLATION - VENTING

Section B - Vertical 2-Pipe Vent System Installation

- B1. This section applies to vertically vented 2-pipe (one combustion air inlet pipe and one vent pipe) vent systems and is in addition to "Section A - General Instructions - All Units".
- B2. Vertical vent systems terminate vertically (up).
- B3. It is recommended to install a tee with drip leg and clean out cap as shown in Figures 8.1 or 8.2.
- B4. The combustion air and vent pipes must be terminated with (2) Gary Steel Model 1092 caps.
- B5. Vertical vents must terminate a minimum horizontal and vertical distance from roof lines and adjacent walls or obstructions. These minimum distances are outlined in Figure 8.1 and Table 8.1 or Figure 8.2.
- B6. The vent must terminate at least 1 foot above and 16 inches horizontally from the combustion air inlet.
- B7. Once venting is complete, proceed section titled "Installation - Gas Connections".

Figure 8.1 - Vertical Venting - 2 Pipes Sloped Roof

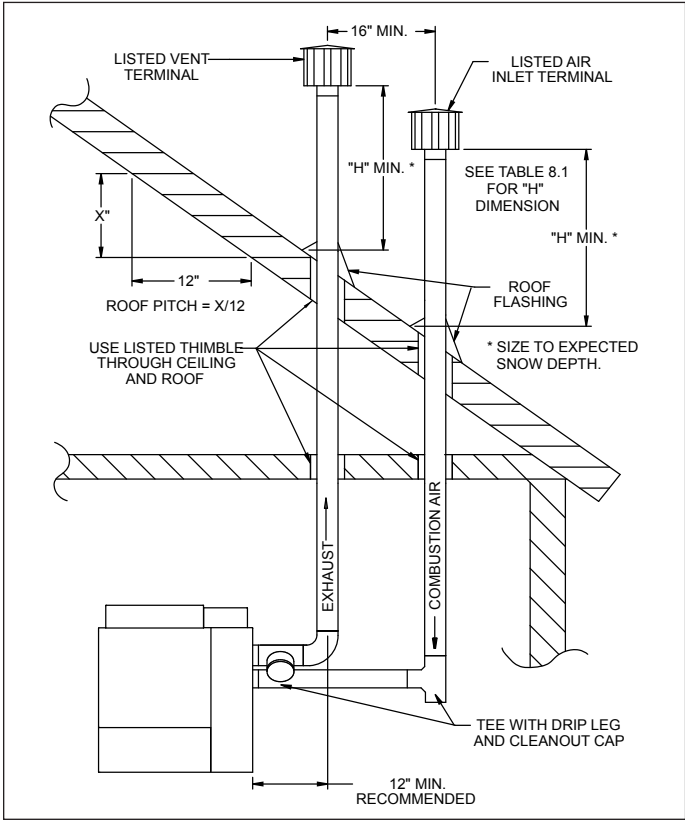
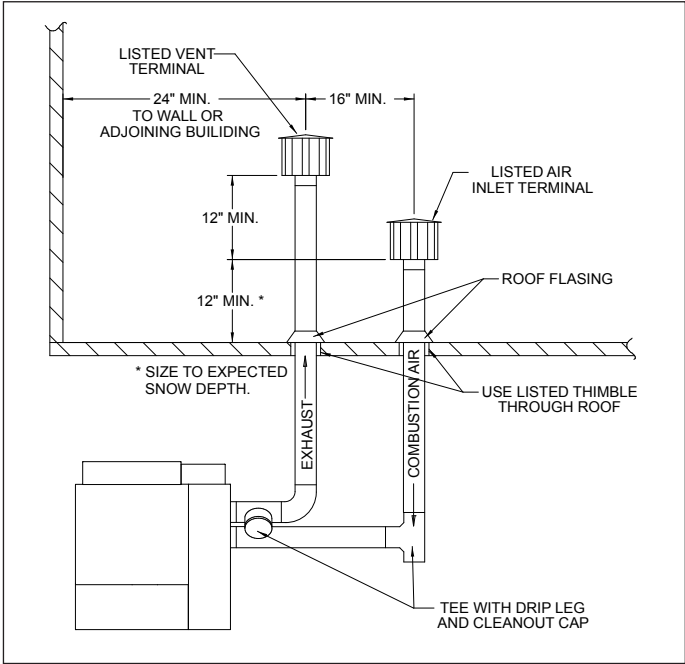


Table 8.1 - Minimum Height from Roof to Lowest Discharge Opening

Rise X (in)	Roof Pitch	Min Height H (ft) ①
0-6	Flat to 6/12	1.00
6-7	6/12 to 7/12	1.25
7-8	7/12 to 8/12	1.50
8-9	8/12 to 9/12	2.00
9-10	9/12 to 10/12	2.50
10-11	10/12 to 11/12	3.25
11-12	11/12 to 12/12	4.00
12-14	12/12 to 14/12	5.00
14-16	14/12 to 16/12	6.00
16-18	16/12 to 18/12	7.00
18-20	18/12 to 20/12	7.50
20-21	20/12 to 21/12	8.00

① Size according to expected snow depth.

Figure 8.2 - Vertical Venting - 2 Pipes Flat Roof

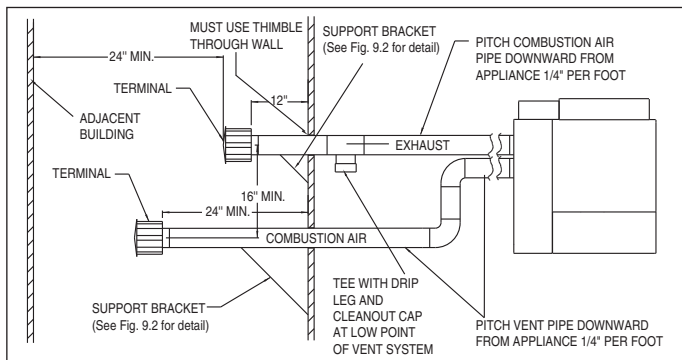


Section C - Horizontal 2-Pipe Vent System Installation

- C1. This section applies to horizontally vented 2-pipe vent systems (one combustion air inlet pipe and one vent pipe) and is in addition to "Section A - General Instructions - All Units".
- C2. Horizontal vent systems terminate horizontally (sideways).
- C3. All horizontal vents must be terminated with a Gary Steel 1092 vent cap. The cap must terminate a minimum distance from the exterior wall, as summarized in Figure 9.1.
- C4. The termination of horizontally vented system must extend 12 inches beyond the exterior surface of an exterior wall.
- C5. The combustion air pipe must be a minimum of 16 inches below the vent pipe, and 24 inches from the exterior wall.
- C6. Construct the vent system as shown in Figure 9.1.

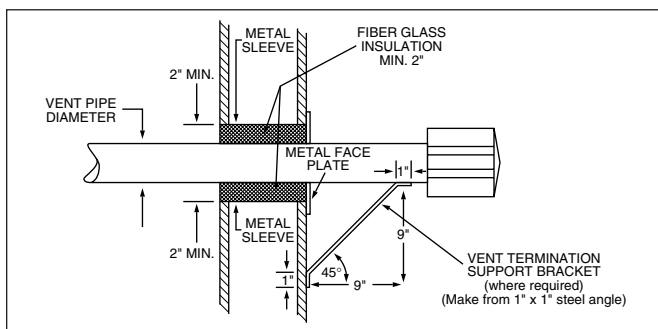
INSTALLATION - VENTING

Figure 9.1 - Horizontal 2-Pipe Venting



- C7. When horizontal vents pass through a combustible wall (up to 8 inches thick), the vent passage must be constructed and insulated as shown in Figure 9.2.
- C8. The vent must be supported as shown in Figure 9.2.
- C9. When condensation may be a problem, the vent system shall not terminate over public walkways or over an area where condensate or vapor could create a nuisance or hazard or could be detrimental to the operation of regulators, relief openings, or other equipment.

Figure 9.2 - Exhaust Vent Construction Through Combustible Walls and Support Bracket



- C10. Maintain a 1/4" per foot downward slope away from the heater and place a drip leg with clean out near the exit of the vent as shown in Figure 9.1, or allow the condensate to drip out the end.
- C11. For a vent termination located under an eave, the distance of the overhang must not exceed 24". The clearance to combustibles above the exterior vent must be maintained at a minimum of 12". Consult the National Fuel Gas Code for additional requirements for eaves that have ventilation openings.
- C12. Once venting is complete, proceed section titled "Installation - Gas Connections".

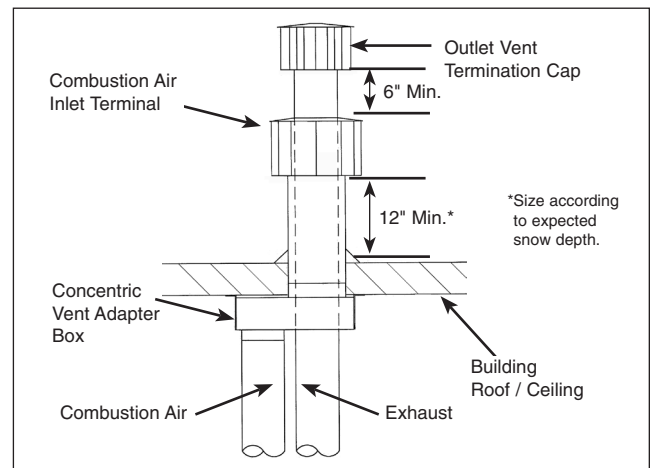
Section D - Concentric Vent System Installation

- D1. This section applies to both horizontally and vertically vented concentric vent systems as defined in "Section A – General Instructions – All Units", and is in addition to the instructions in that section.
- D2. When utilizing the concentric vent option, it should have been predetermined whether the appliance will be horizontally or vertically vented. Before proceeding, verify that the concentric vent kit received contains the correct components for the installation:

For Vertically Vented Units (Refer to Figure 9.3):

- ① Concentric adapter assembly (same for horizontal and vertical kits)
- ② Standard Gary Steel 1092 vent termination
- ③ Specially designed inlet terminal (part #5H75154)

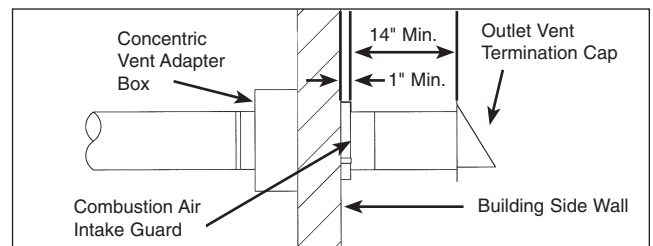
Figure 9.3 - Vertical Concentric Vent Kit Components



For Horizontally Vented Units (Refer to Figure 9.4):

- ① Concentric adapter assembly (same for horizontal and vertical kits)
- ② Special vent termination cap (part #5H75150)
- ③ Special inlet air guard

Figure 9.4 - Horizontal Concentric Vent Kit Components



CAUTION

The concentric vent adapter box must be installed inside of the structure or building. Do not install this box on the exterior of a building or structure.

- D3. Once the kit contents have been verified as correct for the direction of venting, the concentric vent adapter box is to be installed. Determine the location of the box. Be sure to maintain all clearances as listed in these instructions.
- D4. The adapter box is to be mounted on the interior side of the building. It must not be mounted outside the building. The adapter box has integral mounting holes for ease of installation. When horizontal venting multiple units, the minimum spacing between any sides of the adapter boxes must be 18" and boxes must not overlap in the vertical plane (above or below). When condensation may be a problem, the vent system shall not terminate over public walkways or over an area where condensate or vapor could create a nuisance or hazard or could be detrimental to the operation of regulators, relief openings, or other equipment.

INSTALLATION - VENTING

- D5. The adapter box can be mounted flush to the wall (for horizontal kits) or to the ceiling (for vertical kits). The box can also be offset from the wall or ceiling by using field supplied brackets. When mounting the box, consider serviceability and access to the vent and combustion air pipes. If the box is to be mounted using field supplied brackets, these brackets must be strong enough to rigidly secure the box to the wall or ceiling, and should be made from corrosion resistant material.
- D6. Determine the length of the vent pipe and combustion air inlet pipe for the selected location. **THE VENT PIPE WILL PASS THROUGH THE CONCENTRIC VENT BOX. THE LAST SECTION OF VENT PIPE IS A CONTINUOUS LENGTH OF DOUBLE WALL "B" VENT.** See section A12 for attaching and terminating double wall pipe. Begin with pipe lengths on the concentric pipe side of the adapter box referring to Figure 10.1. These pipes will extend through the building wall or roof as well as any added length for the thickness of the wall and the offset from any field installed brackets.

For Vertical Concentric Vent Kits (refer to Figure 9.3):

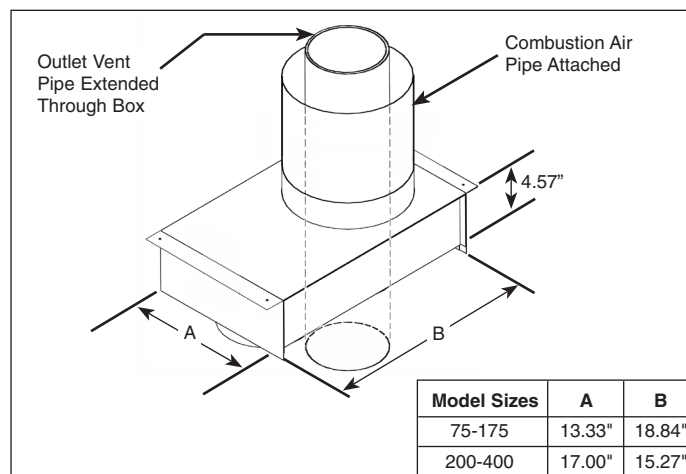
- The bottom of the combustion air intake pipe must terminate above the snow line, or at least 12 inches above the roof, whichever distance is greater.
- The bottom of the vent cap must terminate at least 6 inches above the top of the combustion air intake cap.

For Horizontal Concentric Vent Kits (refer to Figure 9.4):

- The combustion air intake pipe must terminate at least 1 inch from the wall to prevent water from running down the wall and into the pipe.
- The back of the vent cap must terminate at least 14 inches from the combustion air intake pipe.

- D7. Cut the concentric side vent and combustion air pipes to the proper length as determined in the previous step. Note that the vent pipe diameter is 4" and the combustion air intake pipe diameter is 6" for model sizes 75-175, and 6" and 8" respectively for model sizes 200-400. The pipes must be single wall galvanized or stainless steel material, except for the last section of vent pipe, which must be one continuous length of double wall B-vent extended through the concentric vent box and combustion air inlet pipe on the concentric side of the box.
- D8. Allow the concentric side vent pipe to pass through the concentric vent adapter box, as shown in Figure 10.1. Attach the double wall vent pipe to the single wall vent pipe that goes to the unit. Be sure to seal the joint and the open area around the double wall vent. Seal all joints and seams using sealant suitable for temperatures up to 400°F.
- D9. Slide the combustion air pipe over the vent pipe and attach to the air inlet of the concentric adapter box, as shown in Figure 10.1, using at least 3 corrosion resistant sheet metal screws. Seal the joint and seam using sealant suitable for temperatures up to 400°F.
- D10. Place this assembly (the adapter box, vent pipe and combustion air pipe) through the wall or roof and verify that the distance requirements as defined in Step D7 are met. Securely attach the assembly building.
- D11. From outside the building, caulk the gap between the combustion air intake pipe and the building penetration.
- D12. Attach the combustion air intake and vent pipe terminations as follows:

Figure 10.1 - Adapter Box with Combustion Air Intake Pipe Attached



For Vertical Concentric Vent Kits (refer to Figure 9.3):

- Slide the combustion air cap down over the vent pipe and fasten it to the combustion air pipe with at least 3 corrosion resistant sheet metal screws.
- Attach the vent cap to the vent pipe using at least 3 corrosion resistant sheet metal screws. Refer to instruction A12 for connecting terminal to double wall pipe.
- Caulk the gap between the combustion air cap and the vent pipe with silicone sealant, or other appropriate sealants suitable for metal to metal contact and for temperatures up to 400° F.

For Horizontal Concentric Vent Kits (refer to Figure 9.4):

- Attach the combustion air intake guard using corrosion resistant screws at the end of the combustion air intake pipe to prevent animals and debris from entering.
 - Attach the vent cap to the vent pipe using at least 3 corrosion resistant sheet metal screws.
- D13. Install vent pipe and combustion air pipe between unit heater and concentric vent adapter box as outlined in "Section A – General Instructions – All Units".
- D14. Once venting is complete, proceed to the section titled "Installation - Gas Connections".

INSTALLATION

Gas Connections



WARNING

1. All field gas piping must be pressure/leak tested prior to operation. Never use an open flame. Use a soap solution or equivalent for testing.
2. Gas pressure to appliance controls must never exceed 14" W.C. (1/2 psi).
3. To reduce the opportunity for condensation, the minimum sea level input to the appliance, as indicated on the serial plate, must not be less than 5% below the rated input, or 5% below the minimum rated input of dual rated units.



CAUTION

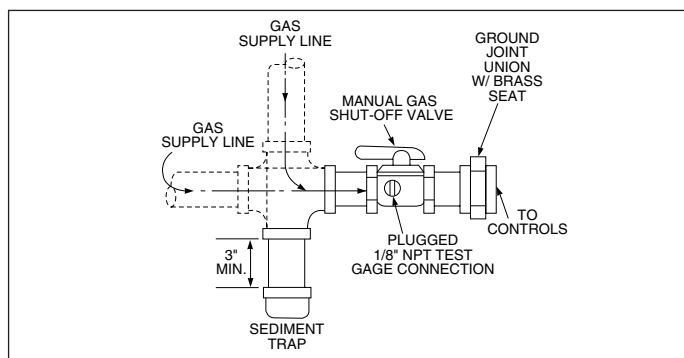
Purging of air from gas supply line should be performed as described in ANSI Z223.1 - latest edition "National Fuel Gas Code", or in Canada in CAN/CGA-B149 codes.

IMPORTANT

To prevent premature heat exchanger failure, the input to the appliance, as indicated on the serial plate, must not exceed the rated input by more than 5%.

1. Installation of piping must conform with local building codes, or in the absence of local codes, with the National Fuel Gas Code, ANSI Z223.1 (NFPA 54) - Latest Edition. In Canada, installation must be in accordance with CAN/CGA-B149.1 for natural gas units and CAN/CGA-B149.2 for propane units.
2. Piping to units should conform with local and national requirements for type and volume of gas handled, and pressure drop allowed in the line. Refer to Table 11.1 to determine the cubic feet per hour (cfh) for the type of gas and size of unit to be installed. Using this cfh value and the length of pipe necessary, determine the pipe diameter from Table 11.2. Where several units are served by the same main, the total capacity, cfh and length of main must be considered. Avoid pipe sizes smaller than 1/2". Table 11.1 allows for a 0.3" W.C. pressure drop in the supply pressure from the building main to the unit. The inlet pressure to the unit must be 6-7" W.C. for natural gas and 11-14" W.C. for propane gas. When sizing the inlet gas pipe diameter, make sure that the unit supply pressure can be met after the 0.3" W.C. has been subtracted. If the 0.3" W.C. pressure drop is too high, refer to the Gas Engineer's Handbook for other gas pipe capacities.
3. The gas piping to the unit can enter the unit from the side of the unit or from below. Install a ground joint union with brass seat and a manual shut-off valve external of the unit casing, and adjacent to the unit for emergency shut-off and easy servicing of controls, including a 1/8" NPT plugged tapping accessible for test gauge connection (See Figure 11.1).
4. Provide a sediment trap before each unit in the line where low spots cannot be avoided. (See Figure 11.1).
5. When Pressure/Leak testing, pressures above 14" W.C. (1/2 psi), close the field installed shut-off valve, disconnect the appliance and its combination gas control from the gas supply line, and plug the supply line before testing. When testing pressures 14" W.C. (1/2 psi) or below, close the manual shut-off valve on the appliance before testing.

Figure 11.1 - Recommended Sediment Trap/Manual Shut-off Valve Installation - Side or Bottom Gas Connection



① Manual shut-off valve is in the "OFF" position when handle is perpendicular to pipe.

Table 11.1 - Manifold Pressure and Gas Consumption

Model Size	Type of Gas	Natural	Propane	No. of Orifices
	Btu/Cu. Ft.	1040	2500	
	Specific Gravity	0.60	1.53	
High Fire Manifold Pressure Inches of Water Column		3.5	10	
75	Cfh Orifice Drill Size	72.1 20	30.0 37	
100	Cfh Orifice Drill Size	96.1 30	40.0 45	2
125	Cfh Orifice Drill Size	120.2 25	50.0 42	2
150	Cfh Orifice Drill Size	144.2 30	60.0 45	3
175	Cfh Orifice Drill Size	168.3 27	70.0 43	3
200	Cfh Orifice Drill Size	192.3 23	80.0 40	3
225	Cfh Orifice Drill Size	216.3 20	90.0 37	3
250	Cfh Orifice Drill Size	240.4 25	100.0 42	4
300	Cfh Orifice Drill Size	288.7 20	120.0 37	4
350	Cfh Orifice Drill Size	336.5 27	140.0 43	6
400	Cfh Orifice Drill Size	384.6 23	160.0 40	6

Table 11.2 - Gas Pipe Capacities (Cu. Ft. per Hour) ①

Pipe Length (feet)	Natural Gas ②					
	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"
10	132	278	520	1050	1600	3050
20	92	190	350	730	1100	2100
30	73	152	285	590	890	1650
40	63	130	245	500	760	1450
50	56	115	215	440	670	1270
60	50	105	195	400	610	1150
70	46	96	180	370	560	1050
80	43	90	170	350	530	990
90	40	84	160	320	490	930
100	38	79	150	305	460	870
125	34	72	130	275	410	780
150	31	64	120	250	380	710

① Gas pipe capacities based on gas pressure up to 14" W.C. through Schedule 40 pipe with a pressure drop of 0.3" W.C. for Natural gas with a specific gravity of 0.60.

② For gas pipe capacities when using Propane gas (specific gravity of 1.50), multiply the value shown for Natural gas at the applicable pipe diameter and length by 0.63.

INSTALLATION / START-UP PROCEDURE

Electrical Connections



WARNING

1. Disconnect power supply before making wiring connections to prevent electrical shock and equipment damage.
2. All appliances must be wired strictly in accordance with wiring diagram furnished with the appliance. Any wiring different from the wiring diagram could result in a hazard to persons and property.
3. Any original factory wiring that requires replacement must be replaced with wiring material having a temperature rating of at least 105°C.
4. Ensure that the supply voltage to the appliance, as indicated on the serial plate, is not 5% greater than rated voltage.



CAUTION

Ensure that the supply voltage to the appliance, as indicated on the serial plate, is not 5% less than rated voltage.

1. Installation of wiring must conform with local building codes, or in the absence of local codes, with the National Electric Code ANSI/NFPA 70 - Latest Edition. Unit must be electrically grounded in conformance to this code. In Canada, wiring must comply with CSA C22.1, Part 1, Electrical Code.
2. All duct furnaces are provided with a wiring diagram located on the inside door of the electrical junction box. Refer to this wiring diagram for all wiring connections. For factory installed options and field installed accessory wiring, refer to Set A and Set B on the provided wiring diagram.
3. The power supply to the duct furnace should be protected with a fused disconnect switch.
4. Refer to Table 12.1 to determine the amp draw of the duct furnace. Size the disconnect switch to cover the amp draw of the unit.
5. Refer to the unit dimensional drawing on page 18 for the electrical knockout locations.

Table 12.1 - Unit Amps

Input (Digits 4-6)	Supply Voltage (Digit 14)	Transformer (Digit 15)				
		1	2	3	4	0
75-175	A	1.75	2.05	2.70	3.57	1.40④
	B or D	0.89	1.06	1.42	1.90	0.70④
	C or E	0.77	0.93	1.25	1.69	0.60④
	F	0.63①	1.25②	2.50③	2.71③	0.00④
	G	0.50①	1.00②	2.00③	2.17③	0.00④
200-400	A	2.75	3.05	3.70	4.57	2.40
	B or D	1.59	1.76	2.12	2.60	1.40
	C or E	1.47	1.63	1.95	2.39	1.30
	F	0.63①	1.25②	2.50③	2.72③	0.00④
	G	0.50①	1.00②	2.00③	2.17③	0.00④

① Includes a field supplied 250 VA step down transformer from supply voltage to 115V.

② Includes a field supplied 500 VA step down transformer from supply voltage to 115V.

③ Includes a field supplied 1000 VA step down transformer from supply voltage to 115V.

④ Unit controls amp draw is included in master unit amp draw.

START-UP PROCEDURE

IMPORTANT

Start-up and adjustment procedures should be performed by a qualified service agency.

1. Turn off power to the unit at the disconnect switch. Check that fuses or circuit breakers are in place and sized correctly. Turn all hand gas valves to the "OFF" position.
2. Check that the supply voltage matches the unit supply voltage listed on the serial plate. Verify that all wiring is secure and properly protected. Trace circuits to insure that the unit has been wired according to the wiring diagram.
3. Check that all electrical and gas connections to the unit are sealed to prevent air leakage.
4. Check to insure that the venting system is installed and free from obstructions.
5. Check to see that there are no obstructions to the intake and discharge of the duct furnace.
6. Perform a visual inspection of the unit to make sure no damage has occurred during installation.
7. Turn on power to the unit at the disconnect switch. Check to insure that the voltage between terminals 1 and 2 is 24V.
8. Check the thermostat, ignition control, gas valve, power exhaustor motor, and supply fan blower motor for electrical operation. If these do not function, recheck the wiring diagram. Check to insure that none of the Gas Control Options & Accessories (see page 17) have tripped.
9. Recheck the gas supply pressure at the field installed manual-shut-off valve. The inlet pressure should be 6"-7" W.C. on natural gas or 11"-14" W.C. on propane. If inlet pressure is too high, install an additional pressure regulator upstream of the combination gas control.
10. Open the field installed manual gas shut-off valve.
11. Open the manual main gas valve on the combination gas control. Call for heat with the thermostat and allow the pilot to light. On a call for heat the power exhaustor relay will energize the power exhaustor motor. Once the power exhaustor motor reaches full speed, the differential pressure switch will close before the pilot can light. If the pilot does not light, purge the pilot line. If air purging is required, disconnect the pilot line at outlet of pilot valve. In no case should line be purged into heat exchanger. Check the pilot flame length (See Pilot Burner Adjustment).
12. Once the pilot has been established, check to make sure that the main gas valve opens. Check the manifold gas pressure (See Main Burner Adjustment) and flame length (See Air Shutter Adjustment) while the circulating air blower is operating.
13. Check to insure that gas controls sequence properly (See Control Operating Sequence). Verify if the unit has any additional control devices and set according to the instructions in the Gas Controls Options.
14. Once proper operation of the duct furnace has been verified, remove any jumper wires that were required for testing.
15. Close the electrical compartment door.
16. Replace all exterior panels.

START-UP PROCEDURE

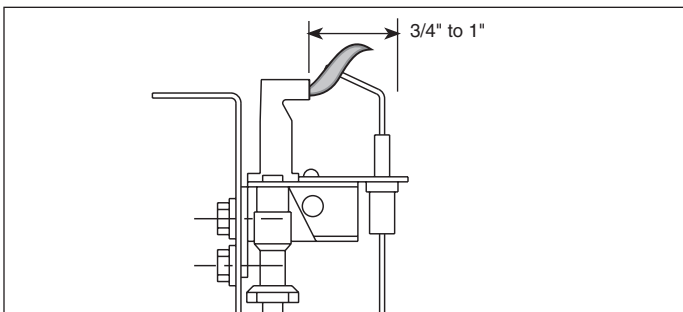
Pilot Burner Adjustment

The pilot burner is orificed to burn properly with an inlet pressure of 6-7" W.C. on natural gas and 11-14" W.C. on propane gas, but final adjustment must be made after installation. If the pilot flame is too long or large, it is possible that it may cause soot and/or impinge on the heat exchanger causing failure. If the pilot flame is shorter than shown, it may cause poor ignition and result in the controls not opening the combination gas control. A short flame can be caused by a dirty pilot orifice. Pilot flame condition should be observed periodically to assure trouble-free operation.

To Adjust the Pilot Flame

1. Create a call for heat from the thermostat.
2. Remove the cap from the pilot adjustment screw. For location, see the combination gas control literature supplied with unit.
3. Adjust the pilot length by turning the screw in or out to achieve a soft steady flame 3/4" to 1" long and encompassing 3/8"-1/2" of the tip of the thermocouple or flame sensing rod (See Figure 13.1).
4. Replace the cap from the pilot adjustment screw.

Figure 13.1 - Correct Pilot Flame



Main Burner Adjustment

The gas pressure regulator (integral to the combination gas control) is adjusted at the factory for average gas conditions. It is important that gas be supplied to the duct furnace in accordance with the input rating on the serial plate. Actual input should be checked and necessary adjustments made after the duct furnace is installed. Over-firing, a result of too high an input, reduces the life of the appliance and increases maintenance. Under no circumstances should the input exceed that shown on the serial plate.

Measuring the manifold pressure is done at the tee in the manifold (See Figure 13.2).

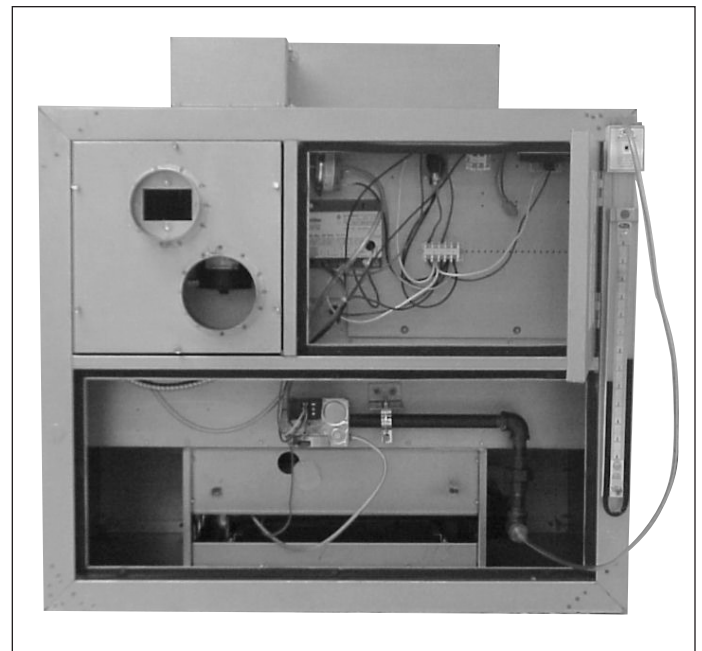
To Adjust the Manifold Pressure

1. Move the field installed manual shut-off valve to the "OFF" position.
2. Remove the 1/8" pipe plug in the pipe tee and attach a water manometer of "U" tube type which is at least 12" high.
3. Move the field installed manual gas shut-off valve to the "ON" position.
4. Create a high fire call for heat from the thermostat.
5. Determine the correct high fire manifold pressure. For natural gas 3.5" W.C., for propane gas 10" W.C. Adjust the main gas pressure regulator spring to achieve the proper manifold pressure (for location, see the combination gas control literature supplied with unit).
6. If the unit has Electronic Modulation gas controls (determine from the Model Identification Digit 12), the low

fire gas pressure needs to be adjusted. Using Figure 14.1 for item number locations, this is accomplished as follows:

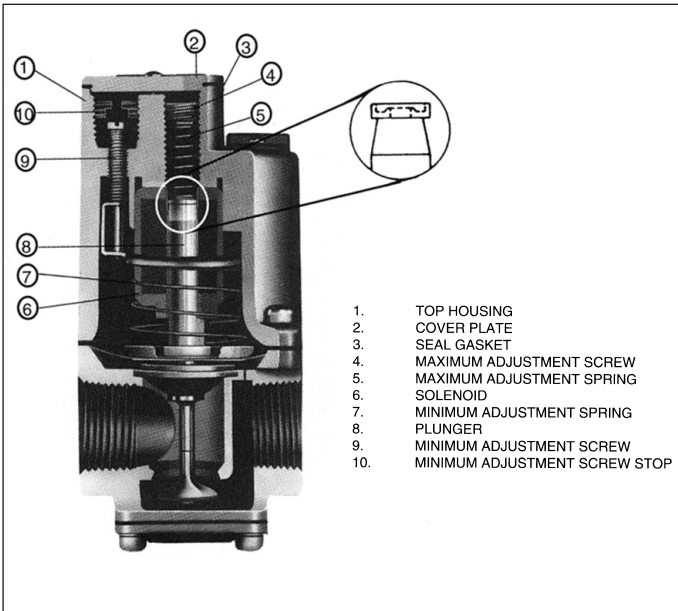
- a. Disconnect power.
 - b. Remove all wires from duct furnace terminal "43" and remove cover plate (2).
 - c. Turn on power at the disconnect switch.
 - d. Remove the maximum adjustment screw (4), spring (5), and plunger (8). A small magnet is useful for this purpose. CAUTION - The plunger is a precision part. Handle carefully to avoid marring or picking up grease and dirt. Do not lubricate.
 - e. Using minimum adjusting screw (9), adjust low fire manifold pressure to 0.56" W.C. for natural gas and 1.6" W.C. for propane gas.
 - f. Replace plunger and spring retainer, spring, and maximum adjusting screw in proper order.
 - g. Using maximum adjustment screw (4), adjust high fire manifold pressure to 3.5" W.C. for natural gas and 10" W.C. for propane gas.
 - h. Disconnect power.
 - i. Replace cover plate (2) and re-install all wires from duct furnace terminal "43".
7. After adjustment, move the field installed manual shut-off valve to the "OFF" position and replace the 1/8" pipe plug.
 8. After the plug is in place, move the field installed manual shut-off valve to the "ON" position and recheck pipe plugs for gas leaks with soap solution.

Figure 13.2 - Checking Manifold Pressure with "U" Tube Manometer



START-UP PROCEDURE

Figure 14.1 - Maxitrol Modulating Valve Adjustments



Air Shutter Adjustment

Proper operation provides a soft blue flame with a well-defined inner core. A lack of primary air will reveal soft yellow-tipped flames. Excess primary air produces short, well-defined flames with a tendency to lift off the burner ports. For both natural and propane gas, the air shutters can be adjusted to control the burner flame height. The air shutters can be accessed by reaching behind the manifold tee shown in Figure 23.1. The larger models may require the removal of the manifold (see Manifold Assembly Removal).

Natural Gas Flame Control

Control of burner flames on duct furnaces utilizing natural gas is achieved by resetting the primary air shutters (See Figure 23.1) to either increase or decrease primary combustion air. Prior to flame adjustment, operate duct furnace for about fifteen minutes. The main burner flame can be viewed after loosening and pushing aside the gas designation disc on the side of the burner box.

To increase primary air, loosen the air shutter set screws and move the air shutters closer to the manifold until the yellow-tipped flames disappear. (See Figure 23.1 for air shutter and heat exchanger support locations.) To decrease primary air, move the air shutters away from the manifolds until flames no longer lift from burner ports, but being careful not to cause yellow tipping. Retighten set screws after adjustment.

Propane Gas Flame Control

An optimum flame will show a slight yellow tip. Prior to flame adjustment, operate furnace for at least fifteen minutes. Loosen air shutter set screws and move the air shutters away from the manifold to reduce the primary air until the yellow flame tips appear. Then increase the primary air until yellow tips diminish and a clean blue flame with a well defined inner cone appears.

START-UP PROCEDURE

IMPORTANT

To prevent premature heat exchanger failure, with all control systems, a blower starting mechanism must be provided so that the blower is running or energized within 45 seconds of the gas control operation.

Control Operating Sequence

All indoor separated combustion duct furnaces are supplied with intermittent pilot ignition systems. These systems are offered with 100% shut-off with continuous retry for operation on natural gas and propane gas. On all systems, both the main burner and pilot burner are turned off 100% when the thermostat is satisfied.

For both natural and propane gas units, the ignition controller is 100% shut-off with continuous retry. On a call for heat, the system will attempt to light the pilot for 70 seconds. If the pilot is not sensed for any reason, the ignition control will wait for approximately six minutes with the combination gas control closed and no spark. After six minutes, the cycle will begin again. After three cycles, some ignition controllers lockout for approximately one hour before the cycle begins again. This will continue indefinitely until the pilot flame is sensed or power is interrupted to the system.

NOTE: Gas Control Options (see page 17) could change the listed sequence of operation based on their function. The descriptions given are for the basic duct furnace.

Single-Stage Gas Controls

Utilizes a single-stage combination gas control, an ignition control, and a single-stage low voltage thermostat.

1. The thermostat calls for heat.
2. The power exhaustor relay is energized starting the power exhaustor motor. Once the motor has reached full speed, the differential pressure switch closes. The power exhaustor relay pre-purge timer closes after 20 to 40 seconds energizing the gas control circuit.
3. The pilot valve opens and the spark ignitor sparks in an attempt to light the pilot. (If the unit was not provided with a time delay relay, the blower starts at this time.)
4. Once the pilot is lit, the flame sensor proves the pilot and stops the spark ignitor from sparking.
5. The main gas valve is opened and the main burner is lit to 100% full fire.
6. If the unit was provided with a time delay relay, the blower starts after 30 to 45 seconds.
7. The unit continues to operate until the thermostat is satisfied, at which time both the main and pilot valves close 100%. (If the unit was not provided with a time delay relay, the blower stops at this time.)
8. If the unit was provided with a time delay relay, the blower stops after 30 to 45 seconds.

Two-Stage Gas Controls

Utilizes a two-stage combination gas control, an ignition control, and a two-stage low voltage thermostat. The unit fires at 50% fire on low stage and 100% fire on high stage.

1. The thermostat calls for low stage heat.
2. The power exhaustor relay is energized starting the power exhaustor motor. Once the motor has reached full speed, the differential pressure switch closes. The power exhaustor relay pre-purge timer closes after 20 to 40 seconds energizing the gas control circuit.
3. The pilot valve opens and the spark ignitor sparks in an attempt to light the pilot. (If the unit was not provided with a time delay relay, the blower starts at this time.)

4. Once the pilot is lit, the flame sensor proves the pilot and stops the spark ignitor from sparking.
5. The main gas valve is opened and the main burner is lit to 50% fire.
6. If the unit was provided with a time delay relay, the blower starts after 30 to 45 seconds.
7. If the temperature at the thermostat continues to fall, the thermostat will call for high stage heat.
8. The main gas valve is opened completely and the main burner is lit to 100% full fire.
9. The unit continues to operate until the high stage of the thermostat is satisfied, at which time the main valve closes to 50% fire.
10. The unit continues to operate until the low stage thermostat is satisfied, at which time both the main and pilot valves close 100%. (If the unit was not provided with a time delay relay, the blower stops at this time.)
11. If the unit was provided with a time delay relay, the blower stops after 30 to 45 seconds.

Electronic Modulating Gas Controls

Single Furnace

Utilizes an electronic modulating/regulating gas control, combination gas valve, an ignition control, modulating amplifier, and either a modulating room thermostat or modulating duct thermostat with remote temperature set point adjuster. The thermostat controls can modulate the gas flow between 40% through 100% full fire. When the thermostat is satisfied, the amplifier cuts power to the combination gas valve which prevents gas flow to both the main and pilot burners.

When duct sensing is utilized, a room override thermostat can be added. When calling for heat, the room override thermostat provides full fire operation until the space temperature is satisfied. Control is then returned to the duct sensing control. In this situation, either the duct sensor or the room override thermostat can call for heat.

1. The thermostat calls for heat.
2. The power exhaustor relay is energized starting the power exhaustor motor. Once the motor has reached full speed, the differential pressure switch closes. The power exhaustor relay pre-purge timer closes after 20 to 40 seconds energizing the gas control circuit.
3. The pilot valve opens and the spark ignitor sparks in an attempt to light the pilot. (If the unit was not provided with a time delay relay, the blower starts at this time.)
4. Once the pilot is lit, the flame sensor proves the pilot and stops the spark ignitor from sparking.
5. The main gas valve is opened and the main burner is lit to 100% full fire.
6. If the unit was provided with a time delay relay, the blower starts after 30 to 45 seconds.
7. The modulating gas valve can be controlled by either an electronic modulating room or duct thermostat. The thermostat can modulate the firing rate between 40% through 100% full fire. The call for heat is created by a resistance signal (8000 to 12000 ohms) in the thermostat. The amplifier converts this resistance into a DC voltage (0 to 12 volts DC with 0 volts high fire and 12 volts low fire). The output voltage is applied to the modulating gas valve to control the gas flow to the main burner. As the temperature drops, the voltage drops causing the modulating valve to open further. If the discharge air temperature increases, the voltage increases causing the modulating valve to close allowing less gas flow to the main burner. For further information regarding the operation of the electronic modulating system, consult the literature provided with the unit.

START-UP PROCEDURE

8. The unit continues to operate in this manner until the thermostat is satisfied, at which time both the main and pilot valves close 100%. (If the unit was not provided with a time delay relay, the blower stops at this time.)
9. If the unit was provided with a time delay relay, the blower stops after 30 to 45 seconds.

Electronic Modulating Gas Controls - Master/Slave

One Master furnace is provided with up to three Slave furnaces that utilize electronic modulating/regulating gas controls, combination gas valves, ignition controls, one multiple furnace modulating amplifier, and either a modulating room thermostat or modulating duct thermostat with remote temperature adjuster. The thermostat controls can modulate the gas flow of all the furnaces between 40% through 100% full fire. The amplifier sends a signal to all of the gas valves so that they modulate at the same percentage. When the thermostat is satisfied, the amplifier cuts power to the combination gas valves which prevents gas flow to both the main and pilot burners.

When duct sensing is utilized, a room override thermostat can be added. When calling for heat, the room override thermostat provides full fire operation until the space temperature is satisfied. Control is then returned to the duct sensing control. In this situation, either the duct sensor or the room override thermostat can call for heat.

The sequence of operation for Electronic Modulating Gas Controls - Master/Slave is the same as Electronic Modulating Gas Controls - Single Furnace.

Electronic Modulating Gas Controls - Building Management Control (0-10Vdc or 4-20 mA Signal)

Utilizes an electronic modulating/regulating gas control, combination gas valve, an ignition control, modulating signal conditioner, and an inverted (0 Vdc or 4 mA being high fire and 10 Vdc or 20 mA being low fire) 0-10 Vdc or 4-20 mA input signal provided by a Building Management System (BMS). The signal conditioner can modulate the gas flow between 40% through 100% full fire. When the BMS thermostat (field supplied) is satisfied, the BMS heat contact (field supplied) opens to cut power to the combination gas valve which prevents gas flow to both the main and pilot burners.

1. The BMS thermostat (field supplied) calls for heat and closes the BMS heat contact (field supplied).
2. The power exhaustor relay is energized starting the power exhaustor motor. Once the motor has reached full speed, the differential pressure switch closes. The power exhaustor relay pre-purge timer closes after 20 to 40 seconds energizing the gas control circuit.
3. The pilot valve opens and the spark ignitor sparks in an attempt to light the pilot. (If the unit was not provided with a time delay relay, the blower starts at this time.)
4. Once the pilot is lit, the flame sensor proves the pilot and stops the spark ignitor from sparking.
5. The main gas valve is opened and the main burner is lit to 100% full fire.
6. If the unit was provided with a time delay relay, the blower starts after 30 to 45 seconds.
7. The modulating gas valve is controlled the BMS thermostat. The thermostat can modulate the firing rate between 40% through 100% full fire by modulating the input signal between either 0-10 Vdc or 4-20 mA (The signal conditioner can accept a 0-10 Vdc signal when all the dip switches are in the "OFF" position and 4-20 mA signal when all the dip switches are in the "ON" position). The signal conditioner converts the input signal into a DC voltage (0 to 12 volts DC with 0 volts high fire and 12 volts low fire). The output voltage is applied to the modulating gas valve to control the

gas flow to the main burner. As the temperature drops, the voltage drops causing the modulating valve to open further. If the discharge air temperature increases, the voltage increases causing the modulating valve to close allowing less gas flow to the main burner. For further information regarding the operation of the electronic modulating system, consult the literature provided with the unit.

8. The unit continues to operate in this manner until the thermostat is satisfied, at which time the BMS heat contact opens resulting in both the main and pilot valves closing 100%. (If the unit was not provided with a time delay relay, the blower stops at this time.)
9. If the unit was provided with a time delay relay, the blower stops after 30 to 45 seconds.

Variable Air Movement Applications

When the air mover supplied by others can provide variable air movement (i.e. 2-speed or variable frequency drive units), the allowable minimum CFM of the duct furnace can be 66% of the minimum listed CFM in Table 20.2 if the unit is applied as follows:

1. The unit is provided with 2-stage, or electronic modulating gas controls. (see Model Identification).
2. The unit is provided with a factory installed discharge air controller.
3. The system does not include a room thermostat.

The factory installed discharge air thermostat will prevent the unit from firing above the allowable 100°F rise when the unit is at or above the minimum CFM by monitoring the discharge air and going to low fire. A room thermostat, because it is located remote from the unit, could cause the unit to over-fire.

START-UP PROCEDURE

Gas Control Options

The unit must be reviewed to determine if any of the listed gas control options were supplied.

① Time Delay Relay

The Time Delay Relay is factory installed in the duct furnace electrical junction box. The standard duct furnace is provided for instantaneous fan operation. On a call for heat, the blower is energized at the same time as the gas controls. The optional time delay relay allows the gas controls to operate for approximately 30 seconds before the blower starts. This allows the heat exchanger a warm up period so that the initial delivered air coming out of the ductwork is not cool. The time delay relay also keeps the motor running for approximately 30 seconds after the call for heat has been satisfied to remove the residual heat from the heat exchanger.

② Low Gas Pressure Switch

The low gas pressure switch is factory installed in the duct furnace above the gas train. The switch monitors the gas pressure upstream of all the gas controls and shuts off the electric supply to the ignition controller and combination gas valve if low gas pressure is experienced. This will shut off all gas flow to the burner. The switch has an automatic reset so that if the gas pressure is interrupted and then is returned, the switch will automatically allow the unit to operate when gas conditions are returned to the allowable range of the pressure switch. The pressure switch range is 2" to 14" W.C. and should be set to insure that the minimum inlet gas pressure is available (6" W.C. for natural gas, 11" W.C. for propane gas).

③ High Gas Pressure Switch

The high gas pressure switch is factory installed in the duct furnace above the gas train. The switch monitors the gas pressure downstream of all the gas controls and shuts off the electric supply to the ignition controller and combination gas valve if high gas pressure is experienced right before the manifold. This will shut off all gas flow to the burner. The switch has a manual reset so that if the gas pressure is too high, a service person must check the unit to make sure that none of the gas controls have been damaged by the high gas pressure and then reset the switch to allow the unit to operate when gas conditions are returned to the allowable range of the pressure switch. The pressure switch range is 2" to 16" W.C. and should be set to insure that the maximum manifold gas pressure is not exceeded (3.5" W.C. for natural gas, 10" W.C. for propane gas).

④ Supply Air Fire Stat

The fire stat is factory installed in the duct furnace electrical junction box with the sensor in the discharge air stream. In case of elevated temperatures in the supply air, the manual reset switch shuts down the entire unit. If the limit temperature is exceeded, a service person must inspect the unit for the cause of the high discharge temperature, take corrective action, and then reset the switch.

⑤ Timed Freeze Protection

The timed freeze protection system is factory installed in the duct furnace electrical junction box with the sensor (30°-75°F adjustable) factory installed in discharge air stream. On initial start-up, the timed delay in the system allows the unit to go through the normal ignition sequence. The timed delay is an automatic reset switch and adjustable for 1-10 minutes. In the event that the unit fails to fire after this period, the discharge air sensor will sense the cold air and will shut down the entire unit.

⑥ Air Flow Proving Switch

The air flow proving switch is factory installed in the duct furnace electrical junction box. The air flow proving switch monitors the pressure differential between the duct furnace and the atmosphere. The purpose of the air flow proving switch is to cut power to the gas controls if a positive pressure is not measured by the switch. This could be caused by a lack of air movement through the heat exchanger.

NOTE: The air flow proving switch will prevent any heat exchanger warm-up (the unit should not be equipped with a time delay relay) because the gas controls can not be energized until air flow is proven.

Setting the Air Flow Proving Switch

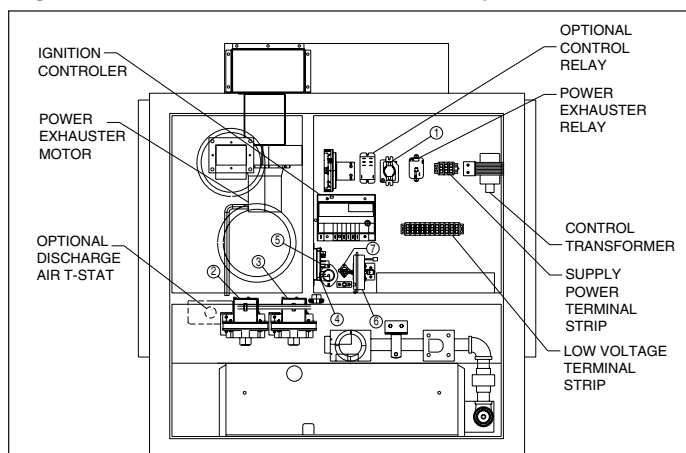
The range of the air flow proving switch is adjustable between 0.17" to 5.0" W.C.

1. Set the thermostat so that there is a call for heat. This should start the blower and then the burner ignition sequence.
2. Turn the set screw of the pressure switch clockwise until it stops. This will set the pressure at 5.0" W.C.
3. Turn the screw counter-clockwise until the gas controls light and then one additional full turn (This is approximately 0.25" W.C.). This will allow for dirty filters or any other slight static pressure increases in the system.

⑦ Manual Reset High Limit

The manual reset high limit switch is factory installed in place of the standard automatic reset high limit switch located in the duct furnace electrical junction box. In case of a failure of the blower motor, blockage of the inlet air, etc., the manual reset switch prevents the unit from cycling on the high limit. If the limit temperature is exceeded, a service person must inspect the unit for the cause of the high discharge temperature, take corrective action, and then reset the switch.

Figure 17.1 - Location of Gas Control Options



DIMENSIONAL DATA

Figure 18.1 - Unit Dimensions (all dimensions in inches)

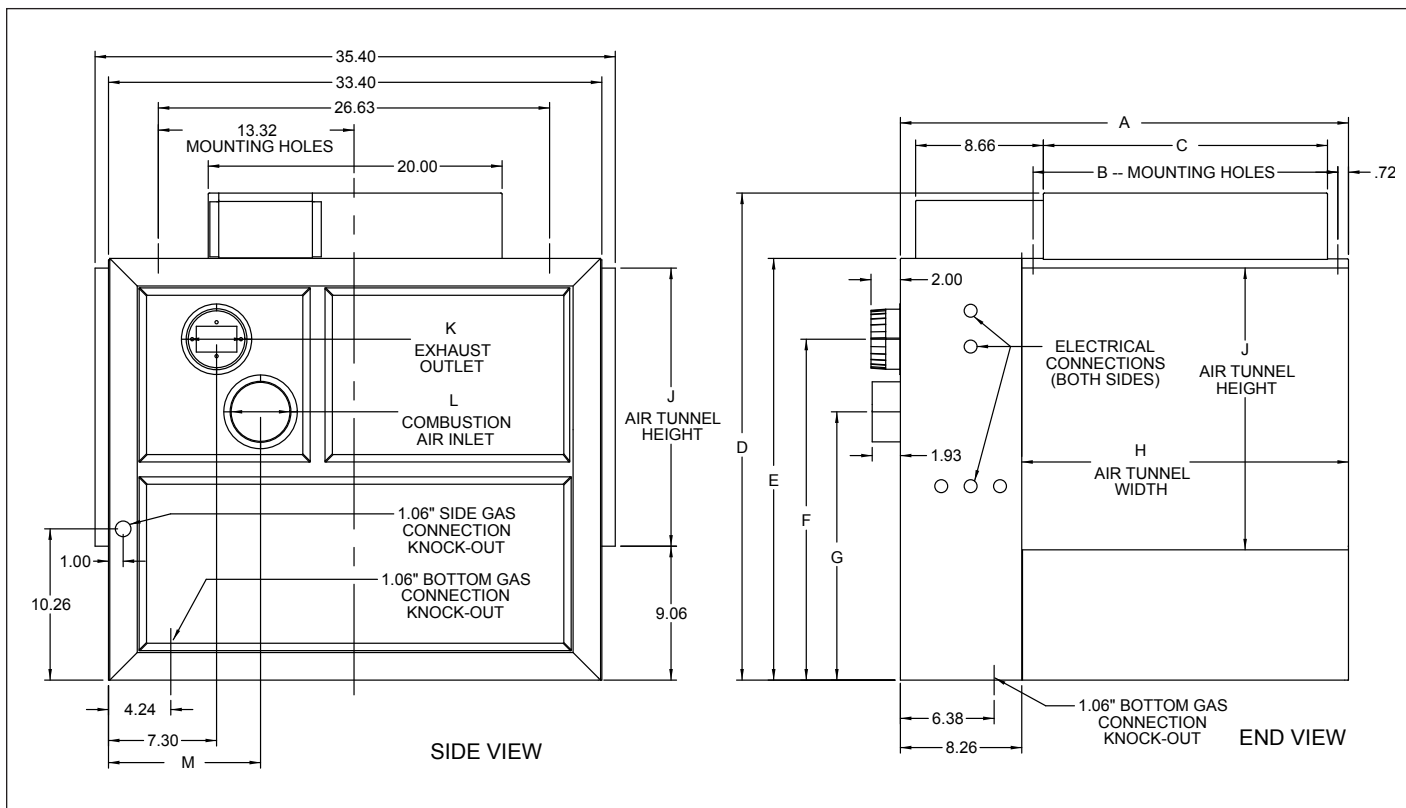


Table 18.1 - Indoor Separated Combustion Duct Furnace Dimensions (All dimensions in inches)

Dimensions	Model Size					
	75	100/125	150/175	200/225	250/300	350/400
A	23.74	26.24	30.50	32.60	35.60	47.14
B	13.98	16.48	20.74	22.85	25.85	37.39
C	12.58	15.08	19.34	21.45	24.48	36.00
D	33.04	33.04	33.04	37.04	37.04	37.04
E	28.61	28.61	28.61	32.61	32.61	32.61
F	23.08	23.08	23.08	26.43	26.43	26.43
G	18.19	18.19	18.19	19.21	19.21	19.21
H	15.12	17.62	21.88	23.99	26.99	38.53
J	18.90	18.90	18.90	22.90	22.90	22.90
K ①	3.86	3.86	3.86	5.86	5.86	5.86
L ①	4.17	4.17	4.17	6.18	6.18	6.18
M	10.26	10.26	10.26	9.60	9.60	9.60
Gas Connection Pipe Size		1/2"	1/2"	1/2"	3/4"	3/4"
Approx. Weight	Unit Shipping	226#	250#	273#	325#	454#
	Unit Net	151#	170#	188#	230#	329#

① Nominal vent pipe size is 4" (Models 75-175) and 6" (Models 200-400). Exhaust pipe installed over collar. Combustion air pipe installed inside collar.

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PERFORMANCE

Table 20.1 - Air Temperature Rise - Low Temperature Rise Duct Furnaces ① ② ③

Model Size	Btu/Hr		Air Temperature Rise Through Unit (°F)								
			20	25	30	35	40	45	50	55	60
	Input	Output	Max	CFM							Min
75	75,000	60,000	2778	2222	1852	1587	1389	1235	1111	1010	926
100	100,000	80,000	3704	2963	2469	2116	1852	1646	1481	1347	1235
125	125,000	100,000	4630	3704	3086	2646	2315	2058	1852	1684	1543
150	150,000	120,000	5556	4444	3704	3175	2778	2469	2222	2020	1852
175	175,000	140,000	6481	5185	4321	3704	3241	2881	2593	2357	2160
200	200,000	160,000	7407	5926	4938	4233	3704	3292	2963	2694	2469
225	225,000	180,000	8333	6667	5556	4762	4167	3704	3333	3030	2778
250	250,000	200,000	9259	7407	6173	5291	4630	4115	3704	3367	3086
300	300,000	240,000	11111	8889	7407	6349	5556	4938	4444	4040	3704
350	350,000	280,000	12963	10370	8642	7407	6481	5761	5185	4714	4321
400	400,000	320,000	14815	11852	9877	8466	7407	6584	5926	5387	4938

Table 20.2 - Air Temperature Rise - High Temperature Rise Duct Furnaces ① ② ③

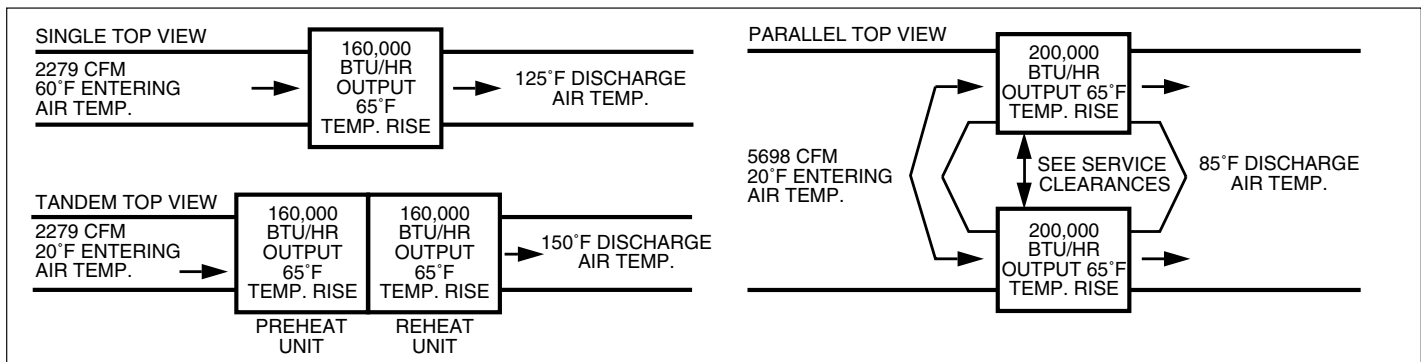
Model Size	Btu/Hr		Air Temperature Rise Through Unit (°F)											
			20 ④	40 ④	50 ④	60	65	70	75	80	85	90	95	100 ⑤
	Input	Output	Max	CFM										Min
75	75,000	60,000	2778	1389	1111	926	855	794	741	694	654	617	585	556
100	100,000	80,000	3704	1852	1481	1235	1140	1058	988	926	871	823	780	741
125	125,000	100,000	4630	2315	1852	1543	1425	1323	1235	1157	1089	1029	975	926
150	150,000	120,000	5556	2778	2222	1852	1709	1587	1481	1389	1307	1235	1170	1111
175	175,000	140,000	6481	3241	2593	2160	1994	1852	1728	1620	1525	1440	1365	1296
200	200,000	160,000	7407	3704	2963	2469	2279	2116	1975	1852	1743	1646	1559	1481
225	225,000	180,000	8333	4167	3333	2778	2564	2381	2222	2083	1961	1852	1754	1667
250	250,000	200,000	9259	4630	3704	3086	2849	2646	2469	2315	2179	2058	1949	1852
300	300,000	240,000	11111	5556	4444	3704	3419	3175	2963	2778	2614	2469	2339	2222
350	350,000	280,000	11111⑥	6481	5185	4321	3989	3704	3457	3241	3050	2881	2729	2593
400	400,000	320,000	11111⑥	7407	5926	4938	4558	4233	3951	3704	3486	3292	3119	2963

- ① Ratings are shown for elevations up to 2000 feet. For higher elevations, the input rating should be reduced at the rate of 4% per 1000 feet elevation above sea level. For Canada, in elevations between 2000 and 4500 feet, the unit must be derated to 90% of the rating listed above.
- ② Units approved for use in California by CEC.
- ③ High air temperature rise units include an air distribution baffle and restrictor change when compared to the low air temperature rise units. Field conversion of a high air temperature rise to a low air temperature rise unit (or the opposite) requires a factory supplied conversion kit.
- ④ The certified range of the High Temperature Rise Duct Furnaces is 20°-100°F but it is recommended that they be used from 60°-100°F to reduce the system pressure drop.
- ⑤ For Variable Air Movement Applications, see page 16.
- ⑥ The maximum CFM for the 350 and 400 results in a 23°F and a 27°F air temperature rise (respectively) based on the maximum unit pressure drop.

Air Temperature and External Static Pressure Limits

The maximum allowable discharge air temperature is 150°F. The maximum allowable air temperature rise for Low Air Temperature Rise Units is 60°F. The maximum allowable air temperature rise for High Air Temperature Rise Units is 100°F. All duct furnaces are designed for a maximum allowable static pressure of 3.0" W.C. on the heat exchanger.

Figure 20.1 - Recommended Unit Configurations



PRESSURE DROP CURVES

Figure 21.1 - Indoor Duct Furnace Without Baffle Pressure Drop vs CFM curves

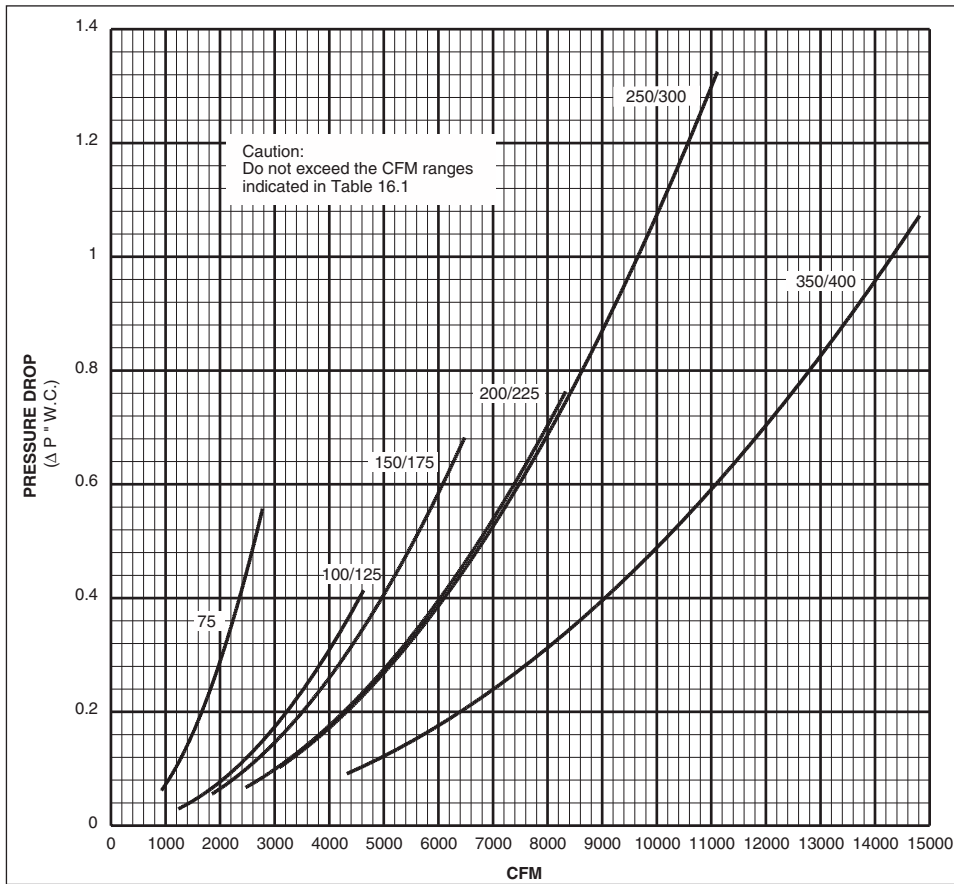
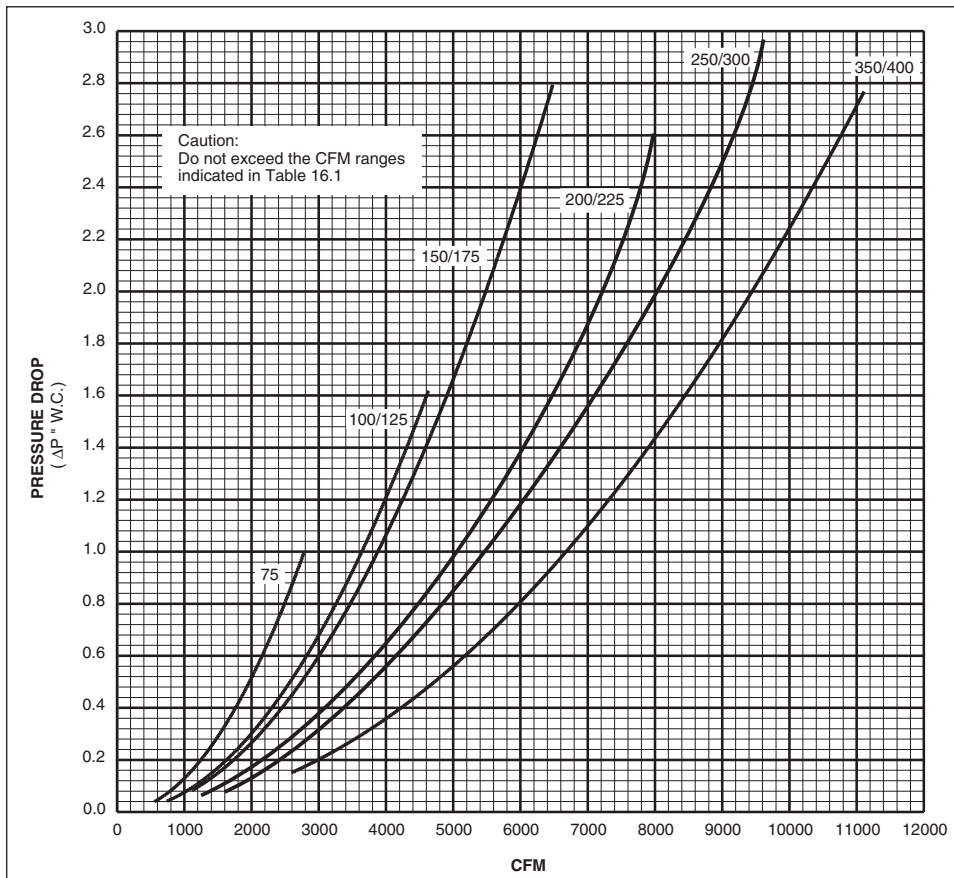


Figure 21.2 - Indoor Duct Furnace With Baffle Pressure Drop vs CFM curves



MAINTENANCE

WARNING

When servicing or repairing this equipment, use only factory-approved service replacement parts. A complete replacement parts list may be obtained by contacting Modine Manufacturing Company. Refer to the rating plate on the appliance for complete appliance model number, serial number, and company address. Any substitution of parts or controls not approved by the factory will be at the owner's risk.

CAUTION

Do not attempt to reuse any mechanical or electrical controller which has been wet. Replace defective controller.

IMPORTANT

To check most of the Possible Remedies in the troubleshooting guide listed in Table 24.1, refer to the applicable sections of the manual.

All heating equipment should be serviced before each heating season to assure proper operations. The following items may be required to have more frequent service schedule based on the environment in which the unit is installed, and the frequency of the equipment operation.

Blower Assembly

The blower assembly includes the bearings, drive sheaves and belts.

Blower bearings should be checked and lubricated based on the blower manufacturer's recommendations. Bearings should also be checked for any unusual wear and replaced if needed.

Drive sheaves should be checked at the same time the bearings are inspected. Check to make sure the sheaves are in alignment and are securely fastened to the blower and motor shafts.

Belt tension should be rechecked shortly after the unit has been installed to check for belt stretching. After the initial start-up, monthly checks are recommended.

Filters

If the unit is supplied with a dirty filter switch and light, clean or replace the filters any time the dirty filter light comes on.

Units which do not have a dirty filter warning light should have the filters checked monthly. Clean or replace if necessary. In dirty atmospheres, filter maintenance may be required more often.

Duct Furnace

When providing annual maintenance for the duct furnace, keep the unit free from dust, dirt, grease and foreign matter. Pay particular attention to:

1. The combustion air and exhaust vent piping.
2. The burner ports and pilot burner orifices (avoid the use of hard, sharp instruments capable of damaging surfaces for cleaning these ports). To check the burner port and pilot burner orifice, see Burner and Pilot Assembly Removal.
3. The air shutters and main burner orifices (avoid the use of hard, sharp instruments capable of damaging surfaces for cleaning these orifices). To check the air shutters and main burner orifices, see for Manifold Assembly Removal.

The heat exchanger should be checked annually for cracks and discoloration of the tubes. If a crack is detected, the heat exchanger should be replaced before the unit is put back into service. If the tubes are dark gray, airflow across the heat exchanger should be checked to insure that a blockage has not occurred or the blower is operating properly.

Electrical Wiring

The electrical wiring should be checked annually for loose connections or deteriorated insulation.

Gas Piping & Controls

The gas valves and piping should be checked annually for general cleanliness and tightness.

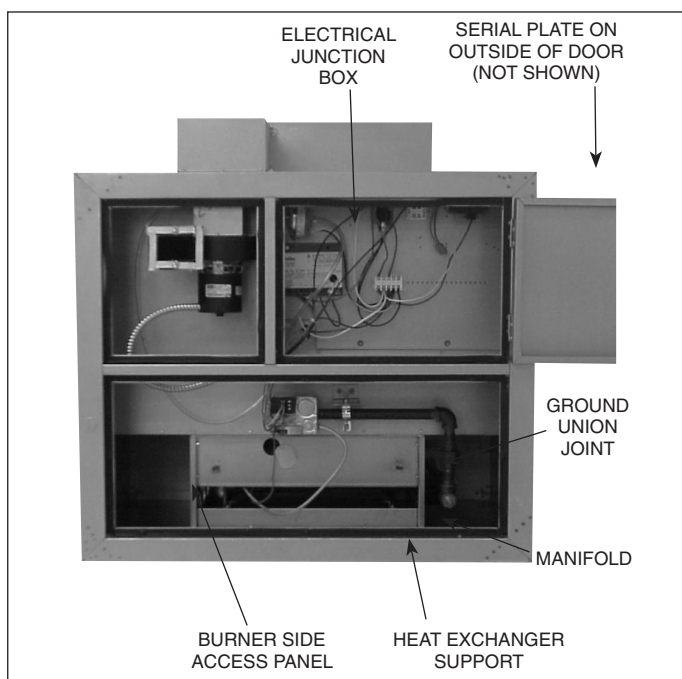
The gas controls should be checked to insure that the unit is operating properly.

Manifold Assembly Removal

To remove the manifold

1. Shut off gas and electric supply.
2. Remove the burner side access panel.
3. Disconnect gas manifold at ground union joint.
4. Remove the two screws holding the manifold to the heat exchanger support.
5. Slide the manifold through the manifold bracket.
6. Clean the orifices and adjust the air shutters as necessary.
7. Follow steps 3-6 in reverse order to install the manifold assembly.
8. Turn on the electric and gas supply.
9. Check the ground union joint for leaks with a soap solution. Tighten if necessary.
10. Install the burner side access panel.

Figure 22.1 - Manifold Assembly Removal



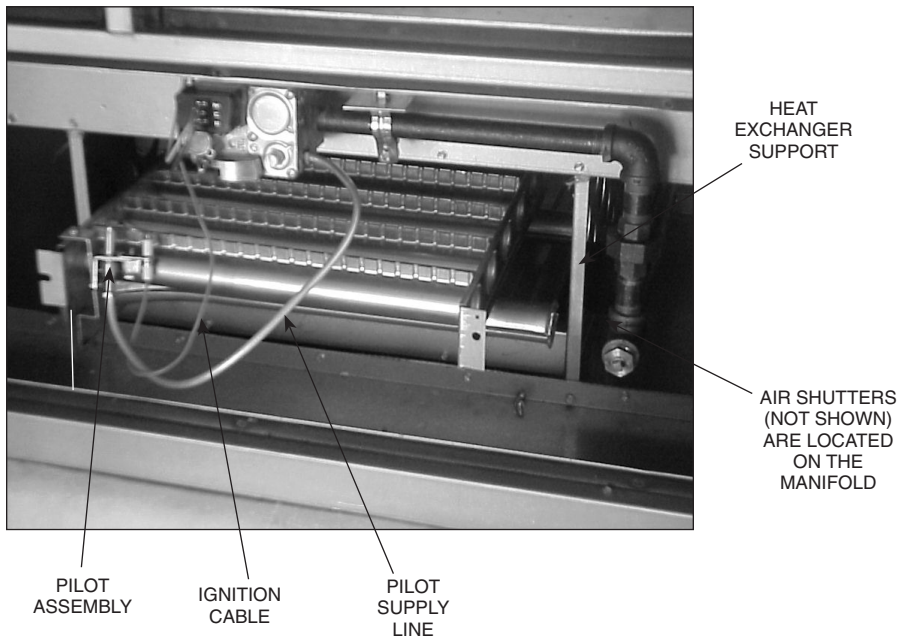
MAINTENANCE

Burner and Pilot Assembly Removal

To remove the burner

1. Shut off gas and electric supply.
2. Remove the burner side access panel.
3. Disconnect the pilot supply line from the gas valve.
4. Disconnect the ignition cable from the ignition controller (located in the electrical junction box). Feed the cable through the bushing in the bottom of the electrical junction box.
5. Remove the screws holding the burner side access panel. Attached to the panel are the burner retaining pins that align the burner.
6. Slide the burner assembly out. The pilot is attached to the burner assembly.
7. Examine the burner and pilot assembly for cleanliness and/or obstructions as necessary (see Duct Furnace for cleaning instructions).
8. Replace the burner assembly in reverse order. In replacing the burner, be certain that the rear burner slots are located properly on the burner retaining pins. Do not force the burner side access panel, it will not fit if the burner is not properly aligned.
9. Reconnect the ignition cable and pilot gas supply line.
10. Install the burner side access panel.
11. Turn on the electric and gas supply.

Figure 23.1 - Burner and Pilot Assembly Removal



SERVICE & TROUBLESHOOTING

Table 24.1 - Troubleshooting

Trouble	Possible Cause	Possible Remedy
Power Exhauster Motor will not start	<ol style="list-style-type: none"> 1. Power supply is off. 2. No 24V power to thermostat. 3. Thermostat malfunction. 4. Defective power exhauster relay. 5. Defective power exhauster motor. 	<ol style="list-style-type: none"> 1. Turn on main power. 2. Check control transformer. 3. Check/replace thermostat. 4. Replace power exhauster relay. 5. Replace power exhauster motor.
Pilot does not light	<ol style="list-style-type: none"> 1. Main gas is off. 2. Power supply is off. 3. Air in gas line. 4. Dirt in pilot orifice. 5. Gas pressure out of proper range. 6. Pilot valve does not open. <ol style="list-style-type: none"> a. Defective ignition controller. b. Defective gas valve. 7. No Spark at ignitor. <ol style="list-style-type: none"> a. Loose wire connections. b. Pilot sensor is grounded. c. Defective ignition controller. 8. Safety device has cut power. 	<ol style="list-style-type: none"> 1. Open manual gas valve. 2. Turn on main power. 3. Purge gas line. 4. Check for plugged pilot orifice and clean with compressed air if necessary. 5. Adjust to a maximum of 14" W.C. Minimum for Natural Gas - 6" W.C. Minimum for Propane Gas - 11" W.C. 6. Check wiring for 24 volts to valve. <ol style="list-style-type: none"> a. Replace ignition controller. b. Replace gas valve. 7. <ol style="list-style-type: none"> a. Check all ignition controller wiring. b. Replace sensor if cracked or worn c. Replace ignition controller. 8. Check all safety devices (High limit, air flow proving switch, differential pressure switch, gas pressure switches, etc.) Determine and correct problem. Reset if necessary.
Main burners do not light (Pilot is lit)	<ol style="list-style-type: none"> 1. Defective valve. 2. Loose wiring. 3. Defective pilot sensor 4. Defective ignition controller. 5. Improper thermostat wiring. 	<ol style="list-style-type: none"> 1. Replace valve. 2. Check wiring to gas valve. 3. Replace pilot sensor. 4. Replace ignition controller. 5. Verify wiring compared to wiring diagram.
Lifting Flames (See Figure 25.1)	<ol style="list-style-type: none"> 1. Too much primary air. 2. Main pressure set too high. 3. Orifice too large. 	<ol style="list-style-type: none"> 1. Reduce primary air. 2. Adjust to a maximum of 14" W.C. 3. Check orifice size with those listed on the serial plate.
Yellow Tipping (With propane gas, some yellow tipping is always present.)	<ol style="list-style-type: none"> 1. Insufficient primary air. 2. Dirty orifice. 3. Misaligned orifice. 	<ol style="list-style-type: none"> 1. Increase primary air. 2. Check orifices and clean with compressed air if necessary. 3. Check manifold, replace if necessary.
Flashback	<ol style="list-style-type: none"> 1. Too much primary air. 2. Main pressure set too high. 3. Orifice too large 	<ol style="list-style-type: none"> 1. Reduce primary air. 2. Adjust to a maximum of 14" W.C. 3. Check orifice size with those listed on the serial plate.
Floating Flames (See Figure 25.2)	<ol style="list-style-type: none"> 1. Insufficient primary air. 2. Main pressure set too high. 3. Orifice too large. 4. Blocked vent. 	<ol style="list-style-type: none"> 1. Increase primary air. 2. Adjust to a maximum of 14" W.C. 3. Check orifice size with those listed on the serial plate. 4. Clean/correct venting system.
Flame Rollout (See Figure 25.3)	<ol style="list-style-type: none"> 1. Main pressure set too high. 2. Orifice too large. 3. Blocked vent. 	<ol style="list-style-type: none"> 1. Adjust to a maximum of 14" W.C. 2. Check orifice size with those listed on the serial plate. 3. Clean/correct venting system.

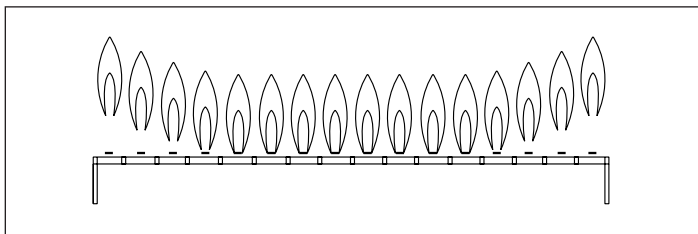
SERVICE & TROUBLESHOOTING

Trouble	Possible Cause	Possible Remedy
Not Enough Heat	<ol style="list-style-type: none"> Unit cycling on high limit. ① <ol style="list-style-type: none"> Obstructions/leaks in duct system. Main pressure set too high. Blower motor not energized. Loose belt Blower speed too low. Blocked/damaged venting system. Air distribution baffle removed (high temperature rise units only). Defective high limit switch. Main pressure set too low. Too much outside air. Thermostat malfunction. Gas controls wired incorrectly. Unit undersized. 	<ol style="list-style-type: none"> <ol style="list-style-type: none"> Clean/correct duct system. Adjust to a maximum of 14" W.C. Check/correct to insure blower motor operates within 45 seconds of when - gas controls are energized. Adjust belt tension. Check/correct blower drive settings for proper rpm. Check/correct venting system. Replace air distribution baffle. Replace high limit switch. Adjust main gas pressure. Minimum for Natural Gas — 6" W.C. Minimum for Propane Gas — 11" W.C. Adjust outside air damper to decrease outside air percentage (if possible). Check/replace thermostat. Check unit wiring against the wiring diagram. Check design conditions. If unit is undersized, an additional unit(s) or other heat source must be added.
Too Much Heat	<ol style="list-style-type: none"> Thermostat malfunction. Gas controls do not shut-off. <ol style="list-style-type: none"> Gas controls wired incorrectly. Short circuit. Main gas pressure set too high. Defective gas valve. 	<ol style="list-style-type: none"> Check/replace thermostat. <ol style="list-style-type: none"> Check unit wiring against the wiring diagram. Check for loose or worn wires. Adjust to a maximum of 14" W.C. Replace gas valve.

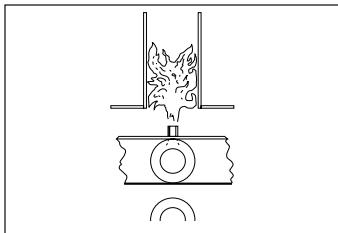
① Automatic Reset High Limit

The duct furnace comes standard with an automatic reset high limit switch that will shut-off the gas should the discharge air temperature become excessive. See Figure 17.1, indicator ⑦ for the location of either the standard automatic or optional manual reset high limit switch. The switch should operate only when something is seriously wrong with the unit operation. Anytime the switch operates, correct the difficulty immediately or serious damage may result. If the switch cuts off the gas supply during normal operation, refer to the "Not Enough Heat" section of Service & Troubleshooting.

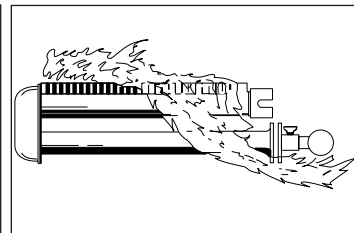
Figure 25.1 - Lifting Flame Condition



**Figure 25.2
Floating Flame Condition**



**Figure 25.3
Flame Rollout Appearance**



REPLACEMENT PARTS ORDERING

Ordering

When servicing, repairing or replacing parts on these units, locate the serial plate of the unit and always give the complete Model Number and Serial Number from the serial plate. The serial plate is located on the door of the electrical control box. The factory part number for some common replacement parts are listed on the sample serial plate (See Figure 26.1). For a complete description of the model number, see Model Identification.

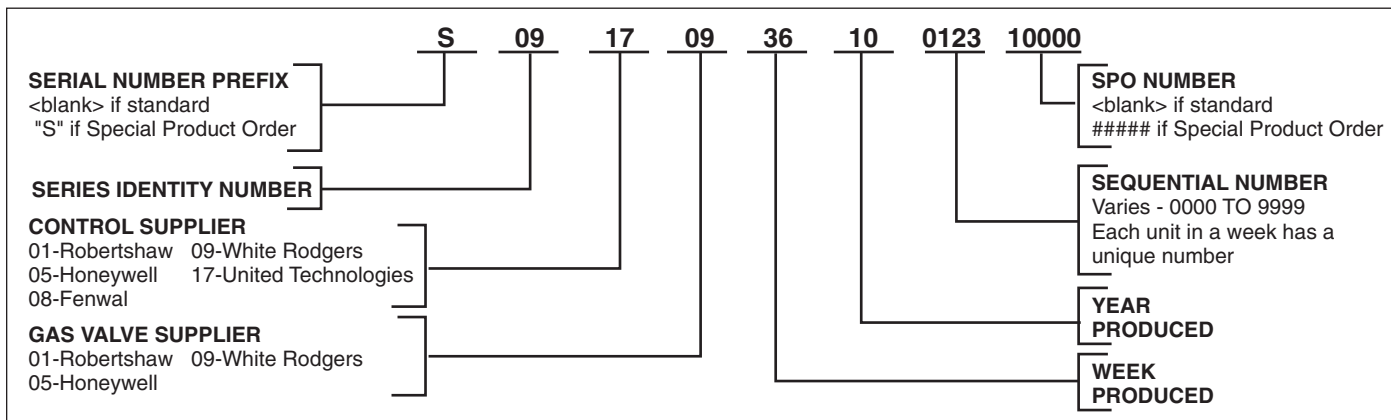
Figure 26.1

Modine Manufacturing Company 1500 DeKoven Ave., Racine, WI 53403 Phone: 800.828.4328				SEPARATED COMBUSTION DUCT FURNACE FOR INDUSTRIAL/COMMERCIAL USE CHAUDIERE A GAZ A CONDUIT SEPARÉ POUR USAGE INDUSTRIEL/COMMERCIAL				MADE IN U.S.A.																																																																													
MODEL NUMBER NUMERO DE MODELE		DFS200AFRHN10A1		MIN. INPUT BTU/HR DEBIT CALORIFIQUE MIN. BTU/HEURE		160000		APPROVALS																																																																													
SERIAL NUMBER NUMERO DE SERIE		09170936100123		MIN. INLET PRESS. FOR PURPOSE OF INPUT ADJUSTMENT PRESSION D'ALIMENTATION EN GAZ MIN. ADMISE		6		DESIGN COMPLIES WITH DUCT FURNACE STANDARD: ANS Z83.8 - 96 CGA 2.8 - M86																																																																													
TYPE OF GAS TYPE DE GAZ		Natural		MANIFOLD PRESSURE PRESSION A LA TUBULURE D'ALIMENTATION		3.5		IN. W.C. PO.C.D'E																																																																													
TEMPERATURE RISE RANGE ELEVATION DE TEMPERATURE		20-100 °F		MAXIMUM EXTERNAL STATIC PRESSURE PRESSION STATIQUE EXTERIEUR MAXIMUM		3		IN. W.C. PO.C.D'E																																																																													
CATEGORY CATEGORIE		HORIZ/VERT HORIZ/VERT		VENT CONNECTOR CONNECTEUR DE VENTILATION		6		IN. PO.																																																																													
		0 TO 2000 FT. 0 ET 610 M.		(IN CANADA) 2000 TO 4500 FT. 610 ET 1370 M.		AIR THROUGHPUT DEBIT D'AIR		VOLTS																																																																													
INPUT BTU/HR DEBIT CALORIFIQUE BTU/HEURE		200000		180000		MIN. CFM		1481																																																																													
OUTPUT BTU/HR RENDIMENT BTU/HEURE		160000		144000		MAX. CFM		7407																																																																													
ORIFICE SIZE DIM. DE L'INJECTEUR		23		26		MIN. VARIABLE SPEED/CFM		1111																																																																													
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COMMON REPLACEMENT PARTS For parts ordering, contact the parts wholesaler or the manufacturer's representative serving your area. When inquiring about parts, always provide model number, serial number, description and part number. When ordering parts, provide part number listed. For service, contact your local qualified installation and service contractor or appropriate utility company. 5H73205-1 Comb. Gas Valve 5H73696-Ignition Control 3H34347-3 Pilot Assy. Kit 5H74976-1 Limit Control 5H74977-1 Transformer 5H76776-1 Wiring Diagram 3H35628-6 Burner Kit 3H35747-6 Heat Exch. Kit 5H75745-1 Power Exhauster				COMBUSTIBLE MATERIALS AND SERVICE CLEARANCES MATERIAUX COMBUSTIBLES ET DÉGAGEMENTS D'ENTRETIEN 				GENERAL 1. FOR INDOOR INSTALLATIONS ONLY. 2. MINIMUM AMBIENT TEMPERATURE -40°F. 3. FOR INSTALLATION DOWN STREAM OF REFRIGERATION SYSTEMS. 4. INSTALL ON THE POSITIVE PRESSURE SIDE OF AIR CIRCULATING BLOWER. 5. FOR UNITS WITH MANUAL RESET HIGH LIMIT SWITCH, RESET BUTTON IS LOCATED IN ELECTRICAL JUNCTION BOX. 6. (IN USA) FOR INSTALLATIONS ABOVE 2000 FEET, DERATE 4 PERCENT FOR EACH 1000 FEET OF ELEVATION ABOVE SEA LEVEL. LIGHTING INSTRUCTIONS 1. OPEN ALL GAS VALVES. TURN ON POWER. 2. SET THERMOSTAT TO DESIRED SETTING. SHUT DOWN INSTRUCTIONS 1. TURN OFF POWER & CLOSE ALL GAS VALVES. REFER TO INSTALLATION AND SERVICE MANUAL FOR MORE INSTRUCTIONS * FOR UNITS WITH TWO STAGE, MECHANICAL MODULATION, OR ELECTRONIC MODULATING GAS CONTROLS, A FACTORY DISCHARGE AIR CONTROLLER AND NO ROOM THERMOSTAT INCLUDED. GÉNÉRAL 1. SEULEMENT POUR INSTALLATION INTÉRIEURE 2. LA TEMPÉRATURE MINIMUM DE L'AIR DEHORS EST -40°C. 3. POUR L'INSTALLATION QUE SUIVE LES SYSTEMS REFRIGÉRANTS. 4. INSTALLER DU CÔTÉ DE LA PRESSION POSITIVE DU VENTILATEUR. 5. POUR APPAREILS AVEC INTERRUPTEUR REMIS MANUEL HAUT-LIMITE, REMISE EST SITUÉE DANS LA BOÎTE JUNCTION ÉLECTRIQUE. POUR REMETTRE PRESSER LE BOUTON. INSTRUCTIONS D'ALLUMAGE 1. DUVRIR TOUTES LES ROBINETS A GAZ. DONNER LE COURANT. 2. RÉGLER LE THERMOSTAT SUR LA POSITION DESIRÉE. INSTRUCTIONS DE FER METURE 1. COUPER LE COURANT ET FERMER TOUTES LES ROBINETS A GAZ. REFERER AU MANUAL D'INSTALLATION ET DE SERVICE POUR PLUS D'INSTRUCTIONS * POUR APPAREILS AVEC DEUX PHASES MODULATION MÉCANIQUE, OU APPAREILS DE CONTRÔLE DE GAZ ÉLECTRIQUES MODULÉS, UN AIR CONTRÔLEUR DÉCHARGE INSTALLÉ À LA MANUFACTURE, ET THERMOSTAT DE CHAMBRE N'EST PAS INCLUS.																																																																													
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5H76854B Rev A

MODEL IDENTIFICATION

Figure 27.1 - Serial Number Designations



Indoor Separated Combustion Duct Furnace Model Nomenclature

1	2	3	4 5 6	7	8	9	10	11	12	13	14	15
PT	UC	V	MBH	HE	DS	AS	ATR	GT	GV	SS	SV	TR

1 - Product Type (PT)

D - Duct Furnace - Indoor

2 - Unit Configuration (UC)

F - Furnace

3 - Venting (V)

S - Separated Combustion

4,5,6 - Furnace Input Rating (MBH)

75 - 75,000 Btu/Hr Input	200 - 200,000 Btu/Hr Input
100 - 100,000 Btu/Hr Input	225 - 225,000 Btu/Hr Input
125 - 125,000 Btu/Hr Input	250 - 250,000 Btu/Hr Input
150 - 150,000 Btu/Hr Input	300 - 300,000 Btu/Hr Input
175 - 175,000 Btu/Hr Input	350 - 350,000 Btu/Hr Input
	400 - 400,000 Btu/Hr Input

7 - Heat Exchanger/Burner/Drip Pan Material (HE)

A - Aluminized Steel
S - 409 Stainless Steel Heat Exchanger/Burner
T - 409 Stainless Steel Heat Exchanger/Burner/Drip Pan

8 - Development Sequence (DS)

F - Single Stage M - 2-stage or Modulating

9 - Access Side (AS)

R - Right Hand L - Left hand

10 - Air Temperature Rise (ATR)

H - High 20°-100°F L - Low 20°-60°

11 - Gas Type (GT)

N - Natural with ignition controller
P - Propane with ignition controller

12 - Gas Valve (GV)

1 - Single Stage	5 - Electronic Modulation Master
2 - Two Stage	6 - Electronic Modulation Slave
4 - Electronic Modulation	7 - Electronic Modulation 0-10 Vdc External Input
	8 - Electronic Modulation 4-20 mA External Input

13 - Additional Safety Switches (SS)

0 - No Additional Switches 2 - High Gas Pressure Switch
1 - Low Gas Pressure Switch 3 - High & Low Gas Pressure Switch

14 - Supply Voltage (SV)

A - 115/60/1	D - 208/60/3
B - 208/60/1	E - 230/60/3
C - 230/60/1	F - 460/60/3
	G - 575/60/3

15 - Transformer (TR)

1 - 40 VA	3 - 150 VA
2 - 75 VA	4 - 250 VA
	0 - None

COMMERCIAL WARRANTY

Seller warrants its products to be free from defects in material and workmanship, EXCLUSIVE, HOWEVER, of failures attributable to the use of materials substituted under emergency conditions for materials normally employed. This warranty covers replacement of any parts furnished from the factory of Seller, but does not cover labor of any kind and materials not furnished by Seller, or any charges for any such labor or materials, whether such labor, materials or charges thereon are due to replacement of parts, adjustments, repairs, or any other work done. This warranty does not apply to any equipment which shall have been repaired or altered outside the factory of Seller in any way so as, in the judgment of Seller, to affect its stability, nor which has been subjected to misuse, negligence, or operating conditions in excess of those for which such equipment was designed. This warranty does not cover the effects of physical or chemical properties of water or steam or other liquids or gases used in the equipment.

BUYER AGREES THAT SELLER'S WARRANTY OF ITS PRODUCTS TO BE FREE FROM DEFECT IN MATERIAL AND WORKMANSHIP, AS LIMITED HEREIN, SHALL BE IN LIEU OF AND EXCLUSIVE OF ALL OTHER WARRANTIES, EITHER EXPRESS OR IMPLIED, WHETHER ARISING FROM LAW, COURSE OF DEALING, USAGE OF TRADE, OR OTHERWISE, **THERE ARE NO OTHER WARRANTIES, INCLUDING WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE, WHICH EXTEND BEYOND THE PRODUCT DESCRIPTION CONFIRMED BY BUYER AND SELLER AS OF THE DATE OF FINAL AGREEMENT.**

This warranty is void if the input to the product exceeds the rated input as indicated on the product serial plate by more than 5% on gas-fired and oil-fired units, or if the product in the judgment of SELLER has been installed in a corrosive atmosphere, or subjected to corrosive fluids or gases, been subjected to misuse, negligence, accident, excessive thermal shock, excessive humidity, physical damage, impact, abrasion, unauthorized alterations, or operation contrary to SELLER'S printed instructions, or if the serial number has been altered, defaced or removed.

BUYER'S REMEDY FOR BREACH OF WARRANTY, EXCLUSIVE OF ALL OTHER REMEDIES PROVIDED BY LAW, IS LIMITED TO REPAIR OR REPLACEMENT AT THE FACTORY OF SELLER, ANY COMPONENT WHICH

SHALL, WITHIN THE APPLICABLE WARRANTY PERIOD DEFINED HEREIN AND UPON PRIOR WRITTEN APPROVAL, BE RETURNED TO SELLER WITH TRANSPORTATION CHARGES PREPAID AND WHICH THE EXAMINATION OF SELLER SHALL DISCLOSE TO HAVE BEEN DEFECTIVE; EXCEPT THAT WHEN THE PRODUCT IS TO BE USED BY BUYER AS A COMPONENT PART OF EQUIPMENT MANUFACTURED BY BUYER, BUYER'S REMEDY FOR BREACH, AS LIMITED HEREIN, SHALL BE LIMITED TO ONE YEAR FROM DATE OF SHIPMENT FROM SELLER. FOR GAS-FIRED PRODUCTS INSTALLED IN HIGH HUMIDITY APPLICATIONS AND UTILIZING STAINLESS STEEL HEAT EXCHANGERS, BUYER'S REMEDY FOR BREACH, AS LIMITED HEREIN, SHALL BE LIMITED TO TEN YEARS FROM DATE OF SHIPMENT FROM SELLER.

These warranties are issued only to the original owner-user and cannot be transferred or assigned. No provision is made in these warranties for any labor allowance or field labor participation. Seller will not honor any expenses incurred in its behalf with regard to repairs to any of Seller's products. No credit shall be issued for any defective part returned without proper written authorization (including, but not limited to, model number, serial number, date of failure, etc.) and freight prepaid.

OPTIONAL SUPPLEMENTAL WARRANTY

Provided a supplemental warranty has been purchased, Seller extends the warranty herein for an additional four (4) years on certain compressors. Provided a supplemental warranty has been purchased, Seller extends the warranty herein for an additional four (4) years or nine (9) years on certain heat exchangers.

EXCLUSION OF CONSUMABLES & CONDITIONS BEYOND SELLER'S CONTROL

The above referenced warranty shall not be applicable to any of the following items: refrigerant gas, belts, filters, fuses and other items consumed or worn out by normal wear and tear or conditions beyond Seller's control, including (without limitation as to generality) polluted or contaminated or foreign matter contained in the air or water utilized for heat exchanger (condenser) cooling or if the failure of the part is caused by improper air or water supply, or improper or incorrect sizing of power supply.

Component Applicable Models	"APPLICABLE WARRANTY PERIOD"
<u>Heat Exchangers</u> Gas-Fired Units except PSH/BSH	TEN YEARS FROM DATE OF FIRST BENEFICIAL USE BY BUYER OR ANY OTHER USER, WITHIN TEN YEARS FROM DATE OF RESALE BY BUYER OR ANY OTHER USER, WITHIN TEN YEARS FROM DATE OF RESALE BY BUYER IN ANY UNCHANGED CONDITION, OR WITHIN ONE HUNDRED TWENTY-SIX MONTHS FROM DATE OF SHIPMENT FROM SELLER, WHICHEVER OCCURS FIRST
<u>Heat Exchangers</u> Low Intensity Infrared Units <u>Compressors</u> Condensing Units for Cassettes	FIVE YEARS FROM DATE OF FIRST BENEFICIAL USE BY BUYER OR ANY OTHER USER, WITHIN FIVE YEARS FROM DATE OF RESALE BY BUYER OR ANY OTHER USER, WITHIN FIVE YEARS FROM DATE OF RESALE BY BUYER IN ANY UNCHANGED CONDITION, OR WITHIN SIXTY-SIX MONTHS FROM DATE OF SHIPMENT FROM SELLER, WHICHEVER OCCURS FIRST
<u>Burners</u> Low Intensity Infrared Units <u>Other</u> Components excluding Heat Exchangers, Coils, Condensers, Burners, Sheet Metal	TWO YEARS FROM DATE OF FIRST BENEFICIAL USE BY BUYER OR ANY OTHER USER, WITHIN TWO YEARS FROM DATE OF RESALE BY BUYER IN ANY UNCHANGED CONDITION, OR WITHIN THIRTY MONTHS FROM DATE OF SHIPMENT FROM SELLER, WHICHEVER OCCURS FIRST
<u>Heat Exchangers/Coils</u> Indoor and Outdoor Duct Furnaces and System Units, PSH/BSH, Steam/Hot Water Units, Oil-Fired Units, Electric Units, Cassettes, Vertical Unit Ventilators <u>Compressors</u> Vertical Unit Ventilators <u>Burners</u> High Intensity Infrared Units <u>Sheet Metal Parts</u> All Products	ONE YEAR FROM DATE OF FIRST BENEFICIAL USE BY BUYER OR ANY OTHER USER, WITHIN ONE YEAR FROM DATE OF RESALE BY BUYER IN ANY UNCHANGED CONDITION, OR WITHIN EIGHTEEN MONTHS FROM DATE OF SHIPMENT FROM SELLER, WHICHEVER OCCURS FIRST

As Modine Manufacturing Company has a continuous product improvement program, it reserves the right to change design and specifications without notice.



Commercial Products Group

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