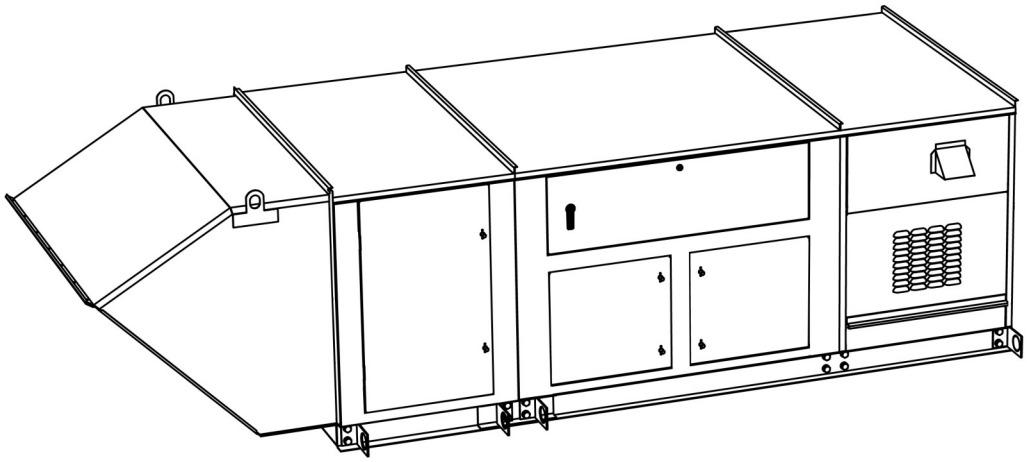
IST DUCT FURNACE SYSTEMS

OCTOBER 2016

Installation and Service Manual
Indoor/Outdoor Heating
and
Individual Duct Furnaces



Notice
Read These Instructions Before Installation

RECEIVING INSTRUCTIONS

Inspect unit on arrival for any shipping damage. If any part is missing or damaged, notify the transportation company.

This unit has been test fired for at least 15 minutes to prove out all phases of operation

WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow safety warnings exactly could result in serious injury, death or property damage.

Be sure to read and understand the installation, operation and service instructions in this manual.

Improper installation, adjustment alteration, service or maintenance can cause serious injury, death or property damages.

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

- WHAT TO DO IF YOU SMELL GAS
  - Do not try to light any appliance.
  - Do not touch any electrical switch: do not use any phone in your building.
  - Leave the building immediately.
  - Immediately call your gas supplier from a phone remote from the building. Follow the gas supplier's instructions.
  - If you cannot reach your gas supplier, call the fire department.

- Installation and service must be performed by a qualified installer, service agency or the gas supplier.

Table of Contents

Model and Serial Number can be found on Equipment Specification Plate inside of Furnace access panel.

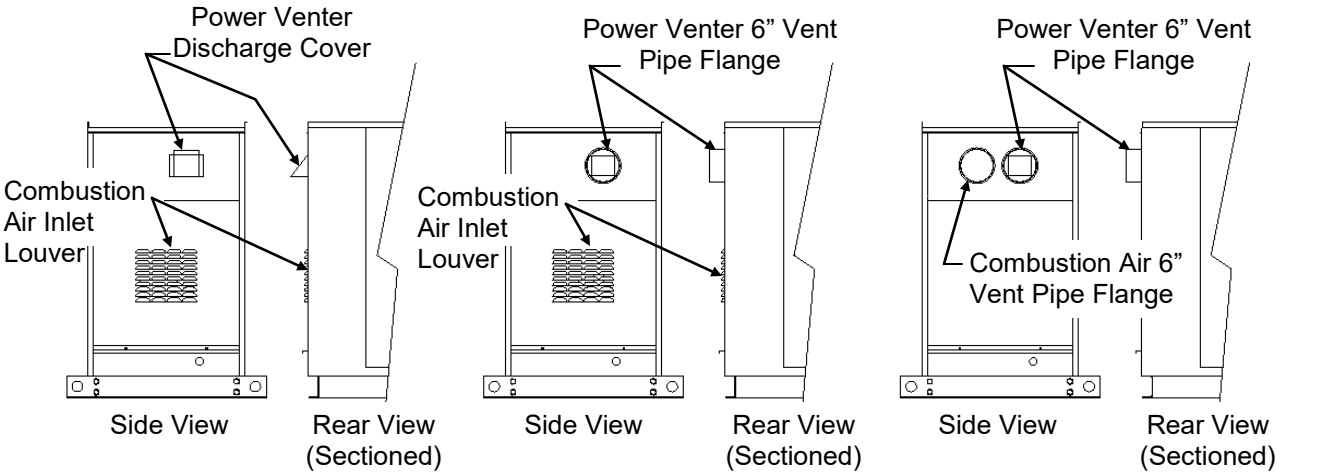
Model # _____
Serial # _____
Date of Purchase _____
Purchased from _____

Model Designation

Model	Configuration		
IST - (X) -	**(X) -**	**(X) -**	**(X)-**
MBH Input	I - Indoor	RA - Space Heating	A - Single Bank
	IS - Indoor / Two Pipe Separate Combustion Air	OA - Make-up Air	B - Double Bank
	O - Outdoor	MA - Heating and Ventilating	C - Triple Bank

Configuration Designations

Furnace Location (I, IS, O)



O- Outdoor Furnace

I - Indoor Furnace

IS - Indoor Furnace
(with Two Pipe Separate Combustion Air)

Furnace Application (RA, OA, MA)

RA - Space Heating

The Space Heating Unit is designed for 100% return air room heating applications with the air temperature being control from the heated space.

OA - Make-up Air

The Make-up Air unit is designed to replace exhausted building air with 100% outside air to prevent the many problems of "air starvation" This replacement air is heated when the outside air temperature is below the desired space conditions.

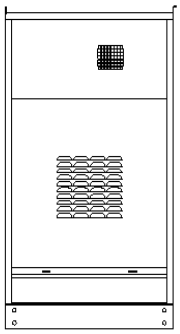
MA - Heating and Ventilating

This unit combines the control of both make-up air and space temperature. This system is equally effective for up to 100% outside or return air heating and ventilating applications, or 100% outside air only.

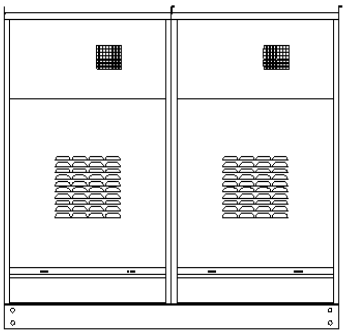
Configuration Designations

Furnace Bank Orientations (A,B,C)

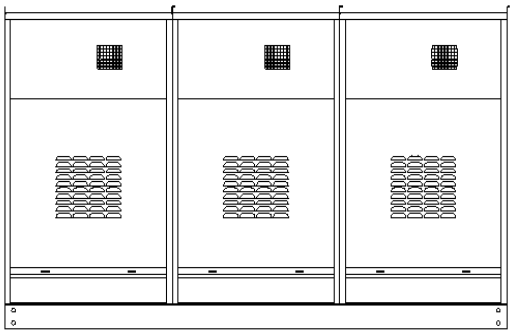
Depending on the heat and airflow requirements, systems may contain Single, Double or Triple banks of furnaces in series.



A
Single Bank



B
Double Bank



C
Triple Bank

Performance Data

Table 1 - CFM Requirements for Single Bank Furnace

Model	Input (Btu/Hr)	Output (Btu/Hr)	Air Temperature Rise						
			30°F	40°F	50°F	60°F	70°F	80°F	90°F
			Airflow (CFM)						
IST-100	100,000	80,000	2468	1850	1480	1234	1058	926	823
IST-150	150,000	120,000	3702	2777	2221	1851	1587	1389	1234
IST-200	200,000	160,000	4936	3702	2962	2468	2116	1851	1645
IST-250	250,000	200,000	6170	4628	3702	3085	2644	2314	2057
IST-300	300,000	240,000	7404	5554	4443	3702	3173	2777	2468
IST-350	350,000	280,000	8638	6479	5183	4319	3702	3240	2880
IST-400	400,000	320,000	9872	7404	5923	4936	4231	3702	3291

Performance Data

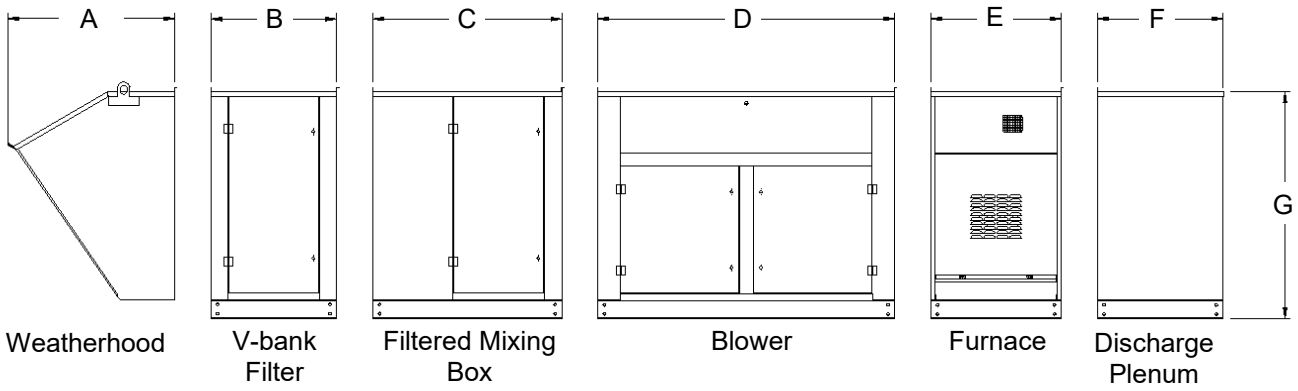
Table 2 - CFM Requirements for Double Bank Furnace

Model	Input (Btu/Hr)	Output (Btu/Hr)	Air Temperature Rise					
			70°F	80°F	90°F	100°F	110°F	120°F
			Airflow (CFM)					
IST-200	200,000	160,000	2115	1850	1645	1480	1346	1234
IST-300	300,000	240,000	3173	2777	2468	2221	2016	1851
IST-400	400,000	320,000	4230	3702	3291	2962	2692	2468
IST-500	500,000	400,000	5288	4626	4114	3072	3366	3085
IST-600	600,000	480,000	6346	5554	4936	4443	4039	3702
IST-700	700,000	560,000	7404	6478	5758	5183	4712	4319
IST-800	800,000	640,000	8460	7404	6582	5923	5385	4936

Table 3 - CFM Requirements for Triple Bank Furnace

Model	Input (Btu/Hr)	Output (Btu/Hr)	Air Temperature Rise		
			90°F	110°F	130°F
			Airflow (CFM)		
IST-1200	1,200,000	960,000	9872	8077	6835

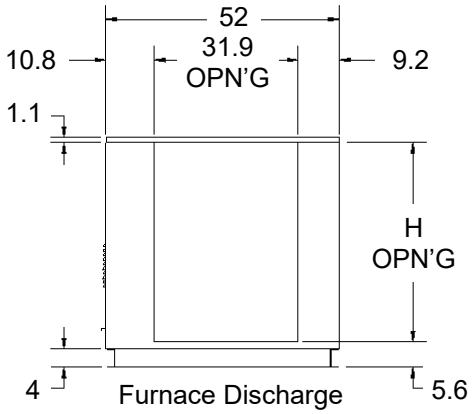
Dimensions (All dimensions are in inches)

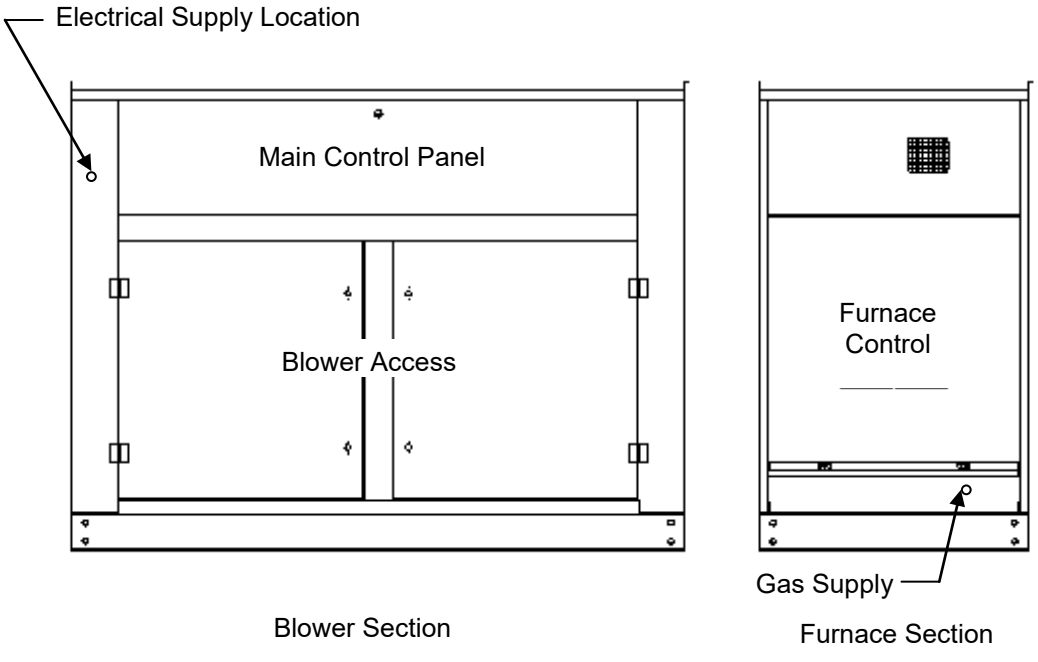


Section Dimensions

Cabinet Size	A	B	C	D	E	F	G	H
IST - 100 Thru IST - 200	37.1	28	42	52	29	28	40	34.4
IST - 250 Thru IST - 400	43.6	28	42	66	29	28	50	44.4

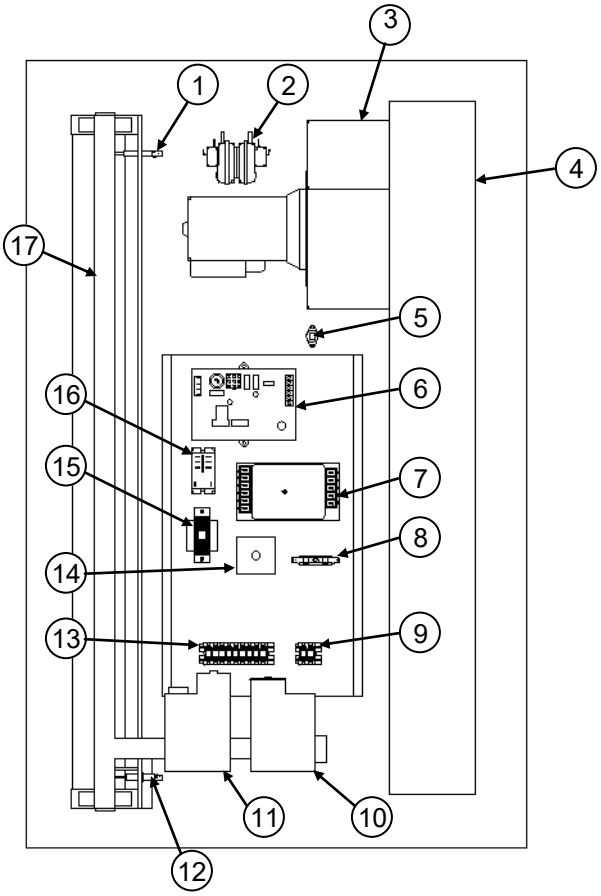
Dimensions are in inches.





Components (General Location)

Furnace Section



Furnace Components: (see Figure 1)

1. Flame Rod
2. Venter Proving Switches
3. Combustion Blower
4. Collector Box
5. High Limit Switch
6. Ignition Module
7. Modulation Control
8. Fuse
9. Supply Power Terminal Strip
10. Combination Valve
11. Modulating Valve
12. Spark Igniter
13. Low Voltage Terminal Strip
14. Timer Delay Relay
15. Control Transformer
16. Relay
17. Burner Manifold

*Components and their locations may vary from Figure 1 and 2. Not all components will be used in every application. Refer to the wiring schematic that was shipped with furnace. The wiring schematic can be found in an envelope in the furnace control access panel.

Figure 1 - Furnace Component Locations*

Blower Section Main Control Panel

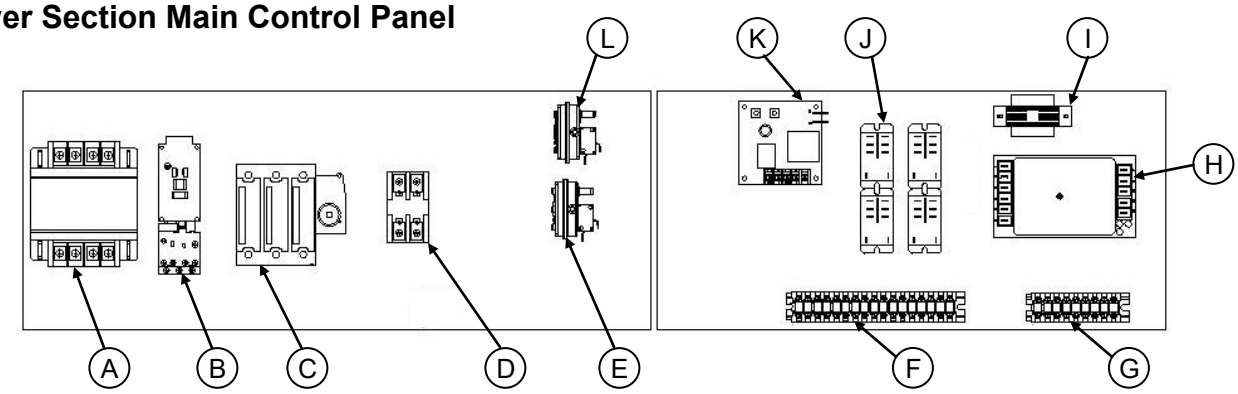


Figure 2 - Main Control Panel Component Locations*

Blower Section Main Control Panel Components: (see Figure 2)

A. Control Transformer
B. Motor Starter and Contacts
C. Fused Disconnect Switch
D. Fuse(s)
E. Clogged Filter Switch
F. 115 V Terminal Strip
G. 24 V Terminal Strip
H. Modulation Control
I. Transformer
J. Relays
K. Low Limit Control
L. Blower Proving Switch

Shipping

- The unit is shipped by either common carrier or flat bed trailer. Consult with the factory on number of sections per load.
- The remote control panel, when provided, is shipped unmounted.

Storage

If equipment is not installed within 5 days after receipt, the equipment must be stored in a dry environment and free of rodents.

Installation Regulations

Installation of this appliance must conform to applicable federal, state, and local codes and regulations, and with guidelines established by CSA (Canadian Standards Association), NFPA (National Fire Protection Association), N.E.C. (National Electrical Code), the National Board of Fire Underwriters and CSA B149.1 Listed are codes appearing in this text, the Associations, and their addresses where they may be obtained.

Intertek Testing Services NA Inc. (E.T.L.)
165 Main Street
Cortland, New York 13045

All NFPA codes, National Electrical Code
National Fire Protection Association, Inc.
Batterymarch Park
Quincy, Massachusetts 02269

Standard of National Board of Fire Underwriters
National Board of Fire Underwriters
85 John Street
New York, New York 10036

Canadian Standards Association/CSA Group
CSA Group
178 Rexdale Blvd.
Toronto ,ON
Canada M9W 1R3

Hoisting Unit

The weight of the systems are available by contacting Hastings HVAC Inc.

Furnaces contain lifting lugs attached to the base rails. Use spreader bars between lifting cables to prevent damage to the furnace. (Figure 3.)

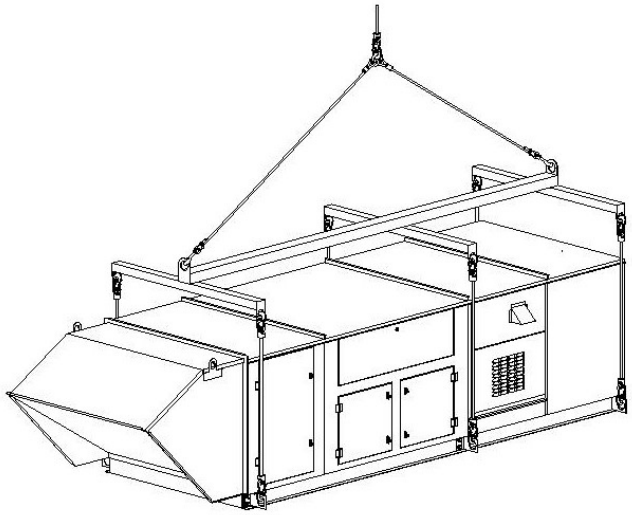


Figure 3— Lifting unit using spreader bars.

Furnace Location

1. Be sure that structural support at the unit location site will support the weight of the unit.
2. Outdoor units with poor venting and other undesirable operating conditions may be caused by a negative pressure condition or high pressure zones created by walls or other obstructions. Therefore, the furnace must be located as far as possible from the source of such turbulence and at least six feet from the edge of the roof.
3. Indoor units must **NOT** be operated in the presence of chlorinated, halogenated or acidic vapors. Even slight traces of chlorine combined with products of combustion will cause serious damage to heat exchanger.
4. Indoor units must have adequate combustion air. If heaters are installed in a closed room, provide outside opening of one square inch per 1,000 BTU for combustion air alone.
5. Indoor units must NOT operate in an area with a negative air pressure condition. Provide adequate make-up air.
6. Indoor units installed where there is sawdust, lint, soot, dirt, etc., areas of high air contamination, must be cleaned frequently or serious damage will result. Refer to section on Maintenance for recommended frequency.

Clearances

Required minimum clearances from furnace sections to combustible material are as follows:

Table 4

Combustible Material Clearances	
Sides	6”
Top	6”
Bottom	0”

Table 5

Service Clearances	
Control Side	46”
Top	6”
Back	6”

Hangars, Garages and Parking Structures

Install in aircraft hangars in accordance with the current ANSI/NFPA 409 - “Latest Revisions”, Standard on Aircraft Hangars, and in public garages in accordance with the current ANSI/NFPA 88A Standard for Parking Structures - “Latest Revisions”, Standards for Repair Garages, ANSI/NFPA 88B and with the Natural Gas and Propane Installation code, CSA-B149.1. A clearance of 10 feet must be provided from the bottom of the heater to the top surface of wings or engine enclosures of the highest aircraft to be housed in the hangar and a minimum clearance of 8 feet from the door in other sections such as offices and shops connected with hangar and in public garages. Also, the heaters must be so located that they will be protected from damage by aircraft, cranes, scaffolding, etc., and must be accessible for servicing and adjustment. Standard ANSI/NFPA 88 A, B - “Latest revisions” specifies that the heater must be so located that the clearance to combustible materials conform with NFPA Nos. 52 and 54 and that such material must not attain a temperature over 160º by continued operation of the heater.

Surface Installation

A 4-inch frame is an integral part of the appliance and may be installed directly on the floor or roof or other combustible construction. For ease of service and safe operation, however, it is suggested that the furnace be located above the installation surface on a field fabricated base. This base may be a mounting frame or support, a factory roof curb mounting frame or a slab. The following items are important in this regard:

- Be sure that roof joist or support will not interfere with inlet and return air ducts.
- Be sure frame or support is square, level and not twisted.
- Field fabricated curb should be insulated with at least 1 1/2” thick rigid type insulation.
- The roof curb should be counterflashed and sealed before unit is installed.
- Standard flashing and mopping procedures are recommended for curb openings and gas and electrical roof penetrations.
- Field fabricated frame, support, or slab must be high enough to prevent any form of moisture from entering unit.
- All joints on frame must be sealed with caulking compound.

Ductwork

Uniform air distribution across the heat exchanger is critical for proper performance and prevention of premature heat exchanger failure.

The duct furnace must be installed on the positive pressure side of the air circulation blower. The blower must provide the required CFM air delivery as specified on the appliance rating plate

A duct furnace shall be installed with an inlet duct which will provide air distribution equivalent to a straight run of duct having the same cross-sectional area as the inlet opening and not less than 2 equivalent diameters in length.

If air distribution across the heat exchanger tubes is not uniform, install additional turning vanes or baffles in the ductwork

Ductwork connected to the duct furnace should have removable access panels on both upstream and downstream sides of the duct furnace. These openings shall be accessible when the appliance is installed in service, and be of such size that smoke or reflected light may be observed inside the casing to indicate the presence of leaks in the heating element. The cover for the opening should be attached in such a manner as to prevent leaks.

All duct connections and seams should be caulked or taped to provide an airtight and weathertight seal. A high temperature caulking (250ºF) or sheet metal flashing may be used for this purpose.

Unit is approved for installation downstream from refrigeration units.

Altitude

For U.S. installations at elevations above 2,000 feet (610 m), the appliance shall be de-rated 4 percent for each 1,000 feet (305 m) of elevation above sea level. For Canadian installations, appliances are certified for altitudes of 0 to 2000 feet (0-610 m) and 2,000 to 4,500 feet (610-1,370 m) and in accordance with standard CGA 2.17.

High altitude ratings may be obtained by a change in orifice and/or manifold pressure. Contact the manufacturer or gas company before changing spud sizes or pressure regulator setting.

Venting

Venting for Outdoor Units

The outdoor model furnace is complete as received. No further venting of unit is required for installation. Make sure the flue products will not negatively affect its surroundings by reviewing section: **Vent Termination Clearances.**

Venting for Indoor Units

IMPORTANT

VENTING IS REQUIRED ON ALL INDOOR INSTALLATIONS.

All venting installations shall conform to the latest edition of the National Fuel Gas Code, ANSI Z223.1 or the Canadian CSA B-149 installation code. Local codes may supersede the above codes

These units are **Category III** appliances and the venting must apply accordingly.

Positive pressure flue vent is recommended for indoor installations. For the requirement of positive pressure flue vent review local codes.

Always use flue pipe of the same size as the flue connections on the duct furnace (see Table 6)

Use 26 gauge or heavier galvanized steel vent pipe. All vent pipe must be sealed gas tight. Seal vent pipe joints with silicon sealant or aluminum foil tape suitable for temperatures up to 350 F.

Type “B” gas vent is recommended for flue venting above roof lines or external wall penetrations.

Single wall vent pipe should be insulated to reduce condensation.

Do not connect the furnaces to other vent systems. Each furnace must have its own vent pipe and vent terminal.

Do not directly attach an elbow to the exhaust venter outlet. A minimum of 12 inches of straight vent pipe should be installed directly to the venter outlet before attaching any elbows.

The maximum vent pipe length for these heaters is shown in Table 6. A total equivalent vent pipe length can be calculated using equivalent straight pipe lengths for tees and elbows. The maximum vent pipe length is decreased by six feet for each sweep elbow, two and one half feet for termination tee, and ten feet for each short radius elbow. Minimum Horizontal vent length is ‘as needed’ to exit the exterior wall.

Table 6 - Flue Pipe Sizing

IST Flue Pipe Sizing: Total Equivalent Feet (TEF)		
Furnace Size (MBH)	Flue Pipe Diameter*	Max. Length of Flue Pipe
100-400	6.0 Inches	100 TEF

* 26 gauge or heavier galvanized vent pipe.

The horizontal portions of the venting system should be supported to prevent sagging. Suspended support straps should be placed at a minimum spacing of 4 feet horizontally and at elbows, or as specified by the vent supplier and in accordance with the pitch as required in the National Fuel Gas Code ANSI Z223.1/NFPA 54 or the National Gas and Propane Installation Code CSA B149.1

Vent Termination Clearances

Vent Termination Clearances (USA)

For U.S.A. standards vent systems must conform to the latest edition of the National Fuel Gas Code (NFPA 54) and the latest edition of NFPA 211, or as follows:

- Not less than 7 feet above grade when located adjacent to public walk ways.
- At least 3 feet above any forced air inlet located within 10 feet.
- At least 4 feet below, 4 feet horizontally from or 1 foot above any door, window or gravity air inlet into any building.
- At least 1 foot above grade, or at least 1 foot above the normally expected snow accumulation level.
- Directed such as to not jeopardize people.
- At least 4 feet from electric meters, gas meters, regulators and relief equipment.
- Sealing or shielding of exposed surfaces with a corrosion resistant material may be required to prevent staining or deterioration of building materials
- Not less than 2 feet from an adjacent building.

Distance from adjacent public walkways, adjacent buildings, opening windows and building openings, shall conform with local codes, or in the absence of local codes, with the National Fuel Gas Code, ANSI Z223.1/NFPA 54, or the Natural Gas and Propane Installation Code, CSA B149.1

Local codes may supersede any of the above provisions.

Vent Termination Clearances (Canada)

In Canada vent systems must conform to the latest edition of the Natural gas and Propane Installation Code (CSA-B149.1 or CSA-B149.2), or as follows:

- A venting system shall not terminate underneath a veranda, porch, or deck, or above a paved sidewalk or a paved driveway that is located between two buildings, and that serves both buildings.
- The exit terminals of mechanical draft systems shall not be less than 2.14m above grade when located adjacent to a paved sidewalk or driveway.
- A venting system shall not direct flue gases towards brickwork, siding, or other construction, in such a manner that may cause damage from heat or condensate from the flue gases.
- A vent system shall not direct flue gases so as to jeopardize people, overheat combustible structures, or enter buildings.
- A venting system shall not terminate within 1.8m of the following:
  - A window, door or mechanical air supply inlet of any building, including soffit openings.
  - A gas service regulator vent outlet/ gas and electric meter(s) / relief devices
  - A combustion air inlet.
  - A property line.
  - A direction facing combustible materials or openings of surrounding buildings.
- A venting system shall not terminate within 1m of the following:
  - Above a gas meter/regulator assembly within 1m horizontally of the vertical centerline of the regulator.
  - An oil tank or an oil tankfill inlet.
  - The inside corner of an L-shaped structure.
- A venting system shall not terminate within .3m of the following:
  - Above grade level or any surface that may support snow, ice, or debris.

Indoor Venting

Single Pipe Venting

Standard single pipe venting uses air inside the building for combustion. The air enters the furnace through the louvered panel. Exhaust is vented through a single penetration in the roof or side wall.

Duct furnaces must **NOT** be installed in locations where atmosphere is corrosive or flammable This environment will cause severe damage to the unit.

Indoor units must have adequate combustion air. If heaters are installed in a closed room, provide an outside opening of one square inch per 1,000 BTU for combustion air alone.

The venting should be installed to prevent condensation from draining back toward unit. Horizontal vent pipes should be pitched downward 1/4 inch per foot away from the furnace. It is recommended to install a Tee with drip leg and cleanout cap at the lowest point of the vent system.

Straight vertical runs out through the roof are preferred. Vertical vent pipes should be equipped with condensate drains.

Every exhaust pipe must have a vent terminal on the end. Vertical flue stacks shall be terminated with an approved cap. The termination vent Tee should be used on horizontal venting. Refer to Figures 5 and 6 for recommended arrangements.

Do not attach elbow directly to exhaust vent flange. A minimum of 12” of horizontal vent pipe must be attached to the exhaust vent flange before attaching additional horizontal or vertical vent pipe. (See Figure 4)

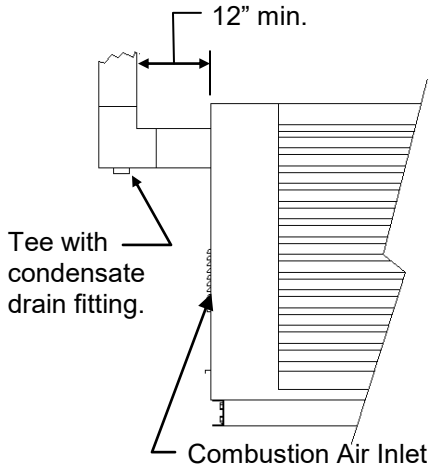
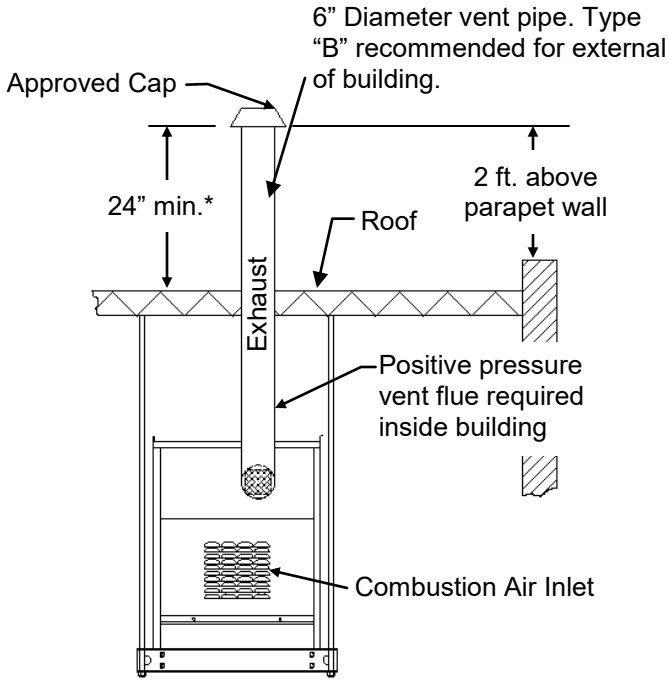


Figure 4 - Required minimum horizontal vent extension from furnace.



* Increase height to adjust for snow depth.

Figure 5 - Vertical single pipe venting

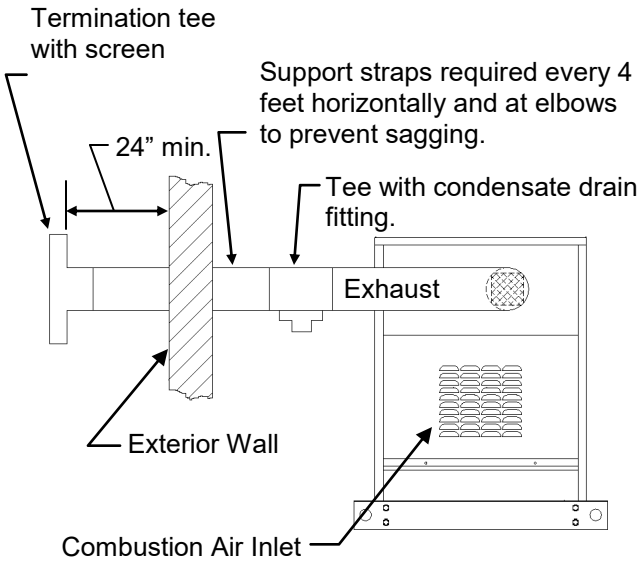


Figure 6 - Horizontal single pipe venting

Indoor Venting

Separate Two Pipe Venting

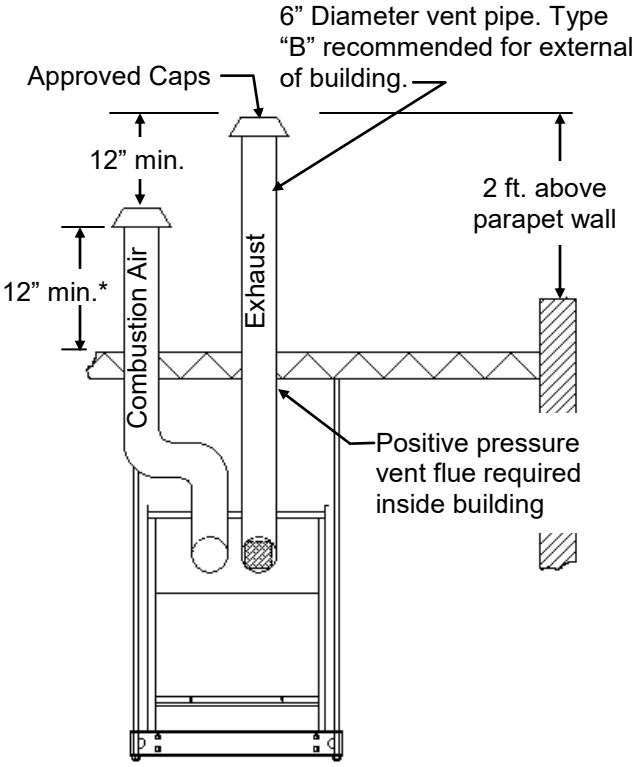
Separate two pipe venting systems use outside air for combustion and vent exhaust to outdoors Two pipe systems require two penetrations through a side wall or roof.

The venting should be installed to prevent condensation from draining back toward unit. Horizontal vent pipes should be pitched downward 1/4 inch per foot away from the furnace. It is recommended to install a Tee with drip leg and cleanout cap at the lowest point of the vent system.

Straight vertical runs out through the roof are preferred. Vertical vent pipes should be equipped with condensate drains.

Every exhaust pipe must have a vent terminal on the end. Vertical flue stacks shall be terminated with an approved cap. The termination vent Tee should be used on horizontal venting. Refer to Figures 7 and 8 for recommended arrangements.

Do not attach elbow directly to exhaust vent flange. A minimum of 12” of horizontal vent pipe must be attached to the exhaust vent flange before attaching additional horizontal or vertical vent pipe. (See Figure 4 Page 13)



* Increase height to adjust for snow depth.

Figure 8– Vertical separate two pipe venting

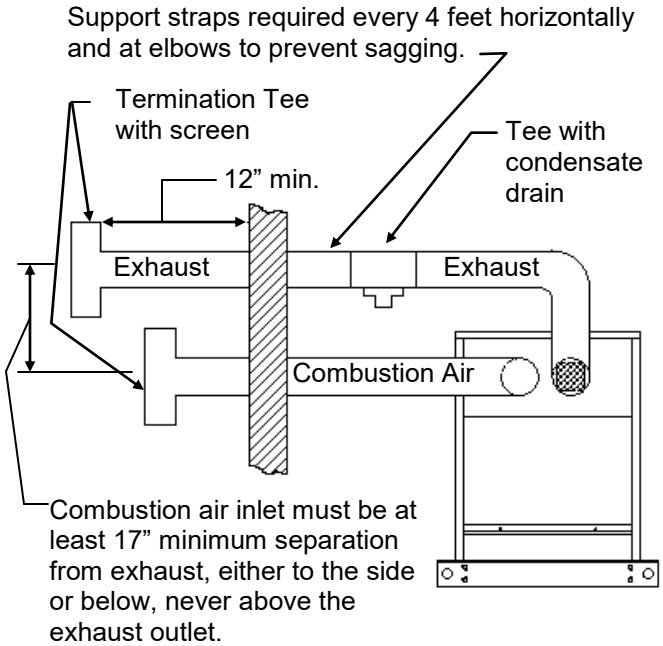


Figure 7 - Horizontal separate two pipe venting

Gas Piping

IMPORTANT

All piping must conform to the latest edition of the national fuel gas code ANSI Z223.1 and any applicable local codes. In Canada, the installations of the equipment should conform to CSA B149 as well as any applicable local codes.

IMPORTANT

Gas Pressure to the appliance should **NEVER** exceed 1/2 psi (14 in. W.C.). Damage to the gas valves will occur.

1. When connecting the gas supply, the length of the run must be considered in determining the pipe size to avoid excessive pressure drop. Refer to a Gas Engineer's Handbook for gas pipe capacities.
2. If supply gas pressure is greater than 1/2 psi (14 in. W.C.), a high pressure regulator is required to reduce the pressure. The regulator must be vented to the outdoors or have a leak limiting orifice.
3. Pipe joint compound should be resistant to the action of L.P gas.
4. Install a trap (tee, nipple, and cap) near connection to each furnace. (see Figure 9)
5. For ease of servicing, an additional union and manual gas valve should be installed adjacent to the furnace exterior. An approved, readily accessible manual gas shut-off valve should be joined to a ground joint type union immediately upstream and connected to the appliance manifold piping. (see Figure 9)
6. A 1/8 N.P.T. plugged tapping, accessible for test gauge connection, must be installed upstream of the gas supply connection to the system. (see Figure 9)
7. When leak testing pressures will exceed 1/2 psi (14 in. wg), the appliance and its individual shutoff valve must be disconnected from the gas supply piping.
8. The appliance must be isolated from the gas supply piping system by closing its individual manual shutoff valve during any pressure testing at pressures equal to or less than 1/2 psi (14 in. wg).

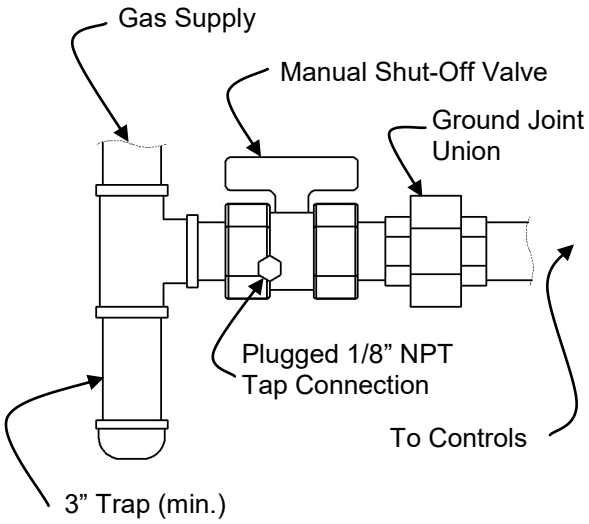
WARNING

Check all gas connections for leaks before placing unit in service. A soap and water solution should be used for this purpose. **NEVER** use a torch or flame of any kind.

CAUTION

PURGING GAS: Refer to NFPA-54 (current edition) on procedures for proper gas purging. Unit main disconnect to be under lock out tag out procedure applied prior to purging. Use an electronic combustible gas indicator as air is purged. Do not depend on sensing the odor of gas to determine if the gas line is purged

Figure 9 - Gas Supply Piping Connection



Electrical Connections

WARNING

Disconnect all electric power before servicing. Failure to disconnect power before servicing can cause severe personal injury or death.

Refer to wiring diagram shipped with unit for all wiring connections. Wiring diagrams are located inside furnace control access panel. Furnace must be wired in accordance with the furnished diagram.

1. Unit must be electrically grounded and all wiring must be done in accordance with applicable local codes and the National Electrical Code, ANSI/NFPA 70, and/or the CSA C22.1 Canadian Electrical code, if an external electrical source is utilized.
2. Only use a voltmeter to check for power across terminals.
3. In order to determine the size of the power supply lines, check the electrical specification plate located on the unit for ampere requirements.
4. On units not ordered with a disconnect switch, it is recommended that a weatherproof disconnect switch be mounted on or near the unit.
5. Connect power supply lines from main disconnect switch to unit disconnect switch.
6. If original wire supplied with the furnace needs to be replaced, it must be replaced with wiring material having a temperature rating of at least 105°C.
7. Install thermostat or remote control station, if supplied, according to wiring diagram.
8. Thermostats and remote control stations must be installed in a suitably protected and secure location to prevent tampering and damage. Do not exposed thermostats to physical shocks or jarring before or after installation.

Gas Valves

Combination Valve (Single and Two-Stage)

Figure 10 - Typical Combination Valve
(Note: single stage and two stage look similar. Refer to component label to confirm type)

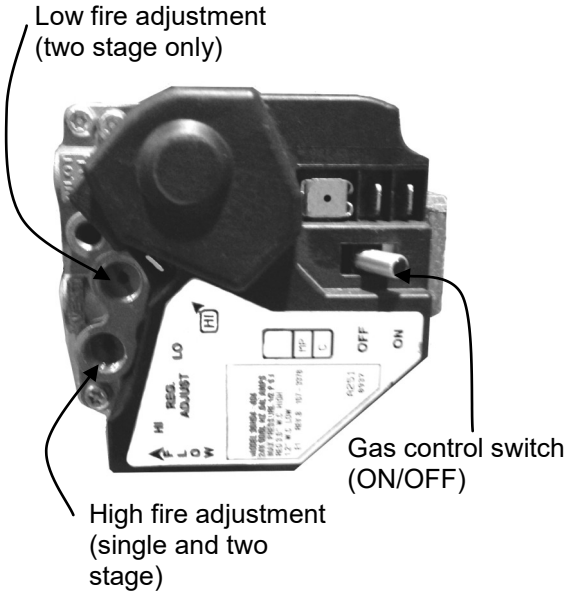


Figure 11 - Combination Valve (Top View)

Modulating Valve

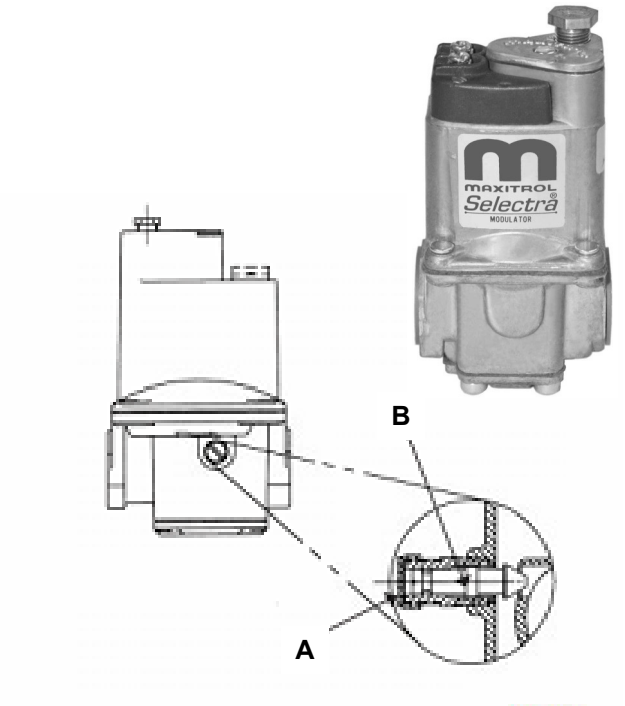


Figure 12– Modulating Valve (model may vary from picture)

Firing Rate

IMPORTANT

Firing rate must NOT be increased above the BTU input shown on the specification plate.

The appliance must be adjusted to the manifold pressure specified on the manufacturer's rating plate.

Make sure combination valve switch is turned ON before setting manifold pressures.

Table 7 - Manifold Set Points

Fire Rate	Manifold Pressure (in. wg)	
	Natural Gas	Propane
High Fire	3.5	10
Low Fire	1.1	2.6

Setting Firing Rate

Two Stage

A two stage furnace manifold consists of a single input burner manifold and a two stage combination valve.

Two stage control fires the burner at either high fire or low fire. Depending on the demand for heat the burners will switch between low and high fire.

1. Turn off all electrical power to the system.
2. Remove test port plug on burner manifold and install barb fitting. (1/8" NPT)
3. Turn on system power. Set thermostat to call for heat (low stage). Main burner should light.
4. Remove regulator cover screw from the low outlet pressure port (Figure 11 p.16) and turn screw clockwise to increase pressure, or counterclockwise to decrease pressure. Always adjust regulator according to furnace specifications (Table 7). Replace regulator cover screw.
5. Set thermostat to call for heat (high stage).
6. Remove regulator cover screw from the high outlet pressure regulator port (Figure 11 p.16) and turn screw clockwise to increase pressure, or counterclockwise to decrease pressure. Always adjust regulator according to furnace specifications (Table 7). Replace regulator cover screw.
7. Turn off all electrical power to system.
8. Remove manometer hose and fitting from burner pressure tap.
9. Replace burner pressure tap plug.
10. Begin normal operation

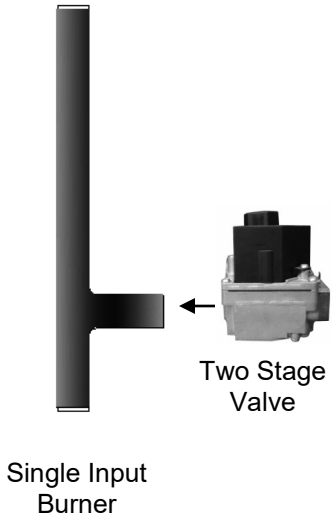


Figure 13– Two Stage Furnace

Setting Firing Rate

Single Stage

A single stage furnace manifold consists of a single input burner manifold and a single stage combination valve.
Single stage control fires the burner at 100% of rate and remains there until call for heat has been met.

1. Turn off all electrical power to the system.
2. Remove test port plug on burner manifold and install barb fitting. (1/8” NPT)
3. Turn on system power. Set thermostat to call for heat. Main burner should light.
4. Remove regulator cover screw from the high outlet pressure regulator port (Figure 11 p.16) and turn screw clockwise to increase pressure, or counterclockwise to decrease pressure. Always adjust regulator according to furnace specifications. (Table 7 p.17)
5. Replace regulator cover screw.
6. Turn off all electrical power to system.
7. Remove manometer hose and fitting from burner pressure tap.
8. Replace burner pressure tap plug.
9. Begin normal operation

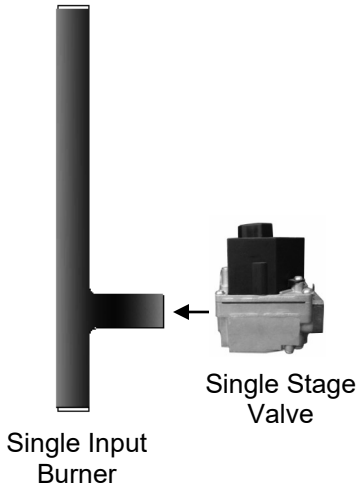


Figure 14 - Single Stage Furnace

Modulating Unit

A Modulation furnace consists of a single input burner manifold, modulating valve and a single stage combination valve. The modulating valve is installed downstream of the combination valve.
Modulating control varies the volume of gas supplied to the burner while the single stage combination valve acts to turn the burner on and off. The modulation allows for the furnace to regulate the heat output that the space requires.

1. Turn off all electrical power to the system.
2. Remove test port plug on burner manifold and install barb fitting. (1/8” NPT)
3. Turn on system power. Set thermostat to call for heat. Main burner should light.

– **High Fire Adjustment**

4. Rotate selector dial to maximum temperature setting. Voltage to the modulating valve must be at least 18 VDC.
5. Remove regulator cover screw from the high outlet pressure regulator port (Figure 11 p.16) and turn screw clockwise to increase pressure, or counterclockwise to decrease pressure. Always adjust regulator according to furnace specifications. (Table 7 p.17)
6. Replace regulator cover screw.

– **Low Fire Adjustment**

7. Disconnect a wire from the modulating valve terminal block. Be careful not to allow wire to come in contact with any other part.
8. On the modulating valve (Figure 12 p.17), remove by-pass cap (A) and turn screw (B) using small screwdriver to desired low fire setting (Table 7 p.17). Note: Clockwise screw rotation reduces flow rate. Do not over tighten.
9. Replace bypass cap.
10. Reconnect wire to modulating valve terminal block.
11. Turn off all electrical power to system.
12. Remove manometer hose and fitting from burner pressure tap.
13. Replace burner pressure tap plug.
14. Begin normal operation

Note: The low fire adjustment, on the modulating valve, should be checked whenever high fire is changed.

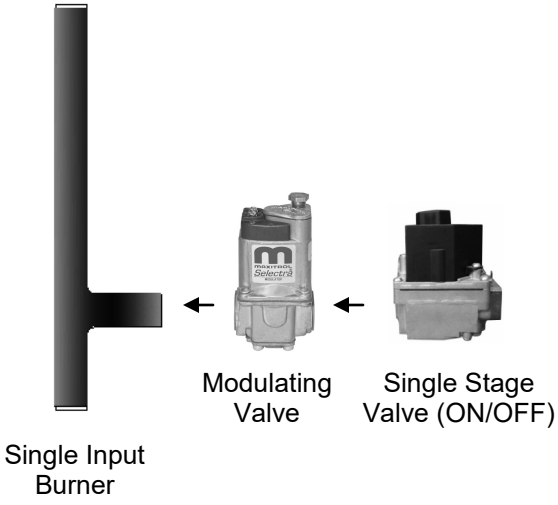


Figure 15 – Modulating Furnace

Setting Firing Rate

Split Manifold - 4 Stage with Modulation Section

The split manifold design consists of a split burner manifold with two manifold inputs. The sectioned manifold operates as two independent manifolds sharing a single inducer. This first manifold input is fully modulating and consists of a modulating valve and a single stage combination valve. The second manifold operates as a two stage burner and is connected to a two-stage combination valve.

The split manifold requires that all the valves are set properly.

1. Turn off all electrical power to the system.
2. Remove test port plug on both burner manifold sections and install barbed fittings. (1/8” NPT)
3. Turn on system power. Set thermostat to call for heat. Burner section with modulation should light.
4. Set the unit to high fire
5. Both burner sections should be on high fire.

Modulated Burner Section (See Figure 16)

6. Voltage to the modulating valve must be at least 18 VDC.
7. Remove regulator cover screw from the high outlet pressure regulator port on the Single Stage combination valve (Figure 11 p.16). Turn screw clockwise to increase pressure, or counterclockwise to decrease pressure. Always adjust regulator according to furnace specifications. (See Table 5)
8. Replace regulator cover screw.
9. Disconnect a wire from the modulating valve terminal block. Be careful not to allow wire to come in contact with any other part.
10. On the modulating valve (Figure 12 p.17), remove by-pass cap (A) and turn screw (B) using a small screwdriver to desired low fire setting. (Table 7 p.17) Note: Clockwise screw rotation reduces flow rate. Do not over tighten.
11. Replace bypass cap.
12. Reconnect wire to modulating valve terminal block.

Two Stage Burner Section (See Figure 16)

13. Remove regulator cover screw from the high outlet pressure regulator port on the Two Stage combination valve (Figure 11 p.16). Turn screw clockwise to increase pressure, or counterclockwise to decrease pressure. Always adjust regulator according to furnace specifications. (Table 7 p.17)
14. Replace regulator cover screw.
15. Force valve to low fire stage by disconnecting wire from the high fire terminal. Be careful not to allow wire to come in contact with any other part.
16. Remove regulator cover screw from the low outlet pressure port (Figure 11 p.16) and turn screw clockwise to increase pressure, or counterclockwise to decrease pressure. Always adjust regulator according to furnace specifications (Table 7 p.17)
17. Reconnect wire back to high fire terminal.
18. Replace regulator cover screw.
19. Turn off all electrical power to system.
20. Remove manometer hose and fitting from burner pressure tap.
21. Replace burner pressure tap plug.
22. Begin normal operation

Note: The low fire adjustment, on the modulating valve, should be checked whenever high fire is changed.

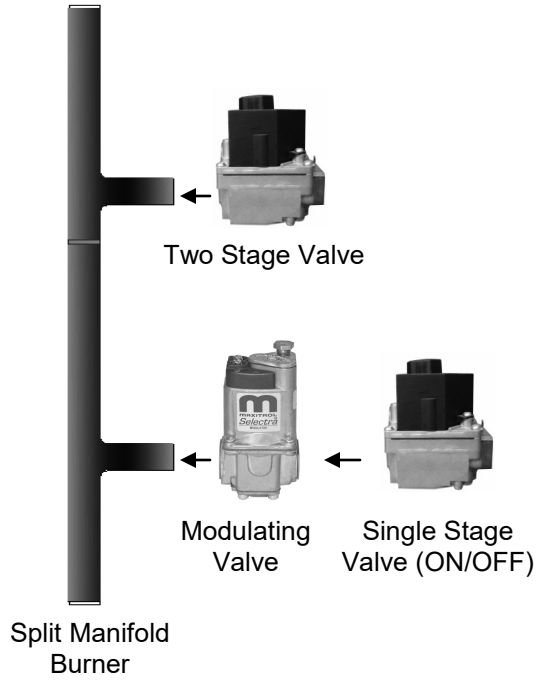


Figure 16 - Split Manifold Furnace

Sequence Of Operation

Heat Cycle

When the Season Switch (SW) or customer provided contact (CU) (via DDC or BMS) calls for the burner circuit to be enabled :

The direct ignition control checks to see the limit switch is closed and the combustion blower pressure switch is open. If the pressure switch is closed for 5 seconds, the control will flash the proper error code and wait indefinitely for the pressure switch to open. If the pressure switch is open, the control proceeds to pre-purge.

- **Pre-Purge**

The control energizes the inducer draft motor and waits for the pressure switch to close. If the pressure switch does not close within 30 seconds of the inducer being energized, the proper error code will flash. The inducer runs until the pressure switch closes or the call for heat is removes. If the pressure switch closes, the error code is reset and the ignition sequence continues. When the pressure switch is proven closed, the control begins the pre-purge time. If flame is present any time while in pre-purge, the pre-purge time is restarted. If flame is present, long enough to cause lockout, the control responds. The control runs the inducer for the pre-purge time, and then proceed to the ignition trial period.

- **Ignition Trial**

The control energizes the spark and gas valve solenoids. The inducer remains energized. Any time flame is sensed above the spark Off level, spark is turned off. If flame drops below the flame lost level during ignition trial, spark turns back on. The control monitors flame level for the entire ignition trial time. If, at the end of ignition trial, flame is sensed above the run level, the control proceeds to run mode. If flame is not sensed above the Run level at the end of ignition trial, the control de-energizes the gas valve and proceeds with ignition retries.

Single Stage - The burner lights at High fire and remains at high fire.

Two Stage - Depending on call for heat, the burner will light at either the low or high fire setting. As the heating demand changes, the controller will switch the valve between high and low fire.

Modulation - Burner will ignite and modulate between the low and high fire set points.

Split Manifold - The modulated section of the split manifold ignites. As the demand for heat increases the modulated section will modulate towards high fire. If demand for heat increases the controller will ignite the two stage burner section. The two stage section will switch between High, Low and Off depending on need. The modulated section will remain on and modulating throughout cycle.

- **Run**

Control inputs are continuously monitored to ensure limit and pressure switches are closed, flame is established, and the thermostat call for heat remains. When the thermostat call for heat is removed, the control de-energizes the gas valve and begins post-purge. If the control is in run mode for 1 hour, the retry and recycle counter is cleared.

- **Post Purge**

The inducer output remains on for the selected post-purge period after the thermostat is satisfied.

Check Safety shutoff Operation:

1. Shut off the gas supply at the manual gas valve ahead of the appliance.
2. Set the thermostat to call for heat. System should operate as indicated in normal heat cycle to lockout.

Troubleshooting: LED codes

Status LED Codes Pattern

LED Blinking Pattern	Indicates	Inspect/Solutions
Short Flashing	Control powered (without call for Heat)	
Heartbeat Call for heat	Normal Operation	
2	Venter proving switch closed when should be open	1. Air proving switch is jumpered or miswired. 2. Blockage in tubing connecting venter to proving switch. 3. Faulty Venter proving switch.
3	Venter proving switch open when should be closed	1. Air proving switch has loose or disconnected wire. 2. Air intake or flue outlet are obstructed or blocked. 3. Blockage in tubing connecting venter to proving switch. 4. Faulty Venter proving switch.
4	Limit circuit open	1. Gas input too high. Check burner operating pressure. 2. Inadequate or uneven airflow across heat exchanger. 3. Check limit switch wiring 4. Faulty limit switch
5	Flame sensed out of sequence flame still present	1. Flame sensor is bad 2. Perform power reset. Gas valve relay is either welded or failed open or gas valve is connected improperly.
6 + 1	Soft Lockout*: Failed to light during four ignition trials	1. Combination valve turned off. 2. Spark ignitor is disconnected, loose connection or damaged. 3. Flame rod disconnected, loose connection or damaged. 4. Burner manifold pressure too low.
6 + 2	Soft Lockout*: Limit circuit opened during run (recycle counter is at its maximum)	1. Gas input too high. Check burner operating pressure. 2. Inadequate or uneven airflow across heat exchanger. 3. Check limit switch wiring 4. Faulty limit switch
6 + 3	Soft Lockout*: Venter proving switch opened during run: did not reclose within 2 seconds (flame lost and recycle is at its maximum)	1. Air proving switch has loose or disconnected wire. 2. Air intake or flue outlet are obstructed or blocked. 3. Blockage in tubing connecting venter to proving switch. 4. Faulty Venter proving switch.

* Soft lockout—furnace will automatically reset from soft lockout after 60 minutes. Soft lockout mode can be cleared by turning power off to the furnace for five seconds or longer and turning it back on. The interrupted power supply clears the lockout and will allow the unit to attempt normal operation again.

Troubleshooting: LED codes

Status LED Code Pattern (continued)

LED Blinking Pattern	Indicates	Inspect/Solutions
6 + 4	Soft Lockout*: Flame failed during run: (recycle is at its maximum)	1. Air proving switch has loose or disconnected wire. 2. Check flame rod and flame rod wiring. 3. Air intake or flue outlet are obstructed or blocked. 4. Blockage in tubing connecting venter to proving switch. 5. Faulty Venter proving switch.
6 + 5	Soft Lockout*: Flame sensed out of sequence and is gone now	1. Check flame rod and flame rod wiring.
7 + 1	Lockout: Bad fuse detected	1. Replace Fuse
7 + 2	Lockout: Low voltage on 24VAC input	1. Check transformer voltage
7 + 3	Contact Hastings HVAC	
7 + 4	Lockout: Flame Rod shorted to ground or there is a big leakage from flame rod to ground	1. Switch power off and check flame rod and flame rod wiring.
7 + 5	Lockout: Gas Valve Fault	1. Perform power reset. Gas valve relay is either welded or failed open or gas valve is connected improperly. If gas valve is fine and error is reported again furnace control must be replaced.
7 + 6	Lockout: Internal Hardware Error detected	1. Perform power reset. Furnace Control must be replaced if error appears again after power-up.

* Soft lockout—furnace will automatically reset from soft lockout after 60 minutes. Soft lockout mode can be cleared by turning power off to the furnace for five seconds or longer and turning it back on. The interrupted power supply clears the lockout and will allow the unit to attempt normal operation again.

General Trouble Shooting

• **Gas Odor**	
SHUT OFF GAS SUPPLY IMMEDIATELY!	
Possible Cause	Corrective Measures
1. Leaking gas or burner manifold	Use an electronic combustible gas indicator to locate gas leaks on piping to unit, and internal piping and gas controls.
2. Negative pressure in building	Indoor units must have adequate combustion air. If heaters are installed in a closed room, provide an outside opening of one square inch per 1,000 BTU for combustion air alone.

• **Burner fails to light**	
Possible Cause	Corrective Measures
1. Gas supply is off	Make sure all manual shutoff valves are open.
2. Combination valve is turned “OFF”	Turn combination valve “ON”
3. No call for heat	Make sure the thermostat is calling for heat
4. Faulty High limit switch	Check all wiring to high limit. Check that high limit switch is closed. If switch is open and no heat is being applied replace switch.
5. Faulty Spark Igniter	Check wiring to spark igniter and make sure it is grounded properly and there is not a crack in porcelain. The spark gap should be .125”. Replace the spark igniter if there is a crack or improper spark gap.
6. Main gas valve	Make sure minimum supply pressure (see specification plate) is being supplied to main valve. Confirm that burner manifold pressure is adjusted correctly. Check all wiring/connections between ignition module and main gas valve are correct. If module and wiring inspections are satisfactory, replace main gas valve.
7. Faulty venter proving switch	Check that wiring/connections are correct and not loose. The air intake or flue outlet should not be obstructed or blocked. Make sure that the tubing connecting the venter to the air proving switch is not clogged or kinked. If all inspections are satisfactory replace switch.

• **Call for heat ends but main burners continue to operate.**	
Possible Cause	Corrective Measures
1. Faulty thermostat/controller or short circuit in respective wiring.	Repair or replace.
2. Main gas valve stuck in open position or inoperative module	Remove MV lead at gas valve. If valve does not close, replace valve. If main gas valve and thermostat/ controller are ok, replace ignition module.

General Trouble Shooting

• **Burner shutdown before call for heat is satisfied**	
Possible Cause	Corrective Measures
1. Faulty High limit switch	Check all wiring to high limit. Check that high limit switch is closed. If switch is open and no heat is being applied replace switch.
2. Interrupted gas supply to unit or faulty main gas valve	Check gas supply. Inspect main gas valve or operator as necessary.
3. Faulty system ground, flame sensing circuit, wiring and or connections	If ground is poor, nuisance shutdowns may occur occasionally even though burner operation is normal at the time of inspection. Check all ground wires and connections. Inspect flame rod. Clean or replace if needed. Check and correct wiring/connections between module and main gas valve.
4. Faulty Ignition Module	If all previous checks are satisfactory and burners continue to shut-down, replace module.

• **Delayed ignition**	
Possible Cause	Corrective Measures
1. Improper (too high or low) gas pressure at unit.	Make sure minimum supply pressure (see specification plate) is being supplied to main valve. Confirm that burner manifold pressure is adjusted correctly. Check all wiring/connections between ignition module and main gas valve are correct. If module and wiring inspections are satisfactory, replace main gas valve.
2. Faulty Spark Igniter	Check wiring to spark igniter and make sure it is grounded properly and there is not a crack in porcelain. The spark gap should be .125”. Replace the spark igniter if there is a crack or improper spark gap.

• **Furnace overheats or cycles on limit switch**	
Possible Cause	Corrective Measures
1. Supply gas pressure too high.	Make sure pressure being supplied to main valve does not exceed pressure called out on specification plate. Confirm that burner manifold pressure is adjusted correctly.
2. Faulty High Limit Switch	Check all wiring to high limit. Check that high limit switch is closed. If switch is open and no heat is being applied replace switch.
3. Inadequate air through furnace	Check to see that correct airflow CFM is passing through duct furnace. (Refer to system Spec. plate)
4. Poor airflow through furnace.	Airflow through furnace should be uniform. Review “DUCTWORK” section.

Maintenance

Notice:
The heater and vent system should be inspected by a qualified service technician on an annual basis. Service should occur before each heating season.

WARNING

Disconnect power and gas supplies before servicing unit.

Combustion Blower
The motor requires minimal maintenance. Removal of surface dirt and grime on the motor exterior surfaces is all that should be necessary. The sealed motor bearings DO NOT require lubrication, as they are pre-lubricated.

Clean and inspect combustion blower wheel blades. If wheel blades are damaged, combustion blower will need to be replaced.

Burners and Orifices
In order for the furnace to operate properly the burners and orifices should be inspected for any dirt and debris build-up. If burners or orifices require cleaning follow these procedures:

1. Turn **OFF** all gas and electrical supply to the unit.
2. Disconnect gas supply union.
3. Remove the front cover panels of the furnace.
4. Remove burner and manifold assembly.
5. Inspect each burner and orifice.
6. Remove any dirt, dust or debris from the burners using a wire brush and/or compressed air.
7. Confirm that the orifices are clean. Use compressed air and/or aerosol degreaser to clean orifice.
8. Look inside the heat exchanger tubes and make sure they are clear of debris. Wire brush the inside surfaces of the heat exchanger to remove any foreign matter.
9. Reattach the burner and manifold assembly.
10. Reconnect gas supply.
11. Check all gas connections for leaks.
12. Turn **ON** electrical supply to the unit.
13. Perform start-up procedure to confirm operation

Automatic Gas Valve
Confirm that the combination gas valve is operating properly.
1. Set thermostat so that the furnace will begin operation.
2. Once the burner is operating, lower thermostat setting. The gas valve should close.
3. Confirm that the burners have extinguished completely.

Electrical
Check all wiring and connections. Tighten any loose connections. If original wire supplied with the furnace needs to be replaced, it must be replaced with wiring material having a temperature rating of at least 105°C.

Vent
Termination vents with screens require periodic cleaning to prevent the loss of proper venting, which can trip the blocked vent switch .

Filters
Filters must be cleaned (cleanable type) or replaced (throwaway type) with filters as often as necessary so as not to restrict air delivery.

Blower Motor
Motors should be relubricated according to the manufacturer's lubrication instructions.

Fan Bearings
Lubricate main fan bearing with a high grade lithium base grease. Perform at least every 3 months or schedule according to equipment use.

Maintenance

Belts and Sheaves

Twice a year check belts and sheaves for alignment and belt tension.

When a belt is replaced, shorten center distance between sheaves by loosening motor bolts and sliding motor on a support. On units requiring multiple belts, use a matched set.

The following procedure is recommended for tensioning belts:

A. Measure span length “X” shown in Figure 17.
B. At the center of span length “X”, apply a force perpendicular to the span and large enough to deflect belt 1/64” for each inch of span length. Example - The required deflection for a 40” span would be 40/64” or 5/8”.
C. Compare the force applied with the values given in Table 8. If force is between the minimum and maximum range shown, the drive tension should be satisfactory. A force below the minimum value indicates an under tensioned belt and a force that exceeds the maximum values indicates an over tensioned belt.

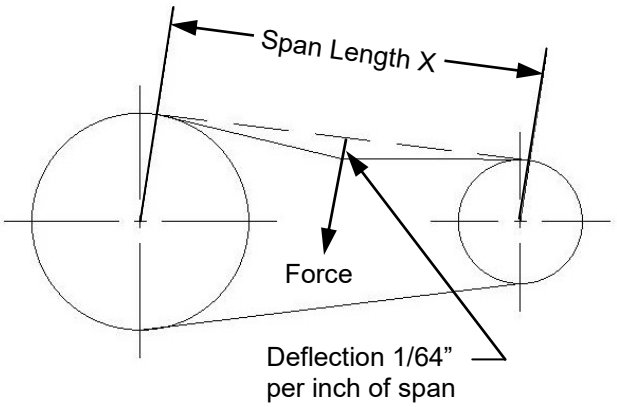


Figure 17- Belt Tensioning

Table 8- Belt Deflection Force

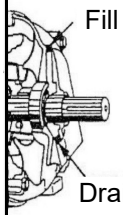
Belt Cross Section (Marked on Belt)	Motor Pulley Pitch Diameter	Deflection Force	
		Minimum	Maximum
A	3.0” - 3.6”	2.62 lbs.	3.25 lbs.
	3.8” -4.8”	3 lbs.	4 lbs.
	5.0”-7.0”	3.25lbs.	5 lbs.
B	3.4” - 4.2”	3 lbs.	5 lbs.
	4.4” - 5.6”	4 lbs.	5.87 lbs.
	5.8” - 8.6”	5.25 lbs.	7.87 lbs.

Blower Motors

Some small motors have sealed bearings which require no relubrication. Motors with regreasable bearings are shipped with a high quality, wide temperature range grease in the bearings.

Motors can be regreased by stopping the motor, removing the drain plug and pumping new grease into fill hole. Run motor with drain plug removed until excess grease has been discharged (minimum 10 min.). Stop motor and replace drain plug.

Units that operate at speeds greater than 1800 RPM should be lubricated on a more frequent maintenance schedule depending on duty cycle. Use a low pressure grease gun and avoid over greasing.



Suggested Regreasing Intervals	
Service	Under 50 HP
A	3-5 years
B	2-4 years
C	1-2 years
D	4 months

Service Symbol	Type of Service
A	Infrequent operation or light duty in clean atmosphere.
B	8-16 hours/day in clean, dry atmosphere.
C	12-24 hours/day, heavy duty, or if moisture is present.
D	Heavy duty in dirty, dusty locations. High ambient temperature moisture laden atmosphere.

Recommended Greases:
Use the following greases or equivalent grease unless a special grease is specified on the motor nameplate.

Manufacturer	Trade Name
Chevron	SR/#2
Shell	Dolium R

Technical Support

Periodic service on any piece of mechanical equipment is necessary for efficient operation. If a service problem arises, Hastings HVAC, Inc. has a technical service department available to provide professional assistance to help you with a solution to that problem. Call our office and you will talk directly with qualified factory service personnel. For needed parts, appliance data, or assistance on a service problem, contact the service department of Hastings HVAC, Inc. Be sure to have the following information ready when contacting us.

1. Model and serial number of unit.
2. Type of gas (LP or Natural)
3. Make of electric valve and voltage.

To contact Hastings HVAC Inc. Service department:

Phone:
Outside of Nebraska:
1-800-228-4243
1-800-228-4270

In Nebraska
402-463-9821

Fax:
402-462-8006

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