Inspections Division
Date: 02/18/14

INSTALLATION MANUAL

RESIDENTIAL GAS FURNACE

MODELS: TM9V*MP

(96% AFUE Two Stage Variable Speed ECM Multi-position)

AHRI CERTIFIED™ www.ahridirectory.org Residential Furnaces DOE 10 CFR Part 430

ENERGY STAR

ISO 9001 Certified Quality Management System

LIST OF SECTIONS

SAFETY 2
DUCTWORK 5
FILTERS 9
GAS PIPING 10
ELECTRICAL POWER 12
CONDENSATE PIPING AND FURNACE VENTING CONFIGURATION 17
COMBUSTION AIR and VENT SYSTEM 23
START-UP AND ADJUSTMENTS 30
SAFETY CONTROLS 35
NORMAL OPERATION AND DIAGNOSTICS 35
REPLACEMENT PARTS LIST 38
REPLACEMENT PART CONTACT INFORMATION 38
WIRING DIAGRAM 39

LIST OF FIGURES

Duct Attachment 5
Vertical Applications 6
Coil Flange 6
Horizontal Right Application 6
Horizontal Left Application 6
PC Series Upflow Coil Installation 7
Horizontal Left or Right application (Right Shown) 7
Combustible Floor Base Accessory 7
Horizontal Application 8
Typical Attic Installation 8
Typical Suspended Furnace / Crawl Space Installation 8
Downflow Venting 8
Dimensions 9
Side Return Cutout Markings 10
Gas Valve 10
Gas Piping 10
Electrical Wiring 12
Thermostat Chart - Single Stage Air Conditioners with Two Stage Variable Speed Furnaces 13
Thermostat Chart - Single Stage Heat Pump with Two Stage Variable Speed Furnace (Hot Heat Pump or Conventional) 14
Thermostat Chart - Two Stage AC with Two Stage Variable Speed Furnace 15
Thermostat Chart - Two Stage HP with Two Stage Variable Speed Furnace (Hot Heat Pump or Conventional) 16
Typical. Condensate drain, vertical installation 17
Typical. Combustion Pipe Drain Tee 18
Upflow Configuration 19
Downflow Configuration 20
Horizontal Left Configuration 21
Horizontal Right Configuration 22
Dimensions 24
Home Layout 25
Termination Configuration - 1 Pipe 26
Termination Configuration - 2 Pipe 26
Termination Configuration - 2 Pipe Basement 26
Double Horizontal Combustion Air Intake and Vent Termination . . . 26
Double Vertical Combustion Air Intake and Vent Termination 26
Downward Venting 27
Direct Vent Air Intake Connection and Vent Connection 27
Combustion Airflow Path Through The Furnace Casing 27
Outside and Ambient Combustion Air 28
Attic and Crawl Space Combustion Air Termination 30
Gas Valve 32
Reading Gas Pressure 3 2
Furnace Control Board 33
Wiring Diagram 39

LIST OF TABLES

Unit Clearances to Combustibles 4
Coil Projection Dimensions - PC Series Coils 7
Cabinet and Duct Dimensions 9
Recommended Filter Sizes (High Velocity 600 FPM) 9
Nominal Manifold Pressure - High Fire 11
Nominal Manifold Pressure - Low Fire 11
Ratings & Physical / Electrical Data 12
Maximum Equivalent Pipe Length 23
Elbow Dimensions 24
Equivalent Length of Fittings 24
Combustion Air Intake and Vent Connection Size at Furnace (All Models) 24
Estimated Free Area 28
Unconfined Space Minimum Area 28
Free Area 28
Gas Rate (CU FT/HR) at Full Input 31
Inlet Gas Pressure Range 32
Nominal Manifold Pressure 32
Air Flow Data 34

These high efficiency, compact units employ induced combustion, reliable hot surface ignition and high heat transfer aluminized tubular heat exchangers. The units are factory shipped for installation in upflow or horizontal applications and may be converted for downflow applications.

These furnaces are designed for residential installation in a basement, closet, alcove, attic, recreation room or garage and are also ideal for commercial applications. All units are factory assembled, wired and tested to assure safe dependable and economical installation and operation.

These units are Category IV listed and may not be common vented with another gas appliance as allowed by the National Fuel Gas Code.

Inspections Division
Date: 02/18/14

'ION I: SAFETY

This is a safety alert symbol. When you see this symbol on labels or in manuals, be alert to the potential for personal injury.

Understand and pay particular attention to the signal words **DANGER**, **WARNING**, or **CAUTION**.

DANGER indicates an **imminently** hazardous situation, which, if not avoided, **will result in death or serious injury**.

WARNING indicates a **potentially** hazardous situation, which, if not avoided, **could result in death or serious injury**.

CAUTION indicates a potentially hazardous situation, which, if not avoided **may result in minor or moderate injury.** It is also used to alert against unsafe practices and hazards involving only property damage.

WARNING

Improper installation may create a condition where the operation of the product could cause personal injury or property damage.

Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. ***Failure to carefully read and follow all instructions in this manual can result in furnace malfunction, death, personal injury and/or property damage.*** *Only a qualified contractor, installer or service agency should install this product.*

SPECIFIC SAFETY RULES AND PRECAUTIONS

1. Only Natural gas or Propane (LP) gas are approved for use with this furnace.
2. Install this furnace only in a location and position as specified in these instructions.
3. A gas-fired furnace for installation in a residential garage must be installed as specified in these instructions.
4. Provide adequate combustion and ventilation air to the furnace space as specified in these instructions.
5. Combustion products must be discharged outdoors. Connect this furnace to an approved vent system only, as specified in SECTION VII, "COMBUSTION AIR and VENT SYSTEM" of these instructions.
6. Test for gas leaks as specified in these instructions.

WARNING

FIRE OR EXPLOSION HAZARD

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

Never test for gas leaks with an open flame. Use a commercially available soap solution made specifically for detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury or loss of life.

7. Always install the furnace to operate within the furnace's intended temperature rise range. Only connect the furnace to a duct system which has an external static pressure within the allowable range, as specified on the furnace rating plate.
8. When a furnace is installed so that supply ducts carry air circulated by the furnace to areas outside the space containing the furnace, the return air shall also be handled by duct(s) sealed to the furnace casing and terminating outside the space containing the furnace.
9. It is permitted to use the furnace for heating of buildings or structures under construction where the application and use must comply with all manufacturer's installation instructions including:
   - Proper vent installation;
   - Furnace operating under thermostatic control;
   - Return air duct sealed to the furnace;
   - Air filters in place;
   - Set furnace input rate and temperature rise per rating plate marking;
   - Means for providing outdoor air required for combustion;
   - Return air temperature maintained between 55ºF (13ºC) and 80ºF (27ºC);
   - The **air filter must be replaced** upon substantial completion of the construction process;
   - Clean furnace, duct work and components upon substantial completion of the construction process, and verify furnace-operating conditions including ignition, input rate, temperature rise and venting, according to the manufacturer's instructions.
10. When installed in a non-HUD-Approved Modular Home or building constructed on-site, combustion air shall not be supplied from occupied spaces.
11. The size of the unit should be based on an acceptable heat loss calculation for the structure. ACCA, Manual J or other approved methods may be used.
12. When moving or handling this furnace prior to installation, always leave the doors on the furnace to provide support and to prevent damage or warping of the cabinet. When lifting the furnace by the cabinet, support the ends of the furnace rather than lifting by the cabinet flanges at the return air openings (bottom or sides) or supply air opening.
13. When lifting the furnace, it is acceptable to use the primary heat exchanger tubes as a lifting point provided that the tubes are lifted at the front of the heat exchangers where attached to the vestibule panel. Do not use the top return bend of the heat exchangers as lifting points as the tubes may shift out of position or their location brackets/baffles.

IMPORTANT

During installation, doors should remain on the furnace when moving or lifting.

SAFETY REQUIREMENTS

CAUTION

This product must be installed in strict compliance with the installation instructions and any applicable local, state, and national codes including, but not limited to building, electrical, and mechanical codes.

- Refer to the unit rating plate for the furnace model number, and then see the dimensions page of this instruction for return air plenum dimensions in Figure 13. The plenum must be installed according to the instructions.
- Provide clearances from combustible materials as listed under Clearances to Combustibles.
- Provide clearances for servicing ensuring that service access is allowed for both the burners and blower.
- These models **ARE NOT** CSA listed or approved for installation into a **HUD Approved Modular Home** or a **Manufactured (Mobile) Home**.
- This furnace is not approved for installation in trailers or recreational vehicles.

Inspections Division
Date: 02/18/14

Furnaces for installation on combustible flooring shall not be installed directly on carpeting, tile or other combustible material other than wood flooring.

- Check the rating plate and power supply to be sure that the electrical characteristics match. All models use nominal 115 VAC, 1 Phase, 60-Hz power supply. DO NOT CONNECT THIS APPLIANCE TO A 50-Hz POWER SUPPLY OR A VOLTAGE ABOVE 130 VOLTS.
- Furnace shall be installed so the electrical components are protected from water.
- Installing and servicing heating equipment can be hazardous due to the electrical components and the gas fired components. Only trained and qualified personnel should install, repair, or service gas heating equipment. Untrained service personnel can perform basic maintenance functions such as cleaning and replacing the air filters. When working on heating equipment, observe precautions in the manuals and on the labels attached to the unit and other safety precautions that may apply.

COMBUSTION AIR QUALITY (LIST OF CONTAMINANTS)

⚠WARNING

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

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

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

The furnace requires **OUTDOOR AIR** for combustion when the furnace is located in any of the following environments.

- Buildings with indoor pools
- Chemical exposure
- Commercial buildings
- Furnaces installed in hobby or craft rooms
- Furnaces installed in laundry rooms
- Furnaces installed near chemical storage areas
- Restricted Environments

The furnace requires **OUTDOOR AIR** for combustion when the furnace is located in an area where the furnace is being exposed to the following substances and / or chemicals.

- Antistatic fabric softeners for clothes dryers
- Carbon tetrachloride
- Cements and glues
- Chlorine based swimming pool chemicals
- Chlorinated waxes and cleaners
- Cleaning solvents (such as perchloroethylene)
- De-icing salts or chemicals
- Halogen type refrigerants
- Hydrochloric acid
- Masonry acid washing materials
- Permanent wave solutions
- Printing inks, paint removers, varnishes, etc.
- Water softening chemicals

When outdoor air is used for combustion, the combustion air intake duct system termination must be located external to the building and in an area where there will be no exposure to the substances listed above.

CODES AND STANDARDS

Follow all national, local codes and standards in addition to this installation manual. The installation must comply with regulations of the serving gas supplier, local building, heating, plumbing, and other codes. In absence of local codes, the installation must comply with the national codes listed below and all authorities having jurisdiction.

In the United States and Canada, follow all codes and standards for the following, using the latest edition available:

STEP 1 - Safety

- US: National Fuel Gas Code (NFGC) NFPA 54/ANSI Z223.1 and the Installation Standards, Warm Air Heating and Air Conditioning Systems ANSI/NFPA 90B
- CANADA: CAN/CGA-B149.1 National Standard of Canada. Natural Gas and Propane Installation Codes (NSCNGPIC)

STEP 2 - General Installation

- US: Current edition of the NFGC and NFPA 90B. For copies, contact the
  National Fire Protection Association Inc.
  Batterymarch Park
  Quincy, MA 02269

  or for only the NFGC, contact the
  American Gas Association,
  400 N. Capital, N.W.
  Washington DC 20001

  or www.NFPA.org
- CANADA: NSCNGPIC. For a copy contact:
  Standard Sales, CSA International
  178 Rexdale Boulevard
  Etobicoke, (Toronto) Ontario Canada M9W 1RS

STEP 3 - Combustion and Ventilation Air

- US: Section 5.3 of the NFGC, air for Combustion and Ventilation
- CANADA: Part 7 of NSCNGPIC, Venting Systems and Air Supply for Appliances

STEP 4 - Duct Systems

- US and CANADA: Air Conditioning Contractors Association (ACCA) Manual D, Sheet Metal and Air Conditioning Contractors Association National Association (SMACNA), or American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) 1997 Fundamentals Handbook Chapter 32.

STEP 5 - Acoustical Lining and Fibrous Glass Duct

- US and CANADA: Current edition of SMACNA and NFPA 90B as tested by UL Standard 181 for Class I Rigid Air Ducts

STEP 6 - Gas Piping and Gas Pipe Pressure Testing

- US: NFGC; chapters 2, 3, 4, & 9 and National Plumbing Codes
- CANADA: NSCNGPIC Part 5

STEP 7 - Electrical Connections

- US: National Electrical Code (NEC) ANSI/NFPA 70
- CANADA: Canadian Electrical Code CSA C22.1

These instructions cover minimum requirements and conform to existing national standards and safety codes. In some instances these instructions exceed certain local codes and ordinances, especially those who have not kept up with changing residential and non-HUD modular home construction practices. These instructions are required as a minimum for a safe installation.

Inspections Division
Date: 02/18/14

FURNACES INSTALLED IN THE COMMONWEALTH OF MASSACHUSETTS ONLY

For all side wall horizontally vented gas fueled equipment installed in every dwelling, building or structure used in whole or in part for residential purposes, including those owned or operated by the Commonwealth and where the side wall exhaust vent termination is less than seven (7) feet above finished grade in the area of the venting, including but not limited to decks and porches, the following requirements shall be satisfied:

1. **INSTALLATION OF CARBON MONOXIDE DETECTORS.** At the time of installation of the side wall horizontal vented gas fueled equipment, the installing plumber or gasfitter shall observe that a hard wired carbon monoxide detector with an alarm and battery back-up is installed on the floor level where the gas equipment is to be installed. In addition, the installing plumber or gasfitter shall observe that a battery operated or hard wired carbon monoxide detector with an alarm is installed on each additional level of the dwelling, building or structure served by the side wall horizontal vented gas fueled equipment. It shall be the responsibility of the property owner to secure the services of qualified licensed professionals for the installation of hard wired carbon monoxide detectors
   a. In the event that the side wall horizontally vented gas fueled equipment is installed in a crawl space or an attic, the hard wired carbon monoxide detector with alarm and battery back-up may be installed on the next adjacent floor level.
   b. In the event that the requirements of this subdivision can not be met at the time of completion of installation, the owner shall have a period of thirty (30) days to comply with the above requirements; provided, however, that during said thirty (30) day period, a battery operated carbon monoxide detector with an alarm shall be installed.
2. **APPROVED CARBON MONOXIDE DETECTORS.** Each carbon monoxide detector as required in accordance with the above provisions shall comply with NFPA 720 and be ANSI/UL 2034 listed and IAS certified.
3. **SIGNAGE.** A metal or plastic identification plate shall be permanently mounted to the exterior of the building at a minimum height of eight (8) feet above grade directly in line with the exhaust vent terminal for the horizontally vented gas fueled heating appliance or equipment. The sign shall read, in print size no less than one-half (1/2) inch in size, "**GAS VENT DIRECTLY BELOW. KEEP CLEAR OF ALL OBSTRUCTIONS**".
4. **INSPECTION.** The state or local gas inspector of the side wall horizontally vented gas fueled equipment shall not approve the installation unless, upon inspection, the inspector observes carbon monoxide detectors and signage installed in accordance with the provisions of 248 CMR 5.08(2)(a)1 through 4.

INSPECTION

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

FURNACE LOCATION AND CLEARANCES

The furnace shall be located using the following guidelines:

1. Where a minimum amount of air intake/vent piping and elbows will be required.
2. As centralized with the air distribution as possible.
3. Where adequate combustion air will be available (particularly when the appliance is not using outdoor combustion air).
4. Where it will not interfere with proper air circulation in the confined space.
5. Where the outdoor vent terminal will not be blocked or restricted. Refer to "VENT CLEARANCES" located in SECTION VII of these instructions. These minimum clearances must be maintained in the installation.
6. Where the unit will be installed in a level position with no more than 1/4" (6.4 mm) slope side-to-side and front-to-back to provide proper condensate drainage.

Installation in freezing temperatures:

1. Furnace shall be installed in an area where ventilation facilities provide for safe limits of ambient temperature under normal operating conditions. Ambient temperatures must not fall below 32°F (0°C) unless the condensate system is protected from freezing.

⚠ WARNING

Improper installation in an ambient below 32ºF (0.0° C) could create a hazard, resulting in damage, injury or death.

2. Do not allow return air temperature to be below 55º F (13°C) for extended periods. To do so may cause condensation to occur in the main heat exchanger, leading to premature heat exchanger failure.
3. If this furnace is installed in an unconditioned space and an extended power failure occurs, there will be potential damage to the internal components. Following a power failure situation, do not operate the unit until inspection and repairs are performed.

⚠ WARNING

Liquid anti-freeze will cause damage to internal plastic parts of this furnace. ***DO NOT attempt to winterize the furnace using liquid anti-freeze.***

Clearances for access/service:

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

1. Twenty-four (24) inches (61 cm) between the front of the furnace and an adjacent wall or another appliance, when access is required for servicing and cleaning.
2. Eighteen (18) inches (46 cm) at the side where access is required for passage to the front when servicing or for inspection or replacement of flue/vent connections.

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

Installation in a residential garage:

A gas-fired furnace for installation in a residential garage must be installed so the burner(s) and the ignition source are located not less than 18" (46 cm) above the floor, and the furnace must be located or protected to avoid physical damage by vehicles.

Table 1: Unit Clearances to Combustibles

Application	Upflow	Downflow	Horizontal
Top	1"	0"	0"
Vent	0"	0"	0"
Rear	0"	0"	0"
Side	0"	0"	1"
Front*	0"	0"	0"
Floor	Combustible	Combustible[1]	Combustible
Closet	Yes	Yes	Yes
Line Contact	No	No	Yes

1. For combustible floors only when used with special sub-base.
* 24" clearance in front and 18" on side recommended for service access.
All furnaces approved for alcove and attic installation.

Inspections Division
Date: 02/18/14

ECTION II: DUCTWORK

DUCTWORK GENERAL INFORMATION

The duct system's design and installation must:

1. Handle an air volume appropriate for the served space and within the operating parameters of the furnace specifications.
2. Be installed in accordance of National Fire Protection Association as outlined in NFPA standard 90B (latest editions) or applicable national, provincial, state, and local fire and safety codes.
3. Create a closed duct system. For residential and non-HUD Modular Home installations, when a furnace is installed so that the supply ducts carry air circulated by the furnace to areas outside the space containing the furnace, the return air shall also be handled by a duct(s) sealed to the furnace casing and terminating outside the space containing the furnace.
4. Complete a path for heated or cooled air to circulate through the air conditioning and heating equipment and to and from the conditioned space.

⚠CAUTION

The cooling coil must be installed in the supply air duct, downstream of the furnace. Cooled air may not be passed over the heat exchanger.

When the furnace is used with a cooling coil, the coil must be installed parallel with, or in the supply air side of the furnace to avoid condensation in the primary heat exchanger. When a parallel flow arrangement is used, dampers or other means used to control airflow must be adequate to prevent chilled air from entering the furnace. If manually operated, the damper must be equipped with means to prevent the furnace or the air conditioner from operating unless the damper is in full heat or cool position.

When replacing an existing furnace, if the existing plenum is not the same size as the new furnace then the existing plenum must be removed and a new plenum installed that is the proper size for the new furnace. If the plenum is shorter than 12" (30.5 cm) the turbulent air flow may cause the limit controls not to operate as designed, or the limit controls may not operate at all.

The duct system is a very important part of the installation. **If the duct system is improperly sized the furnace will not operate properly.** The ducts attached to the furnace plenum, should be of sufficient size so that the furnace operates at the specified external static pressure and within the air temperature rise specified on the nameplate.

IMPORTANT

The minimum plenum height is 12" (30.5 cm). The furnace will not operate properly on a shorter plenum height. The minimum recommended rectangular duct height is 4" (10.2 cm) attached to the plenum.

⚠WARNING

The duct system must be properly sized to obtain the correct airflow for the furnace size that is being installed.

Refer to Table 7 or the furnace rating plate for the correct rise range and static pressures.

If the ducts are undersized, the result will be high duct static pressures and/or high temperature rises which can result in a heat exchanger OVERHEATING CONDITION. This condition can result in premature heat exchanger failure, which can result in personal injury, property damage, or death.

If a matching cooling coil is used, it may be placed directly on the furnace outlet and sealed to prevent leakage. If thermoplastic evaporator 'A' coil drain pans are to be installed in the upflow/horizontal configuration, then extra 2" (5.1 cm) minimum spacing may be needed to ensure against drain pan distortion.

On all installations without a coil, a removable access panel is recommended in the outlet duct such that smoke or reflected light would be observable inside the casing to indicate the presence of leaks in the heat exchanger. This access cover shall be attached in such a manner as to prevent leaks.

DUCT FLANGES

Four flanges are provided to attach ductwork to the furnace. These flanges are rotated down for shipment. In order to use the flanges, remove the screw holding an individual flange, rotate the flange so it is in the upward position and reinstall the screw then repeat this for all 4 flanges.

If the flanges are not used, they must remain in the rotated down position as shipped.

FIGURE 1: Duct Attachment

DUCTWORK INSTALLATION AND SUPPLY PLENUM CONNECTION - UPFLOW/HORIZONTAL

Attach the supply plenum to the furnace outlet. The use of an approved flexible duct connector is recommended on all installations. This connection should be sealed to prevent air leakage. The sheet metal should be crosshatched to eliminate any popping of the sheet metal when the indoor fan is energized.

FLOOR BASE AND DUCTWORK INSTALLATION - DOWNFLOW

Installations on combustible material or directly on any floors must use a combustible floor base shown in Figure 8. Follow the instructions supplied with the combustible floor base accessory. This combustible floor base can be replaced with a matching cooling coil, properly sealed to prevent leaks. Follow the instructions supplied with the cooling coil cabinet for installing the cabinet to the duct connector. Plug intake and vent pipe holes in bottom panel and move grommet to desired vent side exit.

Downflow Air Conditioning Coil Cabinet

The furnace should be installed with coil cabinet part number specifically intended for downflow application. If a matching cooling coil is used, it may be placed directly on the furnace outlet and sealed to prevent leakage. For details of the coil cabinet dimensions and installation requirements, refer to the installation instructions supplied with the coil cabinet.

Attach the air conditioning coil cabinet to the duct connector, and then position the furnace on top of the coil cabinet. The connection to the furnace, air conditioning coil cabinet, duct connector, and supply air duct must be sealed to prevent air leakage.

Inspections Division
Date: 02/18/14

NSTALLATION

IMPORTANT

On all installations without a coil, a removable access panel is recommended in the outlet duct such that smoke or reflected light would be observable inside the casing to indicate the presence of leaks in the heat exchanger. This access cover shall be attached in such a manner as to prevent leaks.

COIL/FURNACE ASSEMBLY - MC/FC/PC SERIES COILS

FIGURE 2: Vertical Applications

FURNACE ASSEMBLY - MC & FC SERIES COILS

These coils are factory shipped for installation in either upflow or downflow applications with no conversion.

Position the coil casing over or under the furnace opening as shown in Figure 2 after configuring coil flanges as required see “Coil Flange” section below.

COIL FLANGE INSTALLATION

The coils include removable flanges to allow proper fit up with furnaces having various inlet and outlet flange configurations. The two flanges are attached to the top of the coil in the factory during production. For proper configuration of flanges refer to Figure 3.

FIGURE 3: Coil Flange

FURNACE ASSEMBLY - MC SERIES COILS ONLY

MC coils are supplied ready to be installed in a horizontal position. A horizontal pan is factory installed. MC coils should be installed in all horizontal applications with the horizontal drain pan side down.

FIGURE 4: Horizontal Right Application

For horizontal left hand applications no conversion is required to an MC coil when used with a downflow/horizontal furnace. A mounting plate, supplied with every coil should always be installed on the side designated as top side. See Figures 4 & 5.

FIGURE 5: Horizontal Left Application

FURNACE ASSEMBLY - PC SERIES COILS

These upflow coils are designed for installation on top of upflow furnaces only.

If the coil is used with a furnace of a different size, use a 45° transition to allow proper air distribution through the coil.

1. Position the coil casing over the furnace opening as shown in Figure 6.
2. Place the ductwork over the coil casing flange and secure.
3. Check for air leakage between the furnace and coil casing and seal appropriately.

⚠CAUTION

Do not drill any holes or drive any screws into the front duct flange on the coil in order to prevent damaging coil tubing. See Figure 6

Inspections Division
Date: 02/18/14

FIGURE 6: PC Series Upflow Coil Installation

Table 2: Coil Projection Dimensions - PC Series Coils

COIL SIZE	DIMENSION "C" INCH
PC18	3-1/2
PC24	4-1/2
PC30, PC32, PC35	4-1/2
PC42, PC43, PC36, PC37	5-1/2
PC48	6-1/2
PC60	9

Dimension "C" should be at least 2/3 of dimension "D". See Figure 6.

CRITICAL COIL PROJECTION

The coil assembly must be located in the duct such that a minimum distance is maintained between the top of the coil and the top of the duct. Refer to Table 2.

COIL / FURNACE ASSEMBLY - HC SERIES COILS

These coils are supplied ready to be installed in a right hand position or a left hand position. When used in conjunction with a horizontal furnace (blow through) application, the coil should be oriented with the opening of the "A" coil closest to the furnace. See Figure 7.

NOTICE

Each coil is shipped with an external tie plate that should be used to secure the coil to the furnace. It should be installed on the back side of the coil using the dimpled pilot holes. See Figure 7.

FIGURE 7: Horizontal Left or Right application (Right Shown)

DOWNFLOW DUCT CONNECTORS

All downflow installations must use a suitable duct connector approved by the furnace manufacturer for use with this furnace. The duct connectors are designed to be connected to the rectangular duct under the floor and sealed. Refer to the instructions supplied with the duct connector for proper installation. Refer to the separate accessory parts list at the end of these instructions for the approved accessory duct connectors.

FIGURE 8: Combustible Floor Base Accessory

RESIDENTIAL AND MODULAR HOME UPFLOW RETURN PLENUM CONNECTION

Return air may enter the furnace through the side(s) or bottom depending on the type of application. Return air may not be connected into the rear panel of the unit.

SIDE RETURN APPLICATION

Side return applications pull return air through an opening cut in the side of the furnace casing. This furnace is supplied with a bottom block-off panel that should be left in place if a side return is to be used. If the furnace is to be installed on a flat, solid surface, this bottom panel will provide an adequate seal to prevent air leakage through the unused bottom opening. However, if the furnace is to be installed on a surface that is uneven, or if it is to be installed on blocks or otherwise raised off the floor, **it will be necessary to seal the edges of the bottom panel to the casing using tape or other appropriate gasket material to prevent air leakage.**

BOTTOM RETURN AND ATTIC INSTALLATIONS

Bottom return applications normally pull return air through a base platform or return air plenum. Be sure the return platform structure or return air plenum is suitable to support the weight of the furnace.

The internal bottom panel must be removed for this application.

Attic installations must meet all minimum clearances to combustibles and have floor support with required service accessibility.

Inspections Division
Date: 02/18/14

:ONTAL APPLICATION

FIGURE 9: Horizontal Application

IMPORTANT

This furnace may be installed in a horizontal position on either side as shown above. ***It must not be installed on its back.***

ATTIC INSTALLATION

FIGURE 10: Typical Attic Installation

This appliance is certified for line contact when the furnace is installed in the horizontal left or right position. The line contact is only permissible between lines that are formed by the intersection of the top and two sides of the furnace and the building joists, studs or framing. This line may be in contact with combustible material. Refer to Figure 10.

⚠WARNING

When a furnace is installed in an attic or other insulated space, keep all insulating materials at least 12" (30.5 cm) away from furnace and burner combustion air openings.

IMPORTANT

During installation, doors should remain on the furnace when moving or lifting.

When moving or handling this furnace prior to installation, always leave the doors on the furnace to provide support and to prevent damage or warping of the cabinet. When lifting the furnace, support the ends of the furnace rather than lifting by the cabinet flanges at the return air openings (bottom or sides) or supply air opening.

It is acceptable to use the primary heat exchanger tubes as a lifting point provided that the tubes are lifted at the front of the heat exchangers where attached to the vestibule panel. Do not use the top return bend of the heat exchangers as lifting points as the tubes may shift out of position or their location brackets/baffles.

SUSPENDED FURNACE / CRAWL SPACE INSTALLATION

The furnace can be hung from floor joists or installed on suitable blocks or pad. Blocks or pad installations shall provide adequate height to ensure the unit will not be subject to water damage. Units may also be suspended from rafters or floor joists using rods, pipe angle supports or straps. Angle supports should be placed at the supply air end and near the blower deck. Do not support at return air end of unit. All four suspension points must be level to ensure quite furnace operation. When suspending the furnace use a secure platform constructed of plywood or other building material secured to the floor joists. Refer to Figure 11 for typical crawl space installation.

FIGURE 11: Typical Suspended Furnace / Crawl Space Installation

DOWNFLOW APPLICATION

To apply the furnace in a downflow position, it will be necessary to rotate the vent blower 90° left or right so that the vent pipe passes through the side of the furnace casing. See Figure 12.

FIGURE 12: Downflow Venting

Inspections Division
Date: 02/18/14

FIGURE 13: Dimensions

Table 3: Cabinet and Duct Dimensions

BTUH (kW) Input	Nominal CFM (m^3/min)	Cabinet Size	Cabinet Dimensions (Inches)						Approximate Operating Weights
			A (in)	A (cm)	B (in)	B (cm)	C (in)	C (cm)	Lbs (kg)
40 (11.7)	1000 (28.3)	A	14 1/2	36.8	13 3/8	34.0	11 3/4	29.8	113 (51.2)
60 (17.6)	1200 (34.0)	B	17 1/2	44.4	16 3/8	41.6	13 1/4	33.7	122 (55.3)
80 (23.4)	1200 (34.0)	B	17 1/2	44.4	16 3/8	41.6	14 3/4	37.5	126 (57.1)
80 (23.4)	1600 (45.3)	C	21	53.3	19 7/8	50.5	16 1/2	41.9	136 (61.7)
100 (29.3)	1600 (45.3)	C	21	53.3	19 7/8	50.5	18 1/4	46.4	142 (64.4)
100 (29.3)	2000 (56.6)	C	21	53.3	19 7/8	50.5	18 1/4	46.4	145 (65.8)
120 (35.1)	2000 (56.6)	D	24 1/2	62.2	23 3/8	59.4	21 3/4	55.2	156 (70.7)

SECTION III: FILTERS

FILTER INSTALLATION

All applications require the use of a field installed filter. All filters and mounting provision must be field supplied.

Filters must be installed external to the furnace cabinet. **DO NOT attempt to install filters inside the furnace.**

NOTICE

Single side return above 1800 CFM is approved as long as the filter velocity does not exceed filter manufacturer’s recommendation and a transition is used to allow use on a 20x25 filter.

Table 4: Recommended Filter Sizes (High Velocity 600 FPM)

CFM (m^3/min)	Cabinet Size	Side (in)	Bottom (in)
1000 (28.3)	A	16 x 25	14 x 25
1200 (34.0)	B	16 x 25	16 x 25
1600 (45.3)	C	16 x 25	20 x 25
2000 (56.6)	C	(2) 16 x 25	20 x 25
2000 (56.6)	D	(2) 16 x 25	22 x 25

1. Air velocity through throwaway type filters may not exceed 300 feet per minute (91.4 m/min). All velocities over this require the use of high velocity filters.
2. Do not exceed 1800 CFM using a single side return and a 16x25 filter. For CFM greater than 1800, you may use two side returns or one side and the bottom or one side return with a transition to allow use of a 20x25 filter.

Inspections Division
Date: 02/18/14

RETURN

Locate the "L" shaped corner locators. These indicate the size of the cut-out to be made in the furnace side panel. Refer to Figure 14.

FIGURE 14: Side Return Cutout Markings

Install the side filter rack following the instructions provided with that accessory. If a filter(s) is provided at another location in the return air system, the ductwork may be directly attached to the furnace side panel.

IMPORTANT

Some accessories such as electronic air cleaners and pleated media may require a larger side opening. Follow the instructions supplied with that accessory for side opening requirements. Do not cut the opening larger than the dimensions shown in Figure 13.

HORIZONTAL APPLICATION

Horizontal Filters

CAUTION

All filters and mounting provision must be field supplied. All installations must have a filter installed.

Any branch duct (rectangular or round duct) attached to the plenum must attach to the vertical plenum before the filter. The use of straps and/or supports is required to support the weight of the external filter box.

Downflow Filters

Downflow furnaces typically are installed with the filters located above the furnace, extending into the return air plenum or duct. Any branch duct (rectangular or round duct) attached to the plenum must attach to the vertical plenum above the filter height.

Filter(s) may be located in the duct system external to the furnace using an external duct filter box attached to the furnace plenum or at the end of the duct in a return filter grille(s). The use of straps and/or supports is required to support the weight of the external filter box.

SECTION IV: GAS PIPING

GAS SAFETY

DANGER

An overpressure protection device, such as a pressure regulator, must be installed in the gas piping system upstream of the furnace and must act to limit the downstream pressure to the gas valve so it does not exceed 0.5 psig [14" w.c. (3.48 kPa)]. Pressures exceeding 0.5 psig [14" w.c. (3.48 kPa)] at the gas valve will cause damage to the gas valve, resulting in a fire or explosion or cause damage to the furnace or some of its components that will result in property damage and loss of life.

FIGURE 15: Gas Valve

IMPORTANT

Plan your gas supply before determining the correct gas pipe entry. Use 90-degree service elbow(s), or short nipples and conventional 90-degree elbow(s) to enter through the cabinet access holes.

GAS PIPING INSTALLATION

Properly sized wrought iron, approved flexible or steel pipe must be used when making gas connections to the unit. If local codes allow the use of a flexible gas appliance connection, always use a new listed connector. Do not use a connector that has previously serviced another gas appliance.

Some utility companies or local codes require pipe sizes larger than the minimum sizes listed in these instructions and in the codes. The furnace rating plate and the instructions in this section specify the type of gas approved for this furnace - only use those approved gases. The installation of a drip leg and ground union is required. Refer to Figure 16.

FIGURE 16: Gas Piping

Inspections Division
Date: 02/18/14

IMPORTANT

An accessible manual shutoff valve must be installed upstream of the furnace gas controls and within 6 feet (1.8 m) of the furnace.

The furnace must be isolated from the gas supply piping system by closing its individual external manual shutoff valve during any pressure testing of the gas supply piping system at pressures equal to or less than 0.5 psig (3.5 kPa).

⚠CAUTION

The gas valve body is a very thin casting that cannot take any external pressure. Never apply a pipe wrench to the body of the gas valve when installing piping. A wrench must be placed on the octagon hub located on the gas inlet side of the valve. Placing a wrench to the body of the gas valve will damage the valve causing improper operation and/or the valve to leak.

Gas piping may be connected from either side of the furnace using any of the gas pipe entry knockouts on both sides of the furnace. Refer to Figure 13.

GAS ORIFICE CONVERSION FOR PROPANE (LP)

This furnace is constructed at the factory for natural gas-fired operation, but may be converted to operate on propane (LP) gas by using a factory-supplied LP conversion kit. Follow the instructions supplied with the LP kit.

HIGH ALTITUDE GAS ORIFICE CONVERSION

This furnace is constructed at the factory for natural gas-fired operation at 0 –7,999 feet (0 – 2,438 m) above sea level.

The manifold pressure must be changed in order to maintain proper and safe operation when the furnace is installed in a location where the altitude is greater than 7,999 feet (2,438 m) above sea level. Refer to Table 5 for proper manifold pressure settings.

HIGH ALTITUDE PRESSURE SWITCH CONVERSION

For installation where the altitude is less than 5,000 feet (1,524m), it is not required that the pressure switch be changed unless you are in an area subject to low pressure inversions.

Table 5: Nominal Manifold Pressure - High Fire

Manifold Pressures (in. w.c.)					Manifold Pressures (kPa)				
		Altitude (feet)					Altitude (m)		
		0-7999	8000-8999	9000-9999			0-2437	2438-2742	2743-3048
Gas Heating Value (BTU/cu ft.)	800	3.5	3.5	3.5	Gas Heating Value (MJ/cu m)	29.8	0.87	0.87	0.87
	850	3.5	3.5	3.5		31.7	0.87	0.87	0.87
	900	3.5	3.5	3.5		33.5	0.87	0.87	0.87
	950	3.5	3.5	3.3		35.4	0.87	0.87	0.81
	1000	3.5	3.2	2.9		37.3	0.87	0.80	0.73
	1050	3.5	2.9	2.7		39.1	0.87	0.73	0.67
	1100	3.2	2.7	2.4		41.0	0.80	0.66	0.61
	2500 (LP)	9.8	8.2	7.5		93.2 (LP)	2.44	2.03	1.86

TABLE 6: Nominal Manifold Pressure - Low Fire

First Stage Manifold Pressures (in. w.c.)					First Stage Manifold Pressures (kPa)				
		Altitude (feet)					Altitude (m)		
		0-7999	8000-8999	9000-9999			0-2437	2438-2742	2743-3048
Gas Heating Value (BTU/cu ft.)	800	1.7	1.7	1.7	Gas Heating Value (MJ/cu m)	29.8	0.42	0.42	0.42
	850	1.7	1.7	1.7		31.7	0.42	0.42	0.42
	900	1.7	1.7	1.7		33.5	0.42	0.42	0.42
	950	1.7	1.7	1.5		35.4	0.42	0.42	0.38
	1000	1.6	1.5	1.4		37.3	0.41	0.37	0.34
	1050	1.5	1.4	1.3		39.1	0.37	0.34	0.31
	1100	1.3	1.2	1.1		41.0	0.34	0.31	0.28
	2500 (LP)	4.1	3.8	3.5		93.2 (LP)	1.03	0.95	0.87

⚠DANGER

PROPANE AND HIGH ALTITUDE CONVERSION KITS

It is very important to choose the correct kit and/or gas orifices for the altitude and the type of gas for which the furnace is being installed.

Only use natural gas in furnaces designed for natural gas. Only use propane (LP) gas for furnaces that have been properly converted to use propane (LP) gas. Do not use this furnace with butane gas.

Incorrect gas orifices or a furnace that has been improperly converted will create an extremely dangerous condition resulting in premature heat exchanger failure, excessive sooting, high levels of carbon monoxide, personal injury, property damage, a fire hazard and/or death.

High altitude and propane (LP) conversions are required in order for the appliance to satisfactory meet the application.

An authorized distributor or dealer must make all gas conversions.

In Canada, a certified conversion station or other qualified agency, using factory specified and/or approved parts, must perform the conversion.

The installer must take every precaution to insure that the furnace has been converted to the proper gas orifice size when the furnace is installed. Do not attempt to drill out any orifices to obtain the proper orifice size. Drilling out a gas orifice will cause misalignment of the burner flames, causing premature heat exchanger burnout, high levels of carbon monoxide, excessive sooting, a fire hazard, personal injury, property damage and/or death.

Inspections Division
Date: 02/18/14

'ION V: ELECTRICAL POWER

'RICAL POWER CONNECTIONS

CAUTION

Use copper conductors only.

Field wiring to the unit must be grounded. Electric wires that are field installed shall conform to the temperature limitation for 63°F (35°C) rise wire when installed in accordance with instructions. Refer to Table 7 in these instructions for specific furnace electrical data.

Table 7: Ratings & Physical / Electrical Data

Input High/Low		Output High/Low		Nominal Airflow		Cabinet Width		Total Unit Amps	AFUE	High Fire Air Temp. Rise		Low Fire Air Temp. Rise	
MBH	kW	MBH	kW	CFM	m^3/min	in.	cm		%	°F	°C	°F	°C
40/26	12/8	38/25	11/7	1000	28.3	14-1/2	36.8	9	96	30 - 60	17-33	20-50	11-28
60/39	18/11	58/37	17/11	1200	34	17-1/2	44.4	9	96	35 - 65	19-36	35-65	19-36
80/52	23/15	77/50	22/14	1200	34	17-1/2	44.4	9	96	40 - 70	22-39	35-65	19-36
80/52	23/15	77/50	22/14	1600	45.3	21	53.3	12	96	35 - 65	19-36	35-65	19-36
100/65	29/19	96/62	28/18	1600	45.3	21	53.3	12	96	35 - 65	19-36	30-60	17-33
100/65	29/19	96/62	28/18	2000	56.6	21	53.3	14	96	35 - 65	19-36	35-65	19-36
120/78	35/23	115/75	33/22	2000	56.6	24-1/2	62.2	14	96	35 - 65	19-36	35-65	19-36

Input High/Low		Max. Outlet Air Temp.		Blower		Blower Size		Max. Over-current Protect	Min. Wire Size (awg) @ 75 ft. One Way	Operating Weight	
MBH	kW	°F	°C	HP	Amps	in.	cm			Lbs.	Kg.
40/26	12/8	180	82.2	1/2	7	11 x 8	27.9 x 20.3	15	14	113	51.2
60/39	18/11	170	76.7	1/2	7	11 x 8	27.9 x 20.3	15	14	122	55.3
80/52	23/15	175	79.4	1/2	7	11 x 8	27.9 x 20.3	15	14	126	57.1
80/52	23/15	175	79.4	3/4	10.2	11 x 10	27.9 x 25.4	15	14	136	61.7
100/65	23/15	175	79.4	3/4	10.2	11 x 10	27.9 x 25.4	15	14	142	64.4
100/65	29/19	175	79.4	1	12.7	11 x 11	27.9 x 27.9	20	12	145	65.7
120/78	35/23	170	76.7	1	12.7	11 x 11	27.9 x 27.9	20	12	156	70.7

Annual Fuel Utilization Efficiency (AFUE) numbers are determined in accordance with DOE test procedures.
Wire size and over current protection must comply with the National Electrical Code (NFPA-70-latest edition) and all local codes.
The furnace shall be installed so that the electrical components are protected from water.

SUPPLY VOLTAGE CONNECTIONS

FIGURE 17: Electrical Wiring

1. Provide a power supply separate from all other circuits. Install over-current protection and disconnect switch per local/national electrical codes. The switch should be close to the unit for convenience in servicing. With the disconnect or fused switch in the OFF position, check all wiring against the unit wiring label. Refer to the wiring diagram in this instruction.
2. Remove the wiring box cover screws. Route all power wiring through a conduit connector or other proper bushing that has been installed into the unit opening and the junction box. In the junction box there is a black wire, a white wire and a green ground screw. Connect the power supply as shown on the unit's wiring label located on the inside of the blower compartment door, or the wiring schematic in this section. Connect the black wire to L1 (hot) from the power supply. Connect the white wire to neutral. Connect the ground wire (installer-supplied) to the green (equipment ground) screw. An alternate wiring method is to use a field-provided 2" (5.1 cm) x 4" (10.2 cm) box and cover on the outside of the furnace. Route the furnace leads into the box using a protective bushing where the wires pass through the furnace panel. After making the wiring connections replace the wiring box cover and screws. Refer to Figure 17.
3. The furnace's control system requires correct polarity of the power supply and a proper ground connection. Refer to Figure 17.

IMPORTANT

The power connection leads and wiring box may be relocated to the left side of the furnace. Remove the screws and cut wire tie holding excess wiring. Reposition on the left side of the furnace and fasten using holes provided.

LOW VOLTAGE CONTROL WIRING CONNECTIONS

Install the field-supplied thermostat by following the instructions that come with the thermostat. With the thermostat set in the OFF position and the main electrical source disconnected, connect the thermostat wiring from the wiring connections on the thermostat to the terminal board on the ignition module, as shown in Figures 18 - 21. Electronic thermostats may require the common wire to be connected. Apply strain relief to thermostat wires passing through cabinet. If air conditioning equipment is installed, use thermostat wiring to connect the Y and C terminals on the furnace control board to the proper wires on the condensing unit (unit outside).

IMPORTANT

Set the heat anticipator in the room thermostat to 0.4 amps. Setting it lower will cause short cycles. Setting it higher will cause the room temperature to exceed the set points.

IMPORTANT

Some electronic thermostats do not have adjustable heat anticipators. They should be set to six cycles per hour. Follow the thermostat manufacturer's instructions.

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

Inspections Division
Date: 02/18/14

additional connection diagrams for all UPG equipment refer to “Low Voltage System Wiring” document available on-line at www.upgnet.com in the Product Catalog Section.

FIGURE 18: Thermostat Chart - Single Stage Air Conditioners with Two Stage Variable Speed Furnaces

Inspections Division
Date: 02/18/14

HP 15A Single Stage Heat Pump – Two Stage Variable Speed Furnace (Hot Heat Pump or Conventional)

ID MODELS	
PV(8/9)	
(F/L)*(8/9)V	
(G/L)*(8/9)V	
TM(8/9)V	

OD MODELS	
YZB	
YMB	
H*3	

THERMOSTAT	THERMOSTAT	THERMOSTAT
*DN22U00124	*BP21H50124 *BN21H00124 *DP21H40124 *DN21H00124	*DP32H70124

TWO STAGE VARIABLE SPEED FURNACE

SINGLE STAGE HEAT PUMP

			2 TWO STAGE VARIABLE SPEED FURNACE CONTROL	1 YORKGUARD VI CONTROL
C 24 – Volt Common	C 24 – Volt Common	C 24 – Volt Common	C 24 – Volt Common	C 24 – Volt Common
Y First Stage Compressor	Y1 First Stage Compressor	Y1 First Stage Compressor	Y1 Single Stage Compressor	Y1 Single Stage Compressor
R 24 – Volt Hot (Heat XFMR)	R 24 – Volt Hot	R 24 – Volt Hot	R 24 – Volt Hot	R 24 – Volt Hot
G Fan	G Fan	G Fan	G Fan	
E Emergency Heat	E Emergency Heat	E Emergency Heat	W/W1 First Stage Heat	W1 OUT First Stage Heat
		W2 Third Stage Heat	W2 Second Stage Heat	W2 OUT Second Stage Heat
RC 24 – Volt Hot (Cool XFMR)			Y/Y2 Second or Full Stage Compressor	Y2 OUT Second Stage Compressor
O/B Reversing Valve	O Reversing Valve Energized in Cool	O Reversing Valve Energized in Cool	O Reversing Valve	O Reversing Valve Energized in Cool
L Malfunction Light	L Malfunction Light	L Malfunction Light	X/L Malfunction Light	X/L Malfunction Light
	Y2 Second Stage Compressor	Y2 Second Stage Compressor		Y2 Second Stage Compressor
AUX Auxiliary Heat	W2 Second Stage Heat	W1 Second Stage Aux. Heat		W Auxiliary Heat
		24VAC Humidifier (Optional)	DHUM Dehumidification	BSG Bonnet Sensor
		3 External Humidistat (Optional) Open on Humidity Rise	Bonnet Sensor Kit (Optional) S1-37309243000	BS Bonnet Sensor
		3 External Humidistat (Optional) Open on Humidity Rise		

Thermostat Installer Setup 1-System Type-must be set to 5 – 2 Heat/1 Heat Pump

Thermostat Installer Setup 2-Changeover Valve-must be set to 0 – O/B terminal Energized in Cooling

B/O Switch on Thermostat must be in the O position

Step 1 of Thermostat Installer / Configuration Menu must be set to Heat Pump 1

Move HEAT PUMP jumper to "YES"

Move DHUM jumper to "YES" if humidistat is to be used.

Change FFuel jumper on the heat pump control to "ON"

Change Hot Heat Pump jumper on the heat pump control to "ON" if Hot Heat Pump Operation is desired.

3 Part Number: S1-2HU16700124

2 Part Numbers:
SAP = Legacy
265904 = 031-09169
449572

1 Part Numbers:
SAP = Legacy
126768 = 031-09137
18395 = 031-01996
340512 = 031-09178

FIGURE 19: Thermostat Chart - Single Stage Heat Pump with Two Stage Variable Speed Furnace (Hot Heat Pump or Conventional)

Inspections Division
Date: 02/18/14

FIGURE 20: Thermostat Chart - Two Stage AC with Two Stage Variable Speed Furnace

Inspections Division
Date: 02/18/14

HP 24A Two Stage Heat Pump – Two Stage Variable Speed Furnace (Hot Heat Pump or Conventional)

ID MODELS	
PV(8/9)	
(F/L)*(8/9)V	
(G/L)*(8/9)V	
TM(8/9)V	

OD MODELS	
YZE	
YZH	
H*5	
H*8	

FIGURE 21: Thermostat Chart - Two Stage HP with Two Stage Variable Speed Furnace (Hot Heat Pump or Conventional)

Inspections Division
Date: 02/18/14

ACCESSORY CONNECTIONS

The furnace control will allow power-switching control of various accessories.

ELECTRONIC AIR CLEANER CONNECTION

Two 1/4” (6.4 mm) spade terminals (EAC and NEUTRAL) for electronic air cleaner connections are located on the control board. The terminals provide 115 VAC (1.0 amp maximum) during circulating blower operation.

HUMIDIFIER CONNECTION

Two 1/4” (6.4 mm) spade terminals (HUM and NEUTRAL) for humidifier connections are located on the control board. The terminals provide 115 VAC (1.0 amp maximum) during heating system operation.

A mounting hole is provided on the control panel next to the furnace control board for mounting a humidifier transformer if required.

SINGLE STAGE THERMOSTAT

If a single stage thermostat is used, the high/low input staging will be controlled by the furnace control board, using the staging jumper. If the staging jumper is set to the 10, 15, or 20 position, the furnace will switch from low fire to high fire after 10, 15, or 20 minutes and will stay in high fire until the thermostat is satisfied. If the staging jumper is left in the OFF position and a single stage thermostat is used, the furnace will only operate at low fire.

TWINNING

These furnaces are not to be twinned. If more than one furnace is needed in an application, each furnace must have its own complete duct system and its own wall thermostat.

SECTION VI: CONDENSATE PIPING AND FURNACE VENTING CONFIGURATION

CONDENSATE DRAIN LOCATION

As shipped from the factory:

- For all 040, 060, & 080K input furnaces the main drain is plumbed through the casing right-side opening when viewed from the front of the furnace.
- For all 100, 120, & 130K input furnaces the main drain is plumbed through the casing left-side opening when viewed from the front of the furnace.

NOTICE

The Figures 24 - 27 show the condensate drain arrangement for the various possible furnace and vent blower positions.

The condensate hoses must slope downwards at all points.

⚠CAUTION

The furnace condensate pan is self priming and contains an internal trap to prevent flue gas leaking. Do not install an external condensate trap.

When drain hose routing changes are required (shown in Figures 24-27), be sure to cap all un-used openings.

If rerouting hoses - excess length should be cut off so that no sagging loops will collect and hold condensate - which will cause the furnace to not operate.

No hose clamps are needed for connecting to the condensate pan.

IMPORTANT

The furnace, evaporator coil, and humidifier drains may be combined and drained together. The evaporator coil drain may have an external, field-supplied trap prior to the furnace drain connection to prevent conditioned air leakage. All drain connections (furnace, evaporator coil, or humidifier) must be terminated into an open or vented drain as close to the respective equipment as possible. Regular maintenance is required on condensate drainage system.

IMPORTANT

Condensate must be disposed of properly. Follow local plumbing or wastewater codes. The drain line must maintain a 1/4" per foot (20 mm/m) downward slope to the drain.

IMPORTANT

If an external vent tee is being installed, then it must have its own condensate trap before it is disposed into an open or vented drain. ***This is not to be considered as a second trap as referenced elsewhere in this document.***

FIGURE 22: Typical. Condensate drain, vertical installation

The condensate will flow to the drain better if an open stand pipe is installed in the drain line. See Figure 22.

If evaporator coil or humidifier drains are combined with the furnace drain, then the open stand pipe could be raised higher, above the 5” minimum.

NOTICE

A loop has been added to the pressure switch vacuum hose. However, ensure that all pressure switch hoses are routed such that they prevent any condensate from entering the pressure switch.

Inspections Division
Date: 02/18/14

⚠CAUTION

It is possible for condensation to form inside the combustion air (intake) pipe in the summer months if significant length of combustion air pipe passes through conditioned space. This problem can be averted by the addition of a simple drain tee, or a drain tee with a drain on the combustion air pipe as close to the furnace as possible, as shown in Figure 23. This is true for all long horizontal venting in any furnace configuration. This will prevent the condensate from entering the furnace.

FIGURE 23: Typical. Combustion Pipe Drain Tee

CONDENSATE DRAIN TERMINATION

A condensate sump pump MUST be used if required by local codes, or if no indoor floor drain is available. The condensate sump pump must be approved for use with acidic condensate.

⚠WARNING

DO NOT terminate the condensate drain in a chimney, or where the drain line may freeze. If the drain line will be exposed to temperatures below freezing, adequate measures must be taken to prevent the drain line from freezing. Failure to provide proper protection from freezing can result in improper operation or damage to the equipment and possible property damage. When exposed to temperatures below freezing, use of a 3 to 6 watt per foot at 115 VAC, 40°F (4.4°C) self-regulating, shielded and waterproof heat tape is recommended on the drain line outside the furnace.

DO NOT trap the drain line at any other location than at the condensate drain trap supplied with the furnace.

⚠WARNING

Liquid anti-freeze will cause damage to internal plastic parts of this furnace. ***DO NOT attempt to winterize the furnace using liquid anti-freeze.***

Inspections Division
Date: 02/18/14

When drain hose routing changes are required, be sure to cap all un-used openings.
If rerouting hoses - excess length should be cut off so that no sagging loops will collect and hold condensate, which will cause the furnace to not operate.

INDUCER ROTATED FOR RIGHT SIDE VENTING

For 040, 060 & 080K input furnaces, the condensate drain is plumbed toward the right casing outlet from the factory.

Condensate drain may exit cabinet on either side.

UPFLOW AS RECEIVED

For 100, 120K input furnaces, the condensate drain is plumbed toward the left casing outlet from the factory.

INDUCER ROTATED FOR LEFT SIDE VENTING

FIGURE 24: Upflow Configuration

Inspections Division
Date: 02/18/14

When drain hose routing changes are required, be sure to cap all un-used openings.
If rerouting hoses - excess length should be cut off so that no sagging loops will collect and hold condensate, which will cause the furnace to not operate.

FIGURE 25: Downflow Configuration

Inspections Division
Date: 02/18/14

When drain hose routing changes are required, be sure to cap all unused openings.

If rerouting hoses - excess length should be cut off so that no sagging loops will collect and hold condensate, which will cause the furnace to not operate.

FIGURE 26: Horizontal Left Configuration

Inspections Division
Date: 02/18/14

FIGURE 27: Horizontal Right Configuration

Inspections Division
Date: 02/18/14

SECTION VII: COMBUSTION AIR AND VENT SYSTEM

COMBUSTION AIR AND VENT SAFETY

This Category IV, dual certified direct vent furnace is designed for residential application. It may be installed without modification to the condensate system in a basement, garage, equipment room, alcove, attic or any other indoor location where all required clearance to combustibles and other restrictions are met. The combustion air and the venting system must be installed in accordance with Section 5.3, Air for Combustion and Ventilation, of the National Fuel Gas Code Z223.1/NFPA 54 (latest edition), or Sections 7.2, 7.3 or 7.4 of CSA B149.1, National Gas and Propane Codes (latest edition) or applicable provisions of the local building code and these instructions.

IMPORTANT

The VENT SYSTEM must be installed as specified in these instructions for Residential and non-HUD Modular Homes. The direct vent system is the only configuration that can be installed in a non-HUD Modular Home.

⚠WARNING

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

The furnace shall not be connected to a chimney flue serving a separate appliance designed to burn solid fuel.

⚠CAUTION

When combustion air pipe is installed above a suspended ceiling or when it passes through a warm and humid space, the pipe must be insulated with 1/2" Armaflex or other heat resistant type insulation if two feet or more of pipe is exposed.

Vent piping must be insulated if it will be subjected to freezing temperatures such as routing through unheated areas or through an unused chimney.

COMBUSTION AIR/VENT PIPE SIZING

The size of pipe required will be determined by the furnace model, the total length of pipe required and the number of elbows required.

Table 8 lists the maximum equivalent length of pipe allowed for each model of furnace. The equivalent length of elbows is shown in Table 10. The equivalent length of the vent system is the total length of straight pipe PLUS the equivalent length of all of the elbows.

The following rules must also be followed:

1. Long radius (sweep) elbows are recommended. Standard elbows may be used, but since they have a longer equivalent length, they will reduce the total length of pipe that will be allowed. Short radius (plumbing vent) elbows are not allowed. The standard dimensions of the acceptable elbows are shown below.
2. The maximum equivalent length listed in Table 8 is for the vent piping and the air intake piping separately. For example, if the table allows 65 equivalent feet for a particular model, then the vent can have 65 equivalent feet of pipe, AND the combustion air intake can have another 65 equivalent feet of pipe.
3. Three vent terminal elbows (two for the vent and one for the combustion air intake) are already accounted for and need not be included in the equivalent length calculation.
4. All combustion air and vent pipe must conform to American National Standards Institute (ANSI) and American Society for Testing and Materials (ASTM) standards D1785 (Schedule 40 PVC), D2665 (PVC-DWV), F891 (PVC-DWV Cellular Core), D2261 (ABS-DWV) or F628 (Schedule 40 ABS). Pipe cement and primer must conform to ASTM Standard D2546 (PVC) or D2235 (ABS). If ABS pipe is to be used, any joint where ABS pipe is joined to PVC pipe must be glued with cement that is approved for use with BOTH materials. Metallic materials must not be used for venting or air intake.
5. If a flexible connector is used in the vent system, it must be made of a material that is resistant to acidic exposure and to at least 225°F (107.2°C) temperature. Flexible connectors are also allowed in the combustion air pipe.
6. All models are supplied with 2" (5.1 cm) vent connections. When the pipe must be increased to 3" (7.6 cm) diameter, the transition from 2" to 3" must be done as close to the furnace as possible. For upflow models, the transition from 2" to 3" should be done immediately above the furnace. For downflow or horizontal models, the transition from 2" to 3" pipe should be done immediately after exiting the furnace.
7. In Canada, vents shall be certified to ULC S636, Standard for Type BH Gas Venting Systems.
8. In Canada, the first three feet (91.4 cm) of the vent must be readily accessible for inspection.
9. For single pipe systems it is recommended to install the combustion air coupling provided and install approximately 18" of PVC pipe on the furnace.
10. Minimum vent length for all models is 5 feet (1.5 m).

TABLE 8: Maximum Equivalent Pipe Length

Model Input BTUH (kW)	Pipe Size Inches (cm)	Maximum Equivalent length feet (m)
40,000	2 (5.1)	65 (19.8)
40,000	3 (7.6)	90 (27.4)
40,000	4 (10.2)	150 (45.7)
60,000	2 (5.1)	65 (19.8)
60,000	3 (7.6)	90 (27.4)
60,000	4 (10.2)	150 (45.7)
80,000	2 (5.1)	65 (19.8)
80,000	3 (7.6)	90 (27.4)
80,000	4 (10.2)	150 (45.7)
100,000	2 (5.1)	30 (9.1)
100,000	3 (7.6)	90 (27.4)
100,000	4 (10.2)	150 (45.7)
120,000	2 (5.1)	30 (9.1)
120,000	3 (7.6)	90 (27.4)
120,000	4 (10.2)	150 (45.7)

Inspections Division
Date: 02/18/14

FIGURE 28: Dimensions

TABLE 9: Elbow Dimensions

Elbow	"A" Dimension
2" Standard	2-5/16"
3" Standard	3-1/16"
2" Sweep	3-1/4"
3" Sweep	4-1/16"

Dimensions are those required in Standard ASTM D-3311.

TABLE 10: Equivalent Length of Fittings

Fitting	Equivalent Length
2" 90° sweep elbow	5 feet of 2" pipe
2" 45° sweep elbow	2-1/2 feet of 2" pipe
2" 90° standard elbow	7 feet of 2" pipe
2" 45° standard elbow	3-1/2 feet of 2" pipe
3" 90° sweep elbow	5 feet of 3" pipe
3" 45° sweep elbow	2-1/2 feet of 3" pipe
3" 90° standard elbow	7 feet of 3" pipe
3" 45° standard elbow	3-1/2 feet of 3" pipe
4" 90° elbow (sweep or standard)	5 feet of 4" pipe
4" 45° elbow (sweep or standard)	2-1/2 feet of 4" pipe
2" corrugated connector	10 feet of 2" pipe
3" corrugated connector	10 feet of 3" pipe
4" corrugated connector	10 feet of 4" pipe

Example:

An 80,000 BTUH furnace requires 32 feet of pipe and five 90º elbows. Using 2" pipe and standard elbows, the total equivalent length will be:

32 feet of 2" pipe =	32 equivalent feet
5 - 90º standard 2" elbows = (5 x 7) =	35 equivalent feet
Total =	67 equivalent feet of 2" pipe

This exceeds the 65 foot maximum equivalent length of 2" pipe allowed for that model and is thus <u>not</u> acceptable.

By using sweep elbows, the total equivalent length will be:

32 feet of 2" pipe =	32 equivalent feet
5 - 90º sweep 2" elbows = (5 x 5) =	25 equivalent feet
Total =	57 equivalent feet of 2" pipe

This is less than the 65 foot maximum equivalent length of 2" pipe allowed for that model and is thus acceptable.

Alternatively, using 3" pipe and standard elbows, the total equivalent length will be:

32 feet of 3" pipe =	32 equivalent feet
5 - 90º standard 3" elbows = (5 x 7) =	35 equivalent feet
Total =	67 equivalent feet of 3" pipe

This is less than the 90 foot maximum equivalent length of 3" pipe allowed for that model and is thus acceptable.

TABLE 11: Combustion Air Intake and Vent Connection Size at Furnace (All Models)

FURNACE VENT CONNECTION SIZES	
Furnace Input	All
Intake Pipe Size	2" (5.1 cm)
Vent Pipe Size	2" (5.1 cm)

IMPORTANT

Furnace vent pipe connections are sized for 2" (5.1 cm). pipe. Any pipe size change must be made outside the furnace casing in a vertical pipe section to allow proper drainage of condensate. An offset using two 45º (degree) elbows will be required for plenum clearance when the vent is increased to 3" (7.6 cm).

IMPORTANT

Accessory concentric vent / intake termination kits 1CT0302 and 1CT0303, and for Canadian applications 1CT0302-636 and 1CT0303-636 are available and approved for use with these furnaces. Horizontal sidewall vent terminations kits 1HT0901 & 1HT0902 are also approved for use with these furnaces.

COMBUSTION AIR AND VENT PIPING ASSEMBLY

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

1. Cut piping to the proper length beginning at the furnace.
2. Deburr the piping inside and outside.
3. Chamfer (bevel) the outer edges of the piping.
4. Dry-fit the vent piping assembly from the furnace to the outside termination checking for proper fit support and slope.
5. Dry-fit the combustion air piping assembly checking for proper fit, support and slope on the following systems:
   a. Sealed combustion air systems from the furnace to the outside termination.
   b. Ventilated combustion air systems from the furnace to the attic or crawl space termination.

⚠CAUTION

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

6. Disassemble the combustion air and vent piping, apply cement primer and the cement per the manufactures instructions. Primer and cement must conform to ASTM D2564 for PVC, or ASTM D2235 for ABS piping.
7. All joints must provide a permanent airtight and watertight seal.
8. Support the combustion air and vent piping such that it is angled a minimum of 1/4" per foot (21 mm/m) so that condensate will flow back towards the furnace. Piping should be supported with pipe hangers to prevent sagging.
9. Seal around the openings where the combustion air and / or vent piping pass through the roof or sidewalls.

COMBUSTION AIR / VENTING

IMPORTANT

The vent must be installed with the minimum required clearances, and must comply with local codes and requirements.

Inspections Division
Date: 02/18/14

NT CLEARANCES

FIGURE 29: Home Layout

Direct Vent Terminal Clearances	Canadian Installations[1,3]	US Installation[2,3]
A. Clearance above grade, veranda, porch, deck, or balcony	12” (30.5 cm)	12” (30.5 cm)
B. Clearance to window or door that may be opened	12” (30.5 cm) for models ≤100,000 BTUH (30 kW), 36” (91.4 cm) for models >100,000 BTUH (30 kW).	Two-pipe (direct vent) applications: 9” (23 cm) for models ≤50,000 BTUH (15 kW), 12” (30.5 cm) for models >50,000 BTUH (15 kW). †† Single-pipe applications: 4 feet (1.2 m).
C. Clearance to permanently closed window	12” (30.5 cm)	12” (30.5 cm)
D. Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 feet (61 cm) from the center line of the terminal	12” (30.5 cm) or in accordance with local installation codes and the requirements of the gas supplier.	12” (30.5 cm) or in accordance with local installation codes and the requirements of the gas supplier.
E. Clearance to unventilated soffit	12” (30.5 cm) or in accordance with local installation codes and the requirements of the gas supplier.	12” (30.5 cm) or in accordance with local installation codes and the requirements of the gas supplier.
F. Clearance to outside corner	12” (30.5 cm) or in accordance with local installation codes and the requirements of the gas supplier.	12” (30.5 cm) or in accordance with local installation codes and the requirements of the gas supplier.
G. Clearance to inside corner	3 feet (91.4 cm)	3 feet (91.4 cm)
H. Clearance to each side of center line extended above meter/regulator assembly	Above a meter/regulator assembly within 3 feet (91.4 cm) horizontally of the vertical center-line of the regulator vent outlet to a maximum vertical distance of 15 feet (4.5 m) above the meter/regulator assembly.	Above a meter/regulator assembly within 3 feet (91.4 cm) horizontally of the vertical center-line of the regulator vent outlet to a maximum vertical distance of 15 feet (4.5 m) above the meter/regulator assembly.
I. Clearance to service regulator vent outlet	3 feet (91.4 cm)	3 feet (91.4 cm) or in accordance with local installation codes and the requirements of the gas supplier.
J. Clearance to nonmechanical air supply inlet to building or the combustion air inlet to any other appliance	12” (30.5 cm) for models ≤100,000 BTUH (30 kW), 3 feet (91.4 cm) for models >100,000 BTUH (30 kW).	Two-pipe (direct vent) applications: 9” (23 cm) for models ≤50,000 BTUH (15 kW), 12” (30.5 cm) for models >50,000 BTUH (15 kW). Single-pipe applications: 4 feet (1.2 m).
K. Clearance to a mechanical supply inlet	6 feet (1.83 m)	3 feet (91.4 cm) above if within 10 feet (3 m) horizontally.
L. Clearance above paved sidewalk or paved driveway located on public property	7 feet (2.13 m)†	7 feet (2.13 m) or in accordance with local installation codes and the requirements of the gas supplier.
M. Clearance under veranda, porch, deck, or balcony	12” (30.5 cm)‡	12” (30.5 cm) or in accordance with local installation codes and the requirements of the gas supplier.

1. In accordance with the current CSA B149.1-00, Natural Gas and Propane Installation Code.
2. In accordance with the current ANSI Z223.1 / NFPA 54, National Gas Code.
3. In accordance with the current ANSI Z21.47 * CSA 2.3 American National Standard.

† A vent shall not terminate directly above a sidewalk or paved driveway that is located between two single family dwellings and serves both dwellings.

†† 12” (30.5 cm) up from the bottom edge of the structure for Two-pipe (direct vent) applications per ANSI Z223.1 / NFPA 54, National Gas Code.

‡ Permitted only if veranda, porch, deck, or balcony is fully open on a minimum of two sides beneath the floor and the distance between the top of the vent termination and the underside of the veranda, porch, or deck is greater than 12” (30.5 cm) as specified in CSA B149.1-00.

A vent shall not terminate less than 12” (30.5 cm) above a grade level.

Any fresh air or make up inlet for dryer or furnace area is considered to be forced air inlet.

Avoid areas where condensate drippage may cause problems such as above planters, patios, or adjacent to windows where steam may cause fogging.

A terminus of a vent shall be fitted with a cap in accordance with the vent manufacturer’s installation instructions, or in accordance with the installation instructions for a special venting system.

Responsibility for the provision of proper adequate venting and air supply for application shall rest with the installer.

Vent shall extend high enough above building, or a neighboring obstruction, so that wind from any direction will not create a positive pressure in the vicinity of the vent.

IMPORTANT

Consideration must be given for degradation of building materials by flue gases. Sidewall termination may require sealing or shielding of building surfaces with a corrosion resistant material to protect against combustion product corrosion. Consideration must be given to wind direction in order to prevent flue products and/or condensate from being blown against the building surfaces. If a metal shield is used it must be a stainless steel material at a minimum dimension of 20” (51 cm). It is recommended that a retaining type collar be used that is attached to the building surface to prevent movement of the vent pipe.

Inspections Division
Date: 02/18/14

SYSTEM

This furnace is certified to be installed with one of two possible vent configurations.

1. Horizontal vent system. This vent system can be installed completely horizontal or combinations of horizontal, vertical, or offset using elbows.
2. Vertical vent system. This vent system can be installed completely vertical or a combination of horizontal, vertical, or offset using elbows.

VENT APPLICATIONS AND TERMINATION

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

1. Observe all clearances listed in vent clearances in these instructions.
2. Termination should be positioned where vent vapors will not damage plants or shrubs or air conditioning equipment.
3. Termination should be located where it will not be affected by wind gusts, light snow, airborne leaves or allow recirculation of flue gases.
4. Termination should be located where it will not be damaged or exposed to flying stones, balls, etc.
5. Termination should be positioned where vent vapors are not objectionable.
6. Horizontal portions of the vent system must slope upwards and be supported to prevent sagging.
7. Direct vent systems must be installed so the vent and the combustion air pipes terminate in the same atmospheric zone. Refer to Figures 31 or 32.

FIGURE 30: Termination Configuration - 1 Pipe

FIGURE 31: Termination Configuration - 2 Pipe

FIGURE 32: Termination Configuration - 2 Pipe Basement

VENTING MULTIPLE UNITS

Multiple units can be installed in a space or structure as either a single pipe configuration or a two-pipe configuration.

The combustion air side of the single pipe configuration shown in Figure 30 is referred to in these instructions as ambient combustion air supply. Follow the instructions for ambient combustion air installations, paying particular attention to the section on air source from inside the building. The vent for a single pipe system must be installed as specified in the venting section of these instructions with the vent terminating as shown in Figure 30. Each furnace must have a separate vent pipe. Under NO circumstances can the two vent pipes be tied together.

The combustion air side of the two-pipe configuration shown in Figure 31 can be installed so the combustion air pipe terminates as described in outdoor combustion air or ventilated combustion air sections in these instructions. Follow the instructions for outdoor combustion air or ventilated combustion air and the instructions for installing the vent system with the vent terminating as shown in Figures 33 or 34. The two-pipe system must have a separate combustion air pipe and a separate vent pipe for each furnace. Under NO circumstances can the two combustion air or vent pipes be tied together. The combustion air and vent pipes must terminate in the same atmospheric zone.

FIGURE 33: Double Horizontal Combustion Air Intake and Vent Termination

FIGURE 34: Double Vertical Combustion Air Intake and Vent Termination

Inspections Division
Date: 02/18/14

DOWNWARD VENTING

In some applications, it may be necessary to run the vent pipe and air intake downwards. If this is to be done, the following rules must be followed.

- A condensate trap hose must be connected to both the air intake pipe and the vent pipe at the lowest part of the horizontal run.
- The condensate drain trap must have a trap of a minimum of six inches.
- The total vertical downward distance must not exceed sixteen feet.
- The condensate drain hose must be connected to a condensate drain pump, a open or vented drain or into the condensate drain line from the furnace.
- The condensate drain lines must not pass through unconditioned spaces where the temperature may fall below freezing.
- The condensate drain line must be primed at the initial start-up prior to the start of heating season.

FIGURE 35: Downward Venting

COMBUSTION AIR SUPPLY

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

This furnace is certified to be installed with one of three possible combustion air intake configurations.

1. **OUTDOOR COMBUSTION AIR:** This is a direct vent configuration where the combustion air is supplied through a PVC or ABS pipe that is connected to the PVC coupling attached to the furnace and is terminated in the same atmospheric zone as the vent. This type of installation is approved on all models. Refer to Figure 35.
2. **AMBIENT COMBUSTION AIR:** Combustion air is supplied from the area surrounding the furnace through openings in the furnace casing. The combustion air and the vent pipes are not terminated in the same atmospheric zone. Refer to Figure 30 for vent terminations. Refer to "Ambient Combustion Air Supply" for proper installation. Refer to Figure 36.
3. **VENTILATED COMBUSTION AIR:** Combustion air is supplied through a PVC or ABS pipe that is connected to the PVC coupling attached to the burner box and is terminated in a ventilated attic or crawl space. The combustion air and the vent pipes are not terminated in the same atmospheric zone. Refer to Figure 38 for attic and crawl space termination. Only the combustion air intake may terminate in the attic. The vent must terminate outside.

Outdoor Combustion Air

Combustion Air Intake/Vent Connections

This installation requires combustion air to be brought in from outdoors. This requires a properly sized pipe (Shown in Figure 35) that will bring air in from the outdoors to the furnace combustion air intake collar on the burner box. The second pipe (Shown in Figure 35) is the furnace vent pipe.

NOTICE

An optional plastic birdscreen is shipped in the loose parts bag with every furnace. This may be installed in the intake collar to prevent any small objects from entering the furnace.

FIGURE 36: Direct Vent Air Intake Connection and Vent Connection

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

Also, the terminal assembly should be located as far as possible from a swimming pool or a location where swimming pool chemicals might be stored. Be sure the terminal assembly follows the outdoor clearances listed in Section #1 "Outdoor Air Contaminants."

Ambient Combustion Air Supply

This type installation will draw the air required for combustion from within the space surrounding the appliance and from areas or rooms adjacent to the space surrounding the appliance. This may be from within the space in a non-confined location or it may be brought into the furnace area from outdoors through permanent openings or ducts. It is not piped directly into the furnace. A single, properly sized pipe from the furnace vent connector to the outdoors must be provided. It is recommended that the supplied intake coupling and 18" (46 cm) of pipe be attached to the furnace to prevent accidental blockage of the combustion air intake.

FIGURE 37: Combustion Airflow Path Through The Furnace Casing

Inspections Division
Date: 02/18/14

⚠WARNING

This type of installation requires that the supply air to the appliance(s) be of a sufficient amount to support all of the appliance(s) in the area. Operation of a mechanical exhaust, such as an exhaust fan, kitchen ventilation system, clothes dryer or fireplace may create conditions requiring special attention to avoid unsatisfactory operation of gas appliances. A venting problem or a lack of supply air will result in a hazardous condition, which can cause the appliance to soot and generate dangerous levels of CARBON MONOXIDE, which can lead to serious injury, property damage and / or death.

An **unconfined space** is not less than 50 cu.ft (1.42 m^3) per 1,000 Btu/hr (0.2928 kW) input rating for all of the appliances installed in that area.

Rooms communicating directly with the space containing the appliances are considered part of the unconfined space, if doors are furnished with openings or louvers.

A **confined space** is an area with less than 50 cu.ft (1.42 m^3) per 1,000 Btu/hr (0.2928 kW) input rating for all of the appliances installed in that area. The following must be considered to obtain proper air for combustion and ventilation in confined spaces.

Combustion Air Source From Outdoors

The blocking effects of louvers, grilles and screens must be given consideration in calculating free area. If the free area of a specific louver or grille is not known, refer to Table 12, to estimate free area.

Table 12: Estimated Free Area

Wood or Metal Louvers or Grilles	Wood 20-25%* Metal 60-70% *
Screens+	1/4" (6.4 mm) mesh or larger 100%

* Do not use less than 1/4" (6.4 mm) mesh
\+ Free area of louvers and grille varies widely; the installer should follow louver or grille manufacturer's instructions.

Dampers, Louvers and Grilles (Canada Only)

1. The free area of a supply air opening shall be calculated by subtracting the blockage area of all fixed louvers grilles or screens from the gross area of the opening.
2. Apertures in a fixed louver, a grille, or screen shall have no dimension smaller than 1/4" (6.4 mm).
3. A manually operated damper or manually adjustable louvers are not permitted for use.
4. A automatically operated damper or automatically adjustable louvers shall be interlocked so that the main burner cannot operate unless either the damper or the louver is in the fully open position.

⚠WARNING

When a Category I furnace is removed or replaced, the original venting system may no longer be correctly sized to properly vent the attached appliances.

An improperly sized vent system can cause CARBON MONOXIDE to spill into the living space causing personal injury, and or death.

Table 13: Unconfined Space Minimum Area

BTUH Input Rating	Minimum Free Area Required for Each Opening
40,000	40 in^2 (258 cm^2)
60,000	60 in^2 (387 cm^2)
80,000	80 in^2 (516 cm^2)
100,000	100 in^2 (645 cm^2)
120,000	120 in^2 (742 cm^2)

Table 14: Free Area

BTUH Input Rating	Minimum Free Area Required for Each Opening		
	Horizontal Duct (2,000 BTUH)	Vertical Duct or Opening to Outside (4,000 BTUH)	Round Duct (4,000 BTUH)
40,000	20 in^2 (129 cm^2)	10 in^2 (64 cm^2)	4" (10 cm)
60,000	30 in^2 (193 cm^2)	15 in^2 (97 cm^2)	5" (13 cm)
80,000	40 in^2 (258 cm^2)	20 in^2 (129 cm^2)	5" (13 cm)
100,000	50 in^2 (322 cm^2)	25 in^2 (161 cm^2)	6" (15 cm)
120,000	60 in^2 (387 cm^2)	30 in^2 (193 cm^2)	7" (18 cm)
EXAMPLE: Determining Free Area. Appliance 1 Appliance 2 Total Input 100,000 +30,000 = (130,000 ÷ 4,000) = 32.5 Sq. In. Vertical Appliance 1 Appliance 2 Total Input 100,000 +30,000 = (130,000 ÷ 2,000) = 65 Sq. In. Horizontal			

FIGURE 38: Outside and Ambient Combustion Air

Air Supply Openings and Ducts

1. An opening may be used in lieu of a duct to provide to provide the outside air supply to an appliance unless otherwise permitted by the authority having jurisdiction. The opening shall be located within 12" (30.5 cm) horizontally from, the burner level of the appliance. Refer to "AIR SOURCE FROM OUTDOORS AND VENT AND SUPPLY AIR SAFETY CHECK" in these instructions for additional information and safety check procedure.
2. The duct shall be either metal, or a material meeting the class 1 requirements of CAN4-S110 Standard for Air Ducts.
3. The duct shall be least the same cross-sectional area as the free area of the air supply inlet opening to which it connects.
4. The duct shall terminate within 12" (30.5 cm) above, and within 24" (61 cm) horizontally from, the burner level of the appliance having the largest input.
5. A square or rectangular shaped duct shall only be used when the required free area of the supply opening is 9 in^2 (58.06 cm^2) or larger. When a square or rectangular duct is used, its small dimension shall not be less than 3" (7.6 cm).

Inspections Division
Date: 02/18/14

An air inlet supply from outdoors shall be equipped with a means to prevent the direct entry of rain and wind. Such means shall not reduce the required free area of the air supply opening.

7. An air supply inlet opening from the outdoors shall be located not less than 12” (30.5 cm) above the outside grade level.

Combustion Air Source from Outdoors

1. Two permanent openings, one within 12” (30.5 cm) of the top and one within 12” (30.5 cm) of bottom of the confined space, Two permanent openings, shall communicate directly or by means of ducts with the outdoors, crawl spaces or attic spaces.
2. One permanent openings, commencing within 12” (30.5 cm) of the top of the enclosure shall be permitted where the equipment has clearances of at least 1” (2.54 cm) from the sides and back and 6” (15.2 cm) from the front of the appliance. The opening shall communicate directly with the outdoors and shall have a minimum free area of:
   a. 1 square in. per 3000 Btu per hour (6.45 cm^3 per 0.879 kW) of the total input rating of all equipment located in the enclosure.
   b. Not less than the sum of all vent connectors in the confined space.
3. The duct shall be least the same cross-sectional area as the free area of the air supply inlet opening to which it connects.
4. The blocking effects of louvers, grilles and screens must be given consideration in calculating free area. If the free area of a specific louver or grille is not known. Refer to Table 12.

Ventilated Combustion Air

The ventilated attic space or a crawl space from which the combustion air is taken must comply with the requirements specified in “AIR SOURCE FROM OUTDOORS” in this instruction or in Section 5.3, Air for Combustion and Ventilation of the National Fuel Gas Code, ANSI Z223.1 (latest edition). This type installation requires two properly sized pipes. One brings combustion air from a properly ventilated attic space or crawl space and a second pipe that extends from the furnace vent connection (top right of unit) to the exterior of the building. Refer to Table 8 for intake pipe sizing, allowable length and elbow usage. Follow all notes, procedures and required materials in the "COMBUSTION AIR/VENT PIPE SIZING" section in these instructions when installing the combustion air pipe from the unit and into a ventilated attic space or crawl space. DO NOT terminate vent pipe in an Attic or Crawl Space.

Ventilated Combustion Air Termination

Refer to Figure 38 for required attic termination for the combustion air intake pipe. For attic termination, use two 90° elbows with the open end in a downward position. Be sure to maintain 12” (30.5 cm) clearance above any insulation, flooring or other material.

A crawl space combustion air installation consists of a straight pipe from the PVC coupling on the burner box that extends into the crawl space and terminates with a 1/4” (6.4 mm) mesh screen and no elbows.

⚠ WARNING

CARBON MONOXIDE POISONING HAZARD

Failure to follow the steps outlined below for each appliance connected to the venting system being placed into operation could result in carbon-monxide poisoning or death.

The following steps shall be followed for each appliance connected to the venting system being placed into operation, while all other appliances connected to the venting system are not in operation:

1. Inspect the venting system for proper size and horizontal pitch. Determine that there is no blockage, restriction, leakage, corrosion or other deficiencies, which could cause an unsafe condition
2. Close all building doors and windows and all doors.
3. Turn on clothes dryers and TURN ON any exhaust fans, such as range hoods and bathroom exhausts, so they shall operate at maximum speed. Open the fireplace dampers. Do not operate a summer exhaust fan.
4. Follow the lighting instructions. Place the appliance being inspected in operation. Adjust thermostat so the appliance shall operate continuously.
5. Test each appliance (such as a water heater) equipped with a draft hood for spillage (down-draft or no draft) at the draft hood relief opening after 5 minutes of main burner operation. Appliances that do not have draft hoods need to be checked at the vent pipe as close to the appliance as possible. Use a combustion analyzer to check the CO_2 and CO levels of each appliance. Use a draft gauge to check for a downdraft or inadequate draft condition.
6. After it has been determined that each appliance properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas burning appliance to their normal condition.
7. If improper venting is observed during any of the above tests, a problem exists with either the venting system or the appliance does not have enough combustion air (Supply Air from outside) to complete combustion. This condition must be corrected before the appliance can function safely.

NOTE: A unsafe condition exists when the CO reading exceeds 40 ppm and the draft reading is not in excess of - 0.1 in. w.c. (-25 kPa) with all of the appliance(s) operating at the same time.

8. Any corrections to the venting system and / or to the supply (outside) air system must be in accordance with the National Fuel Gas Code Z223.1 or CAN/CGA B149.1 Natural Gas and Propane Installation Code (latest editions). If the vent system must be resized, follow the appropriate tables in Appendix G of the above codes or for this appliance.

Inspections Division
Date: 02/18/14

FIGURE 39: Attic and Crawl Space Combustion Air Termination

Specially Engineered Installations

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

⚠WARNING

Be sure to instruct the owner not to block this intake pipe.

VENT BLOWER ROTATION

For ease of venting, the vent blower may be rotated 90° in either direction. For upflow installations the vent may exit through the top or either side of the cabinet. For downflow installations, the vent blower must be rotated so that the vent exits through either side of the cabinet. See Figures 24-27 for details.

SECTION VIII: START-UP AND ADJUSTMENTS

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

IMPORTANT

All electrical connections made in the field and in the factory should be checked for proper tightness.

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

GAS PIPING LEAK CHECK

⚠WARNING

FIRE OR EXPLOSION HAZARD

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

Never test for gas leaks with an open flame. Use a commercially available soap solution made specifically for the detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury or loss of life.

IMPORTANT

Burner ignition may not be satisfactory on first startup due to residual air in the gas line or until gas manifold pressure is adjusted. The ignition control will make three attempts to light before locking out.

It is recommended that when the gas supply is first connected to the furnace, the ground union be loosened until the odor of gas is detected. When gas is detected, immediately tighten the union and check for gas leaks. Allow five minutes for any gas to dissipate before continuing with the startup procedure. Be sure that proper ventilation is available to dilute and carry away any vented gas.

With furnace in operation, check all of the pipe joints, gas valve connections and manual valve connections for leakage using an approved gas detector, a non-corrosive leak detection fluid or other leak detection methods. Take appropriate action to stop any leak. If a leak persists, replace the faulty component.

The furnace and its equipment shutoff valve must be disconnected from the gas supply during any pressure testing of that system at test pressures in excess of 0.5 psig (3.45 kPa).

The furnace must be isolated from the gas supply piping system by closing the equipment shutoff valve during any pressure testing of the gas supply system.

IGNITION SYSTEM SEQUENCE

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

⚠WARNING

HOT SURFACE IGNITION SYSTEM

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

CALCULATING THE FURNACE INPUT (NAT. GAS)

Burner orifices are sized to provide proper input rate using natural gas with a heating value of 1030 BTU/Ft^3 (38.4 MJ/m^3). If the heating value of your gas is significantly different, it may be necessary to replace the orifices.

NOTICE

DO NOT *set manifold pressure less than 3.2” w.c. or more than 3.8” w.c. for natural gas at sea level. If manifold pressure is outside this range, change main burner orifices.*

NOTICE

If orifice hole appears damaged or it is suspected to have been redrilled, check orifice hole with a numbered drill bit of correct size. Never redrill an orifice. A burr-free and squarely aligned orifice hole is essential for proper flame characteristics.

⚠CAUTION

DO NOT *bottom out gas valve regulator adjusting screw. This can result in unregulated manifold pressure and result in excess overfire and heat exchanger failures.*

Inspections Division
Date: 02/18/14

ify natural gas input rate by clocking meter.

1. Turn off all other gas appliances and pilots.
2. Run furnace for a minimum of 3 minutes in heating operation.
3. Measure time (in sec) for gas meter to complete 1 revolution and note reading. The 2 cubic feet dial provides a more accurate measurement of gas flow.
4. Refer to Table 15 for cubic feet of gas per hour.
5. Multiply cubic feet per hour by heating valve (BTU/cu ft) to obtain input.

If clocked rate does not match the input rate from the unit nameplate. follow steps in next section to adjust the manifold pressure. Repeat steps 2 - 5 until correct input is achieved.

CAUTION

Be sure to relight any gas appliances that were turned off at the start of this input check.

Table 15: Gas Rate (CU FT/HR) at Full Input

Seconds For 1 Revolution	Size of Test Dial		
	1 Cu Ft	2 Cu Ft	5 Cu Ft
10	360	720	1800
11	327	655	1636
12	300	600	1500
13	277	555	1385
14	257	514	1286
15	240	480	1200
16	225	450	1125
17	212	424	1059
18	200	400	1000
19	189	379	947
20	180	360	900
21	171	343	857
22	164	327	818
23	157	313	783
24	150	300	750
25	144	288	720
26	138	277	692
27	133	267	667
28	129	257	643
29	124	248	621
30	120	240	600
31	116	232	581
32	113	225	563
33	109	218	545
34	106	212	529
35	103	206	514
36	100	200	500
37	97	195	486
38	95	189	474
39	92	185	462
40	90	180	450
41	88	176	439
42	86	172	429
43	84	167	419
44	82	164	409
45	80	160	400
46	78	157	391
47	76	153	383
48	75	150	375
49	73	147	367
50	72	144	360
51	71	141	355
52	69	138	346
53	68	136	340
54	67	133	333

Seconds For 1 Revolution	Size of Test Dial		
	1 Cu Ft	2 Cu Ft	5 Cu Ft
55	65	131	327
56	64	129	321
57	63	126	316
58	62	124	310
59	61	122	305
60	60	120	300
62	58	116	290
64	56	112	281
66	54	109	273
68	53	106	265
70	51	103	257
72	50	100	250
74	48	97	243
76	47	95	237
78	46	92	231
80	45	90	225
82	44	88	220
84	43	86	214
86	42	84	209
88	41	82	205
90	40	80	200
92	39	78	196
94	38	76	192
96	38	75	188
98	37	74	184
100	36	72	180
102	35	71	178
104	35	69	173
106	34	68	170
108	33	67	167
110	33	65	164
112	32	64	161
116	31	62	155
120	30	60	150
124	29	58	145
128	28	56	141
133	27	54	135
138	26	52	130
144	25	50	125
150	24	48	120
157	23	46	115
164	22	44	110
171	21	42	105
180	20	40	100

Inspections Division
Date: 02/18/14

STMENT OF MANIFOLD GAS PRESSURE & RATE

Inlet and manifold gas pressure may be measured by connecting the "U" tube manometer to the gas valve with a piece of tubing. Follow the appropriate section in the instructions below. Refer to Figure 39 for a drawing of the locations of the pressure ports on the gas valve.

Turn gas off at the ball valve or gas cock on gas supply line before the gas valve. Find the pressure ports on the gas valve marked Out P and In P.

1. The manifold pressure must be taken at the port marked OUT P.
2. The gas line pressure must be taken at the port marked IN P.
3. Using a 3/32" (2.4 mm) Allen wrench, loosen the set screw by turning it 1 turn counter clockwise. DO NOT REMOVE THE SET SCREW FROM THE PRESSURE PORT.

Read the inlet gas pressure

Connect the positive side of the manometer to the IN P Tap on the gas valve. Do not connect any tubing to the negative side of the manometer, as it will reference atmospheric pressure. Refer to Figure 40 for connection details.

1. Turn gas and electrical supplies on and follow the operating instructions to place the unit back in operation.

Table 16: Inlet Gas Pressure Range

INLET GAS PRESSURE RANGE		
	Natural Gas	Propane (LP)
Minimum	4.5" w.c. (1.12 kPa)	8.0" w.c. (1.99 kPa)
Maximum	10.5" w.c. (2.61 kPa)	13.0" w.c. (3.24 kPa)

IMPORTANT

*The inlet gas pressure operating range table specifies what the minimum and maximum gas line pressures must be for the furnace to operate safely. The gas line pressure **MUST BE** a minimum of:*

- 7" w.c. (1.74 kPA) for Natural Gas
- 11" w.c. (2.74 kPA) for Propane (LP) Gas

in order to obtain the BTU input specified on the rating plate and/or the nominal manifold pressure specified in these instructions and on the rating plate.

2. Once the correct gas inlet pressure has been established, see Table 16, turn the gas valve to OFF and turn the electrical supply switch to OFF; then remove the flexible tubing from the gas valve pressure tap and tighten the pressure tap plug using the 3/32" (2.4 mm) Allen wrench.
3. Turn the electrical and gas supplies back on, and with the burners in operation, check for gas leakage around the gas valve pressure port for leakage using an approved non-corrosive gas leak detection fluid, or other non-flammable leak detection methods.

Read the manifold gas pressure

Connect the positive side of the manometer to the adapter previously installed in the OUT P Tap on the gas valve. Do not connect any tubing to the negative side of the manometer, as it will reference atmospheric pressure. Refer to Figure 40 for connection details.

IMPORTANT

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

NOTICE

The regulated outlet pressure has been calibrated at the factory. Additional pressure adjustment should not be necessary. If adjustment is necessary, set to the following specifications. After adjustment, check for gas leakage.

This gas valve has separate regulator adjustment screws for high fire and low fire, as shown in Figure 39. The procedure below is used to adjust either the high fire manifold pressure or the low fire manifold pressure.

1. Refer to Figure 39 for location of pressure regulator adjustment cap and adjustment screws on main gas valve.
2. Turn gas and electrical supplies on and follow the operating instructions to place the unit back in operation.
3. Adjust manifold pressure by adjusting gas valve regulator screw for the appropriate gas per the following:

Table 17: Nominal Manifold Pressure

NOMINAL MANIFOLD PRESSURE	
Natural Gas (High Fire)	3.5" w.c. (0.87 kPa)
Natural Gas (Low Fire)	1.6" w.c. (0.40 kPa)
Propane (LP) Gas (High Fire)	9.8" w.c. (2.488 kPa)
Propane (LP) Gas (Low Fire)	4.0" w.c. (0.99 kPa)

FIGURE 40: Gas Valve

IMPORTANT

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

4. After the manifold pressure has been adjusted, re-calculate the furnace input to make sure you have not exceeded the specified input on the rating plate. Refer to "CALCULATING THE FURNACE INPUT (NATURAL GAS)".
5. Once the correct BTU (kW) input has been established, turn the gas valve to OFF and turn the electrical supply switch to OFF; then remove the flexible tubing from the gas valve pressure tap and tighten the pressure tap plug using the 3/32" (2.4 mm) Allen wrench.
6. Turn the electrical and gas supplies back on, and with the burners in operation, check for gas leakage around the gas valve pressure port for leakage using an approved non-corrosive gas leak detection fluid, or other non-flammable leak detection methods.

FIGURE 41: Reading Gas Pressure

Inspections Division
Date: 02/18/14

ADJUSTMENT OF TEMPERATURE RISE

DANGER

The temperature rise, or temperature difference between the return air and the supply (heated) air from the furnace, must be within the range shown on the furnace rating plate and within the application limitations shown in Table 7 "ELECTRICAL AND PERFORMANCE DATA".

The supply air temperature cannot exceed the ***"Maximum Supply Air Temperature"*** *specified in these instructions and on the furnace rating plate. Under NO circumstances can the furnace be allowed to operate above the Maximum Supply Air Temperature. Operating the furnace above the Maximum Supply Air Temperature will cause premature heat exchanger failure, high levels of Carbon Monoxide, a fire hazard, personal injury, property damage, and/or death.*

After about 5 minutes of operation, determine the furnace temperature rise. Take readings of both the return air and the heated air in the ducts, about six feet (1.83 m) from the furnace where they will not be affected by radiant heat. Increase the blower speed to decrease the temperature rise; decrease the blower speed to increase the rise.

VARIABLE SPEED MOTORS

The variable speed motor must be configured so the blower will provide a sufficient airflow so that the furnace operates with in the temperature rise range on the rating plate and within the application limitations shown in Table 7 in these Instructions.

ADJUSTMENT OF FAN CONTROL SETTINGS

Heating Indoor Fan Off Delay

This furnace is equipped with a time-on/time-off heating fan control. The fan on delay is fixed at 30 seconds. The fan off delay has 4 settings (60, 90, 120 and 180 seconds). The fan off delay is factory set to 120 seconds. The fan-off setting must be long enough to adequately cool the furnace, but not so long that cold air is blown into the heated space. The fan-off timing may be adjusted by positioning the jumper on two of the four pins as shown in Figure 41.

FIGURE 42: Furnace Control Board

Inspections Division
Date: 02/18/14

3: Air Flow Data

HIGH / LOW SPEED COOLING AND HEAT PUMP CFM							
040A10		060B12		080B12		Jumper Settings	
High	Low	High	Low	High	Low	COOL Tap	ADJ Tap*
1080	750	1343	865	1320	882	A	B
960	680	1116	727	1093	755	B	B
980	690	1235	791	1203	810	A	A
870	620	1026	661	1001	693	B	A
890	620	1079	709	1080	730	A	C
770	550	889	590	880	641	C	B
790	560	900	599	910	642	B	C
650	480	787	531	803	585	D	B
700	500	814	542	836	597	C	A
590	440	712	490	738	557	D	A
640	450	725	499	749	561	C	C
540	400	641	456	682	529	D	C
080C16		100C16		100C20		Jumper Settings	
High	Low	High	Low	High	Low	COOL Tap	ADJ Tap*
1787	1171	1818	1192	2019	1290	A	B
1503	987	1545	1030	1790	1174	B	B
1620	1053	1661	1083	1818	1195	A	A
1405	914	1427	936	1630	1068	B	A
1462	964	1497	991	1649	1082	A	C
1217	785	1234	819	1269	848	C	B
1245	818	1265	832	1432	956	B	C
940	608	977	648	1078	704	D	B
1091	702	1116	728	1169	770	C	A
852	551	884	572	986	638	D	A
983	626	1019	666	1062	685	C	C
764	544	791	519	866	576	D	C
				120D20		Jumper Settings	
				High	Low	COOL Tap	ADJ Tap*
				2006	1397	A	B
				1687	1131	B	B
				1845	1282	A	A
				1552	1050	B	A
				1694	1157	A	C
				1502	1011	C	B
				1400	944	B	C
				1365	922	D	B
				1364	931	C	A
				1232	808	D	A
				1225	808	C	C
				1117	718	D	C
HIGH / LOW HEAT CFM							
040A10		060B12		80B12		Jumper Settings	
High	Low	High	Low	High	Low	HEAT Tap	ADJ Tap*
960	670	1364	843	1433	945	A	Any
840	590	1253	745	1320	887	B	Any
740	520	1102	660	1223	840	C	Any
640	450	1014	607	1134	768	D	Any
80C16		100C16		100C20		Jumper Settings	
High	Low	High	Low	High	Low	HEAT Tap	ADJ Tap*
1684	1095	1803	1182	2194	1417	A	Any
1542	1011	1686	1084	1999	1290	B	Any
1426	927	1530	1016	1799	1182	C	Any
1289	832	1427	936	1614	1062	D	Any
				120D20		Jumper Settings	
				High	Low	HEAT Tap	ADJ Tap*
				1937	1323	A	Any
				1757	1199	B	Any
				1594	1062	C	Any
				1429	957	D	Any

All CFM's are shown at 0.5" w.c. external static pressure.These units have variable speed motors that automatically adjust to provide constant CFM from 0.0" to 0.6" w.c. static pressure. From 0.6" to 1.0" static pressure, CFM is reduced by 2% per 0.1" increase in static. Operation on duct systems with greater than 1.0" w.c. external static pressure is not recommended.

NOTE: At some settings, LOW COOL and/or LOW HEAT airflow may be lower that what is required to operate an airflow switch on certain models of electronic air cleaners. Consult the instructions for the electronic air cleaner for further details.

* The ADJ "D" tap should not be used.

Inspections Division
Date: 02/18/14

SECTION IX: SAFETY CONTROLS

CONTROL CIRCUIT FUSE

A 3-amp fuse is provided on the control circuit board to protect the 24-volt transformer from overload caused by control circuit wiring errors. This is an ATO 3, automotive type fuse and is located on the control board.

BLOWER DOOR SAFETY SWITCH

⚠CAUTION

Main power to the unit must still be interrupted at the main power disconnect switch before any service or repair work is to be done to the unit. Do not rely upon the interlock switch as a main power disconnect.
Blower and burner must never be operated without the blower panel in place.

This unit is equipped with an electrical interlock switch mounted in the burner compartment. This switch interrupts all power at the unit when the panel covering the blower compartment is removed.

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

ROLLOUT SWITCH CONTROLS

These controls are mounted on the burner assembly. If the temperature in the area surrounding burner exceeds its set point, the gas valve is de-energized. The operation of this control indicates a malfunction in the combustion air blower, heat exchanger or a blocked vent pipe connection. Corrective action is required. These are manual reset controls that must be reset before operation can continue.

PRESSURE SWITCHES

This furnace is supplied with three pressure switches, which monitor the flow through the combustion air/vent piping and condensate drain system. These switches de-energize the gas valve if any of the following conditions are present. Refer to SECTION VI, "CONDENSATE PIPING AND FURNACE VENTING CONFIGURATION" for tubing connections.

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

LIMIT CONTROLS

There is a high temperature limit control located on the furnace vestibule panel near the gas valve. This is an automatic reset control that provides over temperature protection due to reduced airflow. This may be caused by:

1. A dirty filter.
2. If the indoor fan motor should fail.
3. Too many supply or return registers closed or blocked off.

The control module will lockout if the limit trips 5 consecutive times. If this occurs, control will reset & try ignition again after 1 hour.

SECTION X: NORMAL OPERATION AND DIAGNOSTICS

NORMAL OPERATION SEQUENCE

Heating and Cooling Airflow

The heating and the cooling airflows are preset at the factory. The heating airflow is set to the maximum CFM. The cooling airflow is set to provide 90 percent of the maximum CFM. The heating and cooling airflows must be field adjusted to match the HVAC system at installation. See Table 18 for the HEAT, COOL and ADJ jumper settings to use for specific airflows.

CFM Board - Delay Taps Selection

The set of jumper pins on the control board labeled DELAY are used to set the delay profiles for the furnace. These can be chosen so as to maximize the comfort and sound levels for various regions of the country.

Tap A is the default profile. It provides a 30-second ramp-up from zero airflow to full capacity and a 30-second ramp-down from full capacity back to zero airflow. Whenever there is a change in airflow mode, such as from low heat to high heat, the motor will take 30 seconds to ramp from one speed to the other.

Tap B is the humid profile. This profile is best-suited for installations where the humidity is frequently very high during cooling season, such as in the southern part of the country. On a call for cooling, the blower will ramp up to 50% of full capacity and will stay there for two minutes, then will ramp up to 82% of full capacity and will stay there for five minutes, and then will ramp up to full capacity, where it will stay until the wall thermostat is satisfied. In every case, it will take the motor 30 seconds to ramp from one speed to another.

Tap C is the dry profile. This profile is best suited to parts of the country where excessive humidity is not generally a problem, where the summer months are usually dry. On a call for cooling the motor will ramp up to full capacity and will stay there until the thermostat is satisfied. At the end of the cooling cycle, the blower will ramp down to 50% of full capacity where it will stay for 60 seconds. Then it will ramp down to zero. In every case, it will take the motor 30 seconds to ramp from one speed to another.

Tap D is the normal profile, best suited for most of the country, where neither excessive humidity nor extremely dry conditions are the norm. On a call for cooling, the motor will ramp up to 63% of full capacity and will stay there for 90 seconds, then will ramp up to full capacity. At the end of the cooling cycle, the motor will ramp down to 63% of full capacity and will stay there for 30 seconds, then will ramp down to zero. In every case, it will take the motor 30 seconds to ramp from one speed to another.

Continuous Blower Operation

The blower will run continuously whenever the wall thermostat fan switch is in the ON position. The furnace blower will run at the speed selected on the FAN SPEED jumpers on the main control board (HI COOL, LO COOL, HI HEAT or LO HEAT). When the jumper is in the VS G position, the blower will run at 50% of the high cool speed.

Intermittent Blower Cooling

On cooling/ heating thermostats with a fan switch, when the fan switch is set in the auto position and the thermostat calls for cooling, a circuit is completed between the R, Y and G terminals. The motor is energized through the Y1 cool terminal and runs on the speed selected on the COOL tap of the control board. The fan off setting is fixed at 60 seconds for SEER enhancement. The control board can accommodate two-stage cooling. When a two-stage cool thermostat is connected to the Y1 and Y2 terminals on the board, the blower will operate on LOW COOL speed when Y1 is energized and on HI COOL speed when Y1 and Y2 are energized.

Intermittent Blower Heating

On cooling/ heating thermostats with a fan switch, when the fan switch is set in the auto position and the thermostat calls for heating, a circuit is completed between the R and W terminals. The indoor fan motor is energized through the W1 heat terminal and runs on the speed selected on the HEAT tap of the control board.

Humidistat

When a humidistat is installed in the system, the “Humidistat Installed?” jumper on the control board should be moved to the YES position.
The cooling CFM will then be reduced by 15% whenever the humidistat indicates high humidity.

Inspections Division
Date: 02/18/14

g Cycle

When the thermostat switch is set on HEAT and the fan is set on AUTO, and there is a call for heat, a circuit is completed between terminals R and W of the thermostat. When the proper amount of combustion air is being provided, the pressure switch will close, the ignition control provides a 17-second ignitor warm-up period, the gas valve then opens, the gas starts to flow, ignition occurs and the flame sensor begins its sensing function. The blower motor will energize 30 seconds after the gas valve opens, if a flame is detected. Normal furnace operation will continue until the thermostat circuit between R and W is opened, which causes the ignition system and gas valve to de-energize and the burner flames to be extinguished. The vent motor will operate for 15 seconds and the blower motor will operate for the amount of time set by the fan-off delay jumper located on the control board. See Figure 41. The heating cycle is now complete, and ready for the start of the next heating cycle.

If the flame is not detected within 7 seconds of the gas valve opening, the gas valve is shut off and a retry operation begins. Also, if the flame is lost for 2 seconds during the 10-second stabilization period, the gas valve is shut off and a retry operation begins. During a retry operation, the vent motor starts a 15 second inter-purge and the ignitor warm-up time is extended to 27 seconds. If the flame is established for more than 10 seconds after ignition during a retry, the control will clear the ignition attempt (retry) counter. If three retries occur during a call for heat, the furnace will shut down for one hour. If at the end of the one hour shut down there is a call for heat, the furnace will initiate a normal start cycle. If the problem has not been corrected the furnace will again lockout after three retries.

A momentary loss of gas supply, flame blowout, or a faulty flame probe circuit will result in a disruption in the flame and be sensed within 1.0 seconds. The gas valve will de-energize and the control will begin a recycle operation. A normal ignition sequence will begin after a 15 second inter-purge. If during the five recycles the gas supply does not return, or the fault condition is not corrected the ignition control will lockout for 60 minutes.

During burner operation, a momentary loss of power for 50 milliseconds or longer will de-energize the gas valve. When the power is restored, the gas valve will remain de-energized and the ignition sequence will immediately restart.

TROUBLESHOOTING

The following visual checks should be made before troubleshooting:

1. Check to see that the power to the furnace and the ignition control module is ON.
2. The manual shut-off valves in the gas line to the furnace must be open.
3. Make sure all wiring connections are secure.
4. Review the sequence of operation. Start the system by setting the thermostat above the room temperature. Observe the system's response. Then use the troubleshooting section in this manual to check the system's operation.

⚠WARNING

Never bypass any safety control to allow furnace operation. To do so will allow furnace to operate under potentially hazardous conditions.
Do not try to repair controls. Replace defective controls with UPG Source 1 Parts.
Never adjust pressure switch to allow furnace operation.

FURNACE CONTROL DIAGNOSTICS

The furnace has built-in, self-diagnostic capability. A blinking LED light on the control board can flash red, green or amber to indicate various conditions. The control continuously monitors its own operation and the operation of the system. If a failure occurs, the LED light will indicate the failure code.

The SLOW flash speed is two seconds on and two seconds off.

The other flash codes listed below have the following timing: LED light will turn on for 1/3 second and off for 1/3 second. This pattern will be repeated the number of times equal to the code. There will be a two-second pause between codes. For example, the six red flash code will flash the LED light on and off six times, then will be off for two seconds. This pattern will repeat as long as the fault condition remains. The continuous flash codes listed below will flash the LED light on and off continuously, with no breaks or longer pauses.

SLOW GREEN FLASH: Normal operation, no thermostat calls.

SLOW AMBER FLASH: Normal operation with call for heat.

LED STEADY OFF – If the LED light does not flash at all, check for power to the board and check for a blown fuse on the board. If the board is properly powered and the fuse is not blown, the control board may need to be replaced.

STEADY ON ANY COLOR: Control failure. Turn power to the furnace off and back on. If the fault code returns, the control board must be replaced. The control board is not field-repairable.

CONTINUOUS AMBER FLASH: Flame sense current is below 1.5 microamps. Check and clean flame sensor. Check for proper gas flow. Verify that current is greater than 1.5 microamps at flame current test pad.

1 RED FLASH: This indicates that flame was sensed when there was not a call for heat. The control will turn on both the inducer motor and supply air blower. Check for a leaking or slow-closing gas valve.

2 RED FLASHES: This indicates that the pressure switch is closed when it should be open. The control confirms that the pressure switch contacts are open at the beginning of each heat cycle and will not let the ignition sequence continue if the pressure switch contacts are closed when they should be open. Check for a faulty pressure switch or miswiring.

3 RED FLASHES: This indicates the pressure switch contacts are open when they should be closed. Check for faulty inducer, blocked vent pipe, broken pressure switch hose, disconnected pressure switch or inducer wires or faulty pressure switch.

4 RED FLASHES: This indicates that the main limit switch has opened its normally closed contacts. The control will turn on the supply air blower and inducer. Check for a dirty filter, improperly sized duct system, incorrect blower speed setting, incorrect firing rate, loose limit switch wiring or faulty blower motor.

If the limit switch has not closed within five minutes, the control will assume that the blower is not functioning, will start a hard lockout and will begin to flash the 11 Red Flashes error code. If, after fifteen minutes, the main limit still has not closed, the control will assume that a manual-reset rollout switch has opened and will begin to flash the 5 Red Flash error code. See the description of "5 Red Flashes" and "11Red Flashes" below.

If the main limit switch opens five times within a single call for heat, the control will indicate 4 Red Flashes and will enter a one-hour soft lockout.

Inspections Division
Date: 02/18/14

ED FLASHES: This fault is indicated if the limit circuit is open for more than fifteen minutes, usually indicating that a manual-reset rollout switch has opened. Check for proper combustion air, proper inducer operation, and primary heat exchanger failure or burner problem. The control will enter a hard lockout and power will have to be cycled off and on to reset the control after the problem has been corrected.

6 RED FLASHES: This indicates that while the unit was operating, the pressure switch opened four times during the call for heat. Check for faulty inducer, blocked vent pipe or faulty pressure switch. The furnace will lock out for one hour and then restart.

7 RED FLASHES: This fault code indicates that the flame could not be established during three trials for ignition. Check that the gas valve switch is in the ON position. Check for low or no gas pressure, faulty gas valve, dirty or faulty flame sensor, faulty hot surface ignitor, loose wires or a burner problem. The furnace will lock out for one hour and then restart.

8 RED FLASHES: This fault is indicated if the flame is lost five times (four recycles) during the heating cycle. Check for low gas pressure, dirty or faulty flame sensor or faulty gas valve. The furnace will lock out for one hour and then restart.

9 RED FLASHES: Indicates reversed line voltage polarity, grounding problem or reversed low voltage transformer wires. Both heating and cooling operations will be affected. Check polarity at furnace and branch. Check furnace grounding. Check that flame probe is not shorted to chassis. The furnace will not start the ignition sequence until this problem is corrected.

10 RED FLASHES: Gas valve energized with no call for heat. The main blower and inducer blower will run and no ignition sequence will be started as long as this condition exists. Check gas valve and gas valve wiring.

11 RED FLASHES: This indicates that the limit circuit has remained open for more than five minutes and less than fifteen minutes. This condition is usually caused by a failed blower motor or blower wheel. The control will enter a hard lockout and power will have to be cycled off and on to reset the control after the problem has been corrected.

13 RED FLASHES: This indicates that the high-fire pressure switch is open when it should be closed. Check for a partially blocked vent pipe or a loose or disconnected wire before replacing pressure switch.

4 AMBER FLASHES: The control is receiving a “Y” signal from the thermostat without a “G” signal. The furnace will operate normally in both heating and cooling, but this fault code will be displayed in order to alert the user that there is a wiring problem. Verify that the “G” wire from the thermostat is connected properly.

SOFT LOCKOUT: This control includes a soft lockout that will reset automatically after one hour. This provides protection to an unoccupied structure if a temporary condition exists causing a furnace malfunction. An example of this is a temporary interruption in gas supply that would prevent the furnace from lighting. The control will keep trying to light each hour and will resume normal operation if the gas supply is restored.

HARD LOCKOUT: Some fault conditions result in a hard lockout, which requires power to the control to be turned off and then back on to reset the control. The control will not automatically restart.

IGNITION CONTROL FLAME SENSE LEVELS
Normal flame sense current is approximately
3.7 microamps DC (μa)
Low flame signal warning starts at 1.5 microamps.
Low flame signal control lockout point is
0.1 microamps DC (μa)

DIAGNOSTIC FAULT CODE STORAGE AND RETRIEVAL

The control in this furnace is equipped with memory that will store up to five error codes to allow a service technician to diagnose problems more easily. This memory will be retained even if power to the furnace is lost. **This feature should only be used by a qualified service technician.**

If more than five error codes have occurred since the last reset, only the five most recent will be retained. The furnace control board has a button, labeled LAST ERROR that is used to retrieve error codes. This function will only work if there are no active thermostat signals. So any call for heating, cooling or continuous fan must be terminated before attempting to retrieve error codes.

To retrieve the error codes, push the LAST ERROR button. The LED on the control will then flash the error codes that are in memory, starting with the most recent. There will be a two-second pause between each flash code. After the error codes have all been displayed, the LED will resume the normal slow green flash after a five second pause. To repeat the series of error codes, push the button again.

If there are no error codes in memory, the LED will flash two green flashes. To clear the memory, push the LAST ERROR button and hold it for more than five seconds. The LED will flash three green flashes when the memory has been cleared and the button is released, then will resume the normal slow green flash after a five-second pause.

Inspections Division
Date: 02/18/14

'ION XI: REPLACEMENT PARTS LIST

DESCRIPTION
MOTOR
MOTOR, DIRECT DRIVE BLOWER
BLOWER, COMBUSTION 2-STAGE
ELECTRICAL
CAPACITOR, RUN
SWITCH, LIMIT
CONTROL, FURNACE 2-STAGE VS
IGNITER
SENSOR, FLAME
SWITCHES, PRESSURE
SWITCH, DOOR
TRANSFORMER
VALVE, GAS 2-STAGE
CONTROL, TEMPERATURE
AIR MOVING
HOUSING, BLOWER
WHEEL, BLOWER
FABRICATED PARTS
RESTRICTOR, COMBUSTION BLOWER
BURNER, MAIN GAS
BRACKET, IGNITER
SHELF, BLOWER
RAIL, BLOWER (2 Req'd)
BRACKET, BLOWER TRACK (2 Req'd)
HEAT EXCHANGER ASS'Y

DESCRIPTION
FABRICATED PARTS Continued
MANIFOLD, GAS
PAN, BOTTOM
PANEL, TOP
PANEL, DOOR (2 Req'd)
PANEL, BLOCKOFF
MISCELLANEOUS
ORIFICE, BURNER (Natural #45)
SIGHT GLASS, OVAL (2 Req'd)
GASKET, FOAM (Door) (1.5 ft req'd)
PAN, CONDENSATE
BRACKET, DOOR
HARNESS, WIRING
FERRULE (3 Req'd)
GROMMET (3 Req'd)
MOTOR MOUNT
TUBING, SILICON
HOSE, RAIN GUTTER
HOSE, CONDENSATE
PLUG, SEAL, 7/8"
PLUG, SEAL, 2-3/8"
PLUG, VENT PIPE
BAG, PARTS
KNOB, QUARTER TURN (4 Req'd)
DIAGRAM, WIRING 2-STAGE VS

REPLACEMENT PART CONTACT INFORMATION

This is a generic parts list. To request a complete parts list, refer to the contact information below:

- Visit our website at www.source1parts.com for the following information:
  1. Search for a part or browse the catalog.
  2. Find a dealer or distributor.
  3. Customer Service contact information.
     a. Click on the "Brand Links" button
     b. Click on the "Customer Service" button
- You can contact us by mail. Just send a written request to:

Johnson Controls Unitary Products
Consumer Relations
5005 York Drive
Norman, OK 73069

Inspections Division
Date: 02/18/14

ECTION XII: WIRING DIAGRAM

FIGURE 43: Wiring Diagram

Inspections Division
Date: 02/18/14

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