

DISPLAY THIS CARD ON PRINCIPAL FRONTAGE OF WORK



CITY OF PORTLAND BUILDING PERMIT



This is to certify that

DIRIGO CAPITAL HOLDINGS LLC /Air Temp

Located at

75 INDUSTRIAL WAY

PERMIT ID: 2012-65642

CBL: 327A A009001

has permission to **HVAC-Install York Gas Furnace in the office area and Solaronic Tube Heater in the warehouse area**

provided that the person or persons, firm or corporation accepting this permit shall comply with all of the provisions of the Statutes of Maine and of the Ordinances of the City of Portland regulating the construction, maintenance and use of the buildings and structures, and of the application on file in the department.

Notification of inspection and written permission procured before this building or part thereof is lathed or otherwise closed-in. 48 HOUR NOTICE IS REQUIRED.

A final inspection must be completed by owner before this building or part thereof is occupied. If a certificate of occupancy is required, it must be procured prior to occupancy.

Fire Prevention Officer

Janine Bonke

Code Enforcement Officer / Plan Reviewer

**THIS CARD MUST BE POSTED ON THE STREET SIDE OF THE PROPERTY
THERE IS A PENALTY FOR REMOVING THIS CARD**

City of Portland, Maine - Building or Use Permit Application

389 Congress Street, 04101 Tel: (207) 874-8703, Fax: (207) 874-8716

Permit No: 2012-65642	Issue Date:	CBL: 327A A009001
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Location of Construction: 75 INDUSTRIAL WAY	Owner Name: DIRIGO CAPITAL HOLDINGS LLC	Owner Address: 75 INDUSTRIAL WAY PORTLAND, ME 04103		Phone:
Business Name:	Contractor Name: Air Temp	Contractor Address: 11 Wallace Ave South Portland ME 04106		Phone (207) 774-2300
Lessee/Buyer's Name	Phone:	Permit Type: HVAC		Zone: IM
Past Use: Warehouse and offices	Proposed Use: Warehouse and offices	Permit Fee: \$80.00	Cost of Work: \$6,000.00	CEO District: 8
		FIRE DEPT: <input checked="" type="checkbox"/> Approved <input type="checkbox"/> Denied <input type="checkbox"/> N/A 1/23/13		INSPECTION: Use Group: B/S-2 Type: HVAC MURBEC 2009 Signature: JMB 1/17/13
Proposed Project Description: HVAC-Install York Gas Furnace in the office area and Solaronic Tube Heater in the warehouse area		Signature: <i>[Signature]</i> (58) PEDESTRIAN ACTIVITIES DISTRICT (P.A.D.) Action: <input type="checkbox"/> Approved <input type="checkbox"/> Approved w/Conditions <input type="checkbox"/> Denied Signature: _____ Date: _____		

Permit Taken By: bjs	Date Applied For: 12/18/2012	Zoning Approval		
1. This permit application does not preclude the Applicant(s) from meeting applicable State and Federal Rules. 2. Building permits do not include plumbing, septic or electrical work. 3. Building permits are void if work is not started within six (6) months of the date of issuance. False information may invalidate a building permit and stop all work..		Special Zone or Reviews <input type="checkbox"/> Shoreland <input type="checkbox"/> Wetland <input type="checkbox"/> Flood Zone <input type="checkbox"/> Subdivision <input type="checkbox"/> Site Plan Maj <input type="checkbox"/> Minor <input type="checkbox"/> MM <input type="checkbox"/> Date: <i>OK 12/19/12</i>	Zoning Appeal <input type="checkbox"/> Variance <input type="checkbox"/> Miscellaneous <input type="checkbox"/> Conditional Use <input type="checkbox"/> Interpretation <input type="checkbox"/> Approved <input type="checkbox"/> Denied Date: _____	Historic Preservation <input checked="" type="checkbox"/> Not in District or Landmark <input type="checkbox"/> Does Not Require Review <input type="checkbox"/> Requires Review <input type="checkbox"/> Approved <input type="checkbox"/> Approved w/Conditions <input type="checkbox"/> Denied Date: <i>Sub per MES</i>

CERTIFICATION

I hereby certify that I am the owner of record of the named property, or that the proposed work is authorized by the owner of record and that I have been authorized by the owner to make this application as his authorized agent and I agree to conform to all applicable laws of this jurisdiction. In addition, if a permit for work described in the application is issued, I certify that the code official's authorized representative shall have the authority to enter all areas covered by such permit at any reasonable hour to enforce the provision of the code(s) applicable to such permit.

SIGNATURE OF APPLICANT	ADDRESS	DATE	PHONE
RESPONSIBLE PERSON IN CHARGE OF WORK, TITLE		DATE	PHONE

BUILDING PERMIT INSPECTION PROCEDURES
Please call 874-8703 (ONLY)
or email: buildinginspections@portlandmaine.gov

With the issuance of this permit, the owner, builder or their designee is required to provide adequate notice to the city of Portland Inspections Services for the following inspections. Appointments must be requested 48 to 72 hours in advance of the required inspection. The inspection date will need to be confirmed by this office.

- **Please read the conditions of approval that is attached to this permit!! Contact this office if you have any questions.**
- **Permits expire in 6 months. If the project is not started or ceases for 6 months.**
- **If the inspection requirements are not followed as stated below additional fees may be incurred due to the issuance of a "Stop Work Order" and subsequent release to continue.**

REQUIRED INSPECTIONS:

Close-in/Elec./Plmb./Framing
Final Inspection

The project cannot move to the next phase prior to the required inspection and approval to continue, REGARDLESS OF THE NOTICE OF CIRCUMSTANCES.

IF THE PERMIT REQUIRES A CERTIFICATE OF OCCUPANCY, IT MUST BE PAID FOR AND ISSUED TO THE OWNER OR DESIGNEE BEFORE THE SPACE MAY BE OCCUPIED.

City of Portland, Maine - Building or Use Permit

389 Congress Street, 04101 Tel: (207) 874-8703, Fax: (207) 874-8716

Permit No: 2012-65642	Date Applied For: 12/18/2012	CBL: 327A A009001
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Location of Construction: 75 INDUSTRIAL WAY	Owner Name: DIRIGO CAPITAL HOLDINGS L	Owner Address: 75 INDUSTRIAL WAY	Phone:
Business Name:	Contractor Name: Air Temp	Contractor Address: 11 Wallace Ave South Portland	Phone (207) 774-2300
Lessee/Buyer's Name	Phone:	Permit Type: HVAC	

Proposed Use: Warehouse and offices	Proposed Project Description: HVAC-Install York Gas Furnace in the office area and Solaronic Tube Heater in the warehouse area
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Dept: Zoning	Status: Approved	Reviewer: Marge Schmuckal	Approval Date: 12/19/2012
Note:	Ok to Issue: <input checked="" type="checkbox"/>		

Dept: Building	Status: Approved w/Conditions	Reviewer: Jeanie Bourke	Approval Date: 01/17/2013
Note:	Ok to Issue: <input checked="" type="checkbox"/>		
<ol style="list-style-type: none"> 1) The appliance and venting shall be installed in accordance with the UL listing, manufacturer's specifications, and NFPA 211 2) The installation must comply with the State of Maine Gas Regulations. 3) Separate permits are required for any electrical, plumbing, sprinkler, fire alarm, HVAC systems, heating appliances, including pellet/wood stoves, commercial hood exhaust systems and fuel tanks. Separate plans may need to be submitted for approval as a part of this process. 			

Dept: Fire	Status: Approved w/Conditions	Reviewer: Ben Wallace Jr	Approval Date: 01/23/2013
Note:	Ok to Issue: <input checked="" type="checkbox"/>		
<ol style="list-style-type: none"> 1) Installation shall comply with City Code Chapter 10. 2) Fuel-fired boilers shall be protected in accordance with NFPA 101, Life Safety Code. 3) Installation shall comply with NFPA 211, Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances; NFPA 54, National Fuel Gas Code; NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems; NFPA 91, Standard for Exhaust Systems for Air Conveying Vapors, Gases, Mists, and Noncombustible Particulate Solids; NFPA 70, National Electrical Code; and the manufacturer's published instructions. 			

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FURNACE M# TG9S1200MP11

INSTALLATION MANUAL

RESIDENTIAL GAS FURNACE

MODELS: TG9S*MP, GG9S*MP

(95.5% AFUE Single Stage Multi-position)



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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.

SECTION 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 "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 55°F (13°C) and 80°F (27°C);
 - 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.
- 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 1R5

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.

FOR 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 32°F (0° C) could create a hazard, resulting in damage, injury or death.

2. Do not allow return air temperature to be below 55°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.

SECTION 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" (10.1 cm) attached to the plenum.

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" 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.

WARNING

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

Refer to Table 6 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.

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.

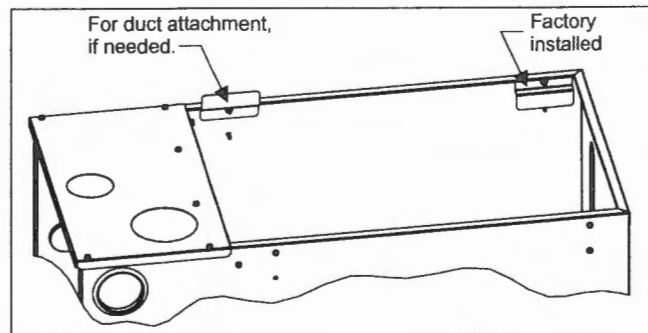
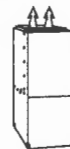


FIGURE 1: Duct Attachment

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.

COIL INSTALLATION

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

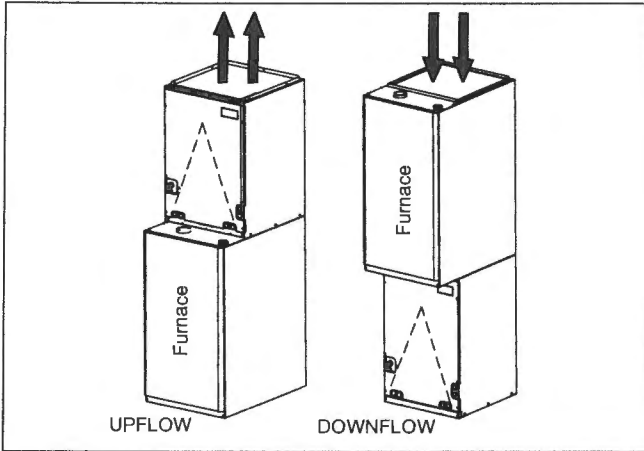


FIGURE 2: Vertical Applications

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.

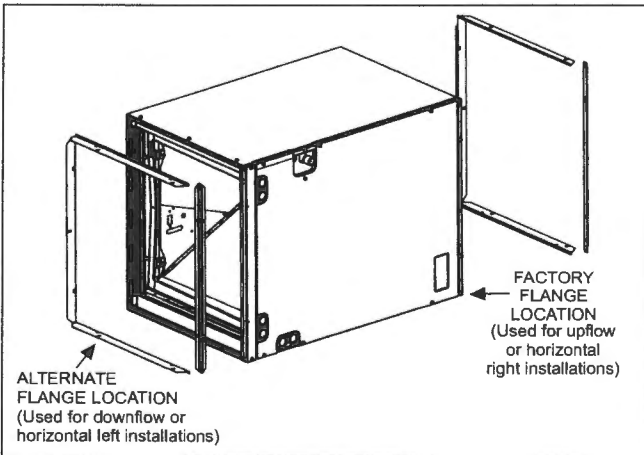


FIGURE 3: Coil Flange

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.

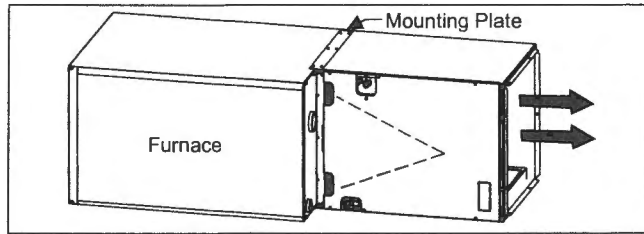


FIGURE 4: Horizontal Right Application

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.

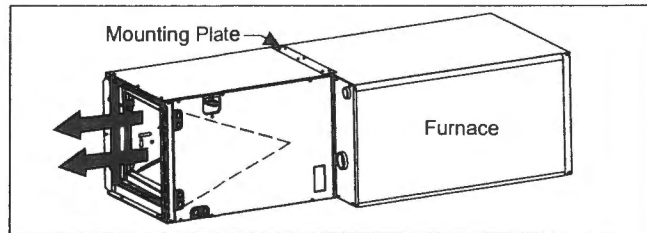


FIGURE 5: Horizontal Left Application

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.

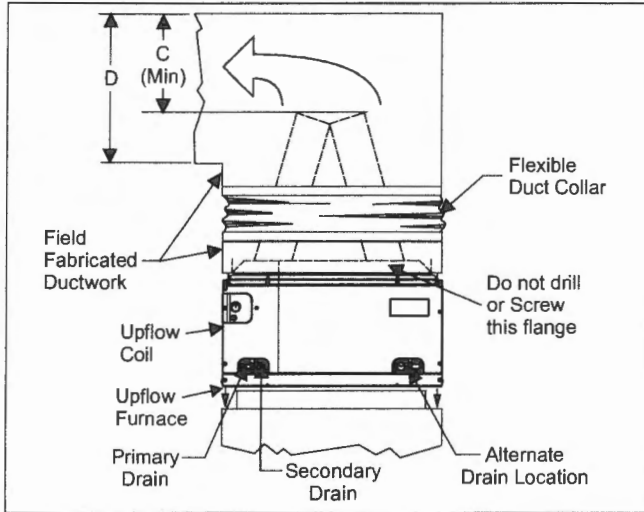


FIGURE 6: PC Series Upflow Coil Installation

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.

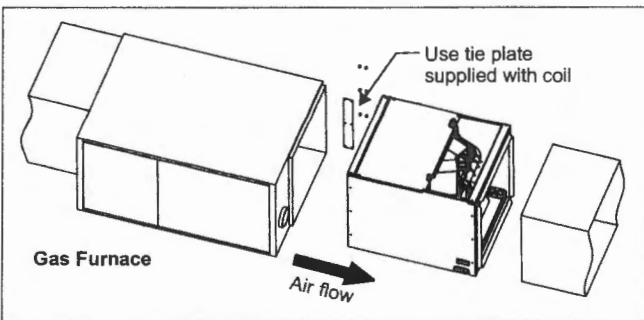


FIGURE 7: Horizontal Left or Right application (Right Shown)

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.

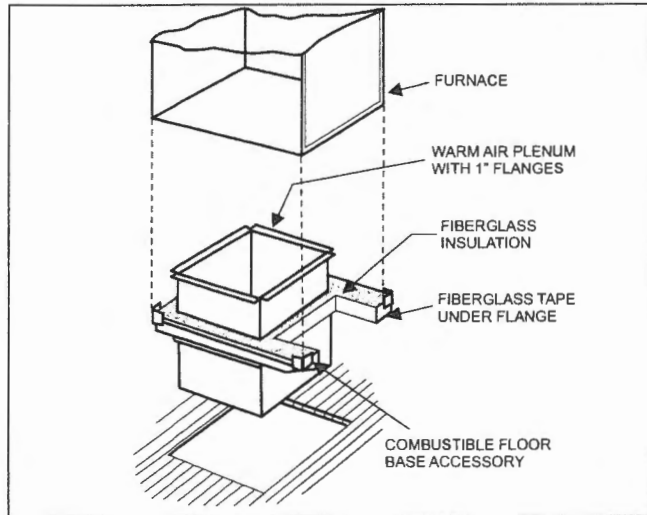


FIGURE 8: Combustible Floor Base Accessory

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.

HORIZONTAL APPLICATION

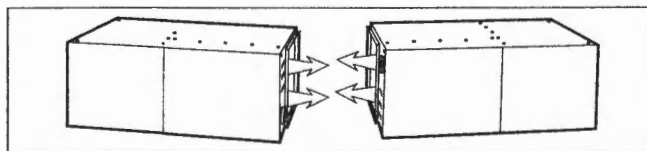


FIGURE 9: Horizontal Application

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

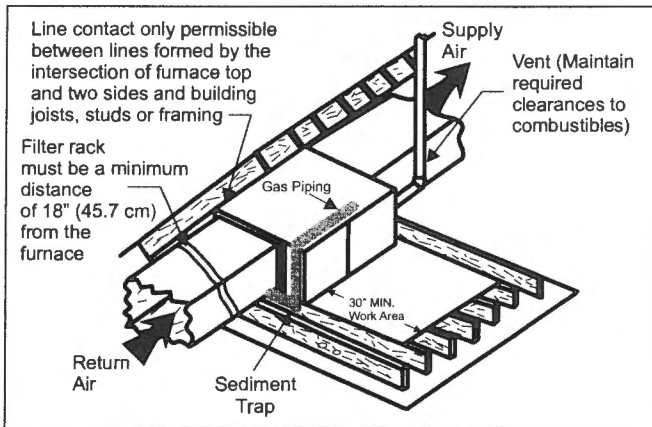


FIGURE 10: Typical Attic Installation

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 pads. Blocks or pad installations shall provide adequate height to ensure that 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. In all cases, the furnace should be supported with rods, straps, or angle supports at three locations to properly support the furnace. Place one support at the supply end of the furnace, one support located approximately in the center of the furnace near the blower shelf, and the third support should be at the return end of the furnace. Maintain a 6" (15.2 cm) minimum clearance between the front of the furnace and the support rods or straps.

All six suspension points must be level to ensure proper and quiet furnace operation. When suspending the furnace, use a secure platform constructed of plywood or other building materials secured to the floor or ceiling joists. Refer to Figure 11 for details and additional information.

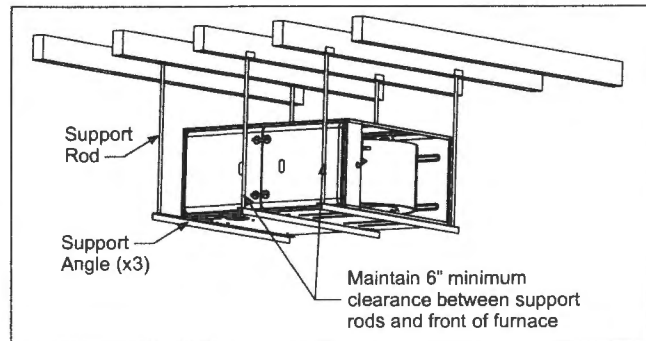


FIGURE 11: Typical Suspended Furnace / Crawl Space Installation

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.

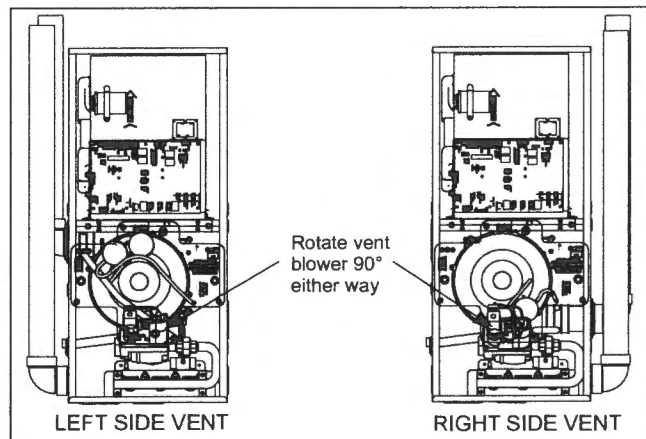


FIGURE 12: Downflow Venting

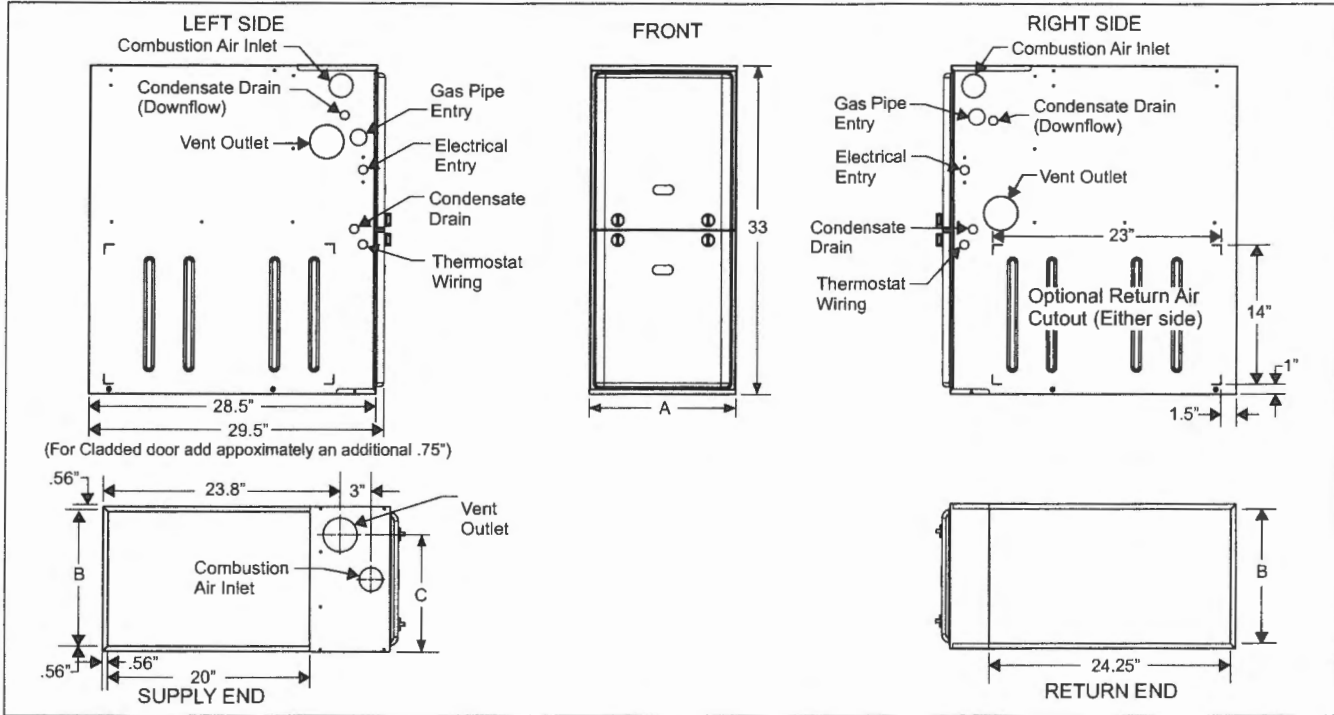


FIGURE 13: Dimensions

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)	800 (22.7)	A	14 1/2	36.8	13 3/8	34.0	11 3/4	29.8	113 (51.3)
60 (17.6)	1000 (28.3)	A	14 1/2	36.8	13 3/8	34.0	11 3/4	29.8	118 (53.5)
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 (57.2)
80 (23.4)	1600 (45.3)	C	21	53.3	19 7/8	50.5	16 1/2	41.9	136 (61.7)
80 (23.4)	2200 (62.3)	C	21	53.3	19 7/8	50.5	16 1/2	41.9	139 (63.0)
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)	1600 (45.3)	D	24 1/2	62.2	23 3/8	59.4	21 3/4	55.2	153 (69.4)
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)
130 (38.1)	2000 (56.6)	D	24 1/2	62.2	23 3/8	59.4	No Hole	No Hole	160 (72.5)

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)
800 (22.7)	A	16 x 25	14 x 25
1000 (28.3)	A	16 x 25	14 x 25
1200 (34.0)	A	16 x 25	14 x 25
1200 (34.0)	B	16 x 25	16 x 25
1600 (45.3)	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
2200 (62.3)	C	(2) 16 x 25	20 x 25
2000 (56.6)	D	(2) 16 x 25	22 x 25

- 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.
- 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.

SIDE 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.

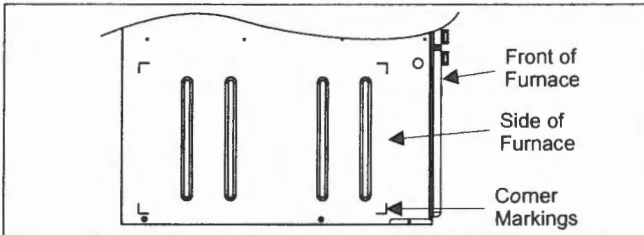


FIGURE 14: Side Return Cutout Markings

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.

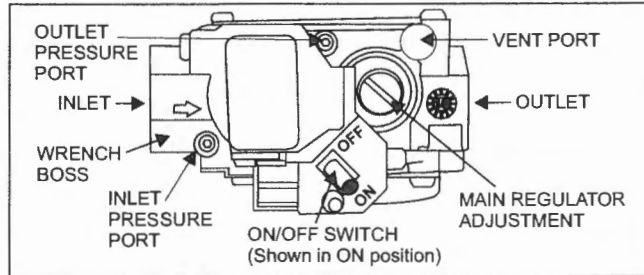


FIGURE 15: Gas Valve

IMPORTANT

Plan your gas supply before determining the correct gas pipe entry. Use 90° service elbow(s), or short nipples and conventional 90° 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.

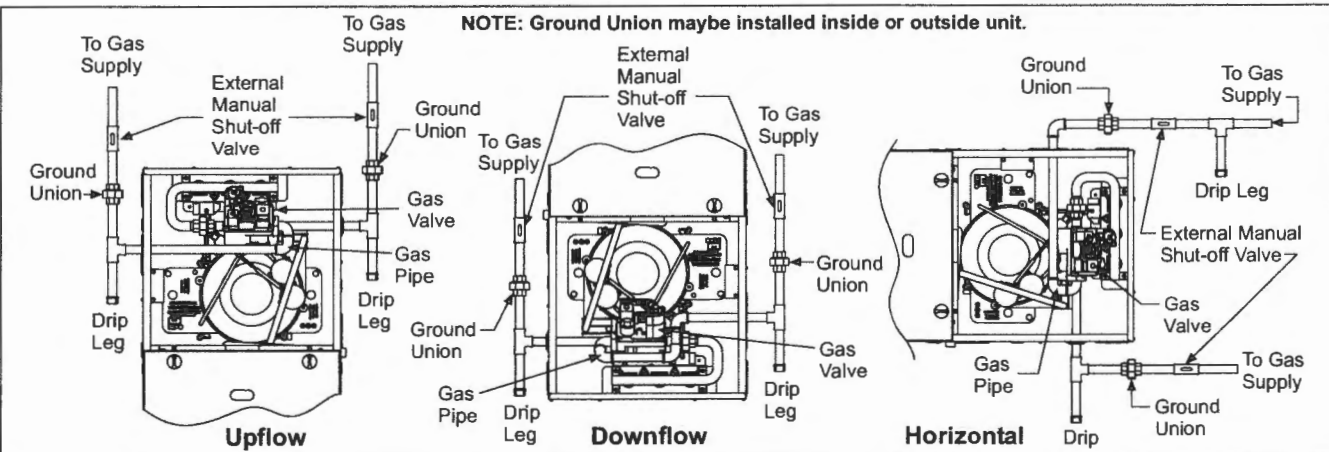


FIGURE 16: Gas Piping

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.)		
		Altitude (feet)		
		0-7999	8000-8999	9000-9999
Gas Heating Value (BTU/cu ft.)	800	3.5	3.5	3.5
	850	3.5	3.5	3.5
	900	3.5	3.5	3.5
	950	3.5	3.5	3.3
	1000	3.5	3.2	2.9
	1050	3.5	2.9	2.7
	1100	3.2	2.7	2.4
	2500 (LP)	9.8	8.2	7.5

		Manifold Pressures (kPa)		
		Altitude (m)		
		0-2437	2438-2742	2743-3048
Gas Heating Value (MJ/cu m)	29.8	0.87	0.87	0.87
	31.7	0.87	0.87	0.87
	33.5	0.87	0.87	0.87
	35.4	0.87	0.87	0.81
	37.3	0.87	0.80	0.73
	39.1	0.87	0.73	0.67
	41.0	0.80	0.66	0.61
	93.2 (LP)	2.44	2.03	1.86

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 satisfactorily 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.

SECTION V: ELECTRICAL POWER**ELECTRICAL POWER CONNECTIONS**

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 6 in these instructions for specific furnace electrical data.

CAUTION

Use copper conductors only.

Table 6: Ratings & Physical / Electrical Data

Input		Output		Nominal Airflow		AFUE %	Air Temp. Rise		Max. Outlet Air Temp		Blower		Blower Size	Max Over-Current Protect	Total Unit Amps	Min. wire Size (awg) @ 75 ft one way
MBH	KW	MBH	KW	CFM	m ³ /min		°F	°C	°F	°C	HP	Amps				
40	11.7	38	11.1	800	22.7	95.5	30-60	17-33	160	71.1	1/3	4.8	11x8	15	8.0	14
60	17.6	57	16.7	1000	28.3	95.5	30-60	19-36	160	71.1	1/2	7.07	11x8	15	10.0	14
60	17.6	57	16.7	1200	34.0	95.5	30-60	19-36	160	71.1	1/2	7.07	11x8	15	10.0	14
80	23.4	76	22.3	1200	34.0	95.5	35-65	19-36	165	73.9	1/2	7.07	11x8	15	10.0	14
80	23.4	76	22.3	1600	45.3	95.5	35-65	19-36	165	73.9	3/4	8.8	11x10	15	11.5	14
80	23.4	76	22.3	2200	62.3	95.5	35-65	19-36	165	73.9	1	14.5	11x11	20	17.0	12
100	29.3	95	27.8	1600	45.3	95.5	35-65	19-36	165	73.9	3/4	8.8	11x10	15	11.5	14
100	29.3	95	27.8	2000	56.6	95.5	35-65	19-36	165	73.9	1	14.5	11x11	20	17.0	12
120	35.1	114	33.4	1600	45.3	95.5	40-70	22-39	170	76.7	3/4	8.8	11x10	15	11.5	14
120	35.1	114	33.4	2000	56.6	95.5	35-65	19-36	165	73.9	1	14.5	11x11	20	17.0	12
130	38.1	123.5	36.2	2000	56.6	95.5	45-75	28-44	175	79.4	1	14.5	11x11	20	17.0	12

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

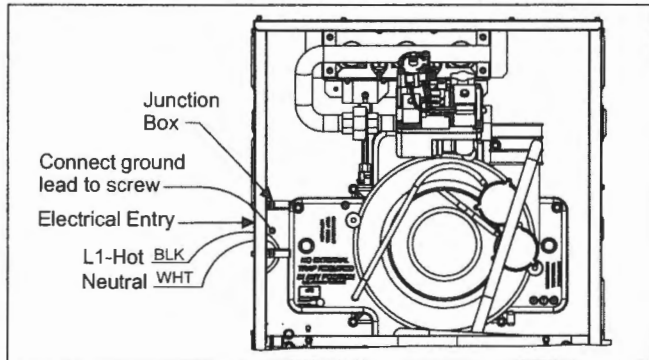


FIGURE 17: Electrical Wiring

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 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 Figure 17. 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.

For 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.

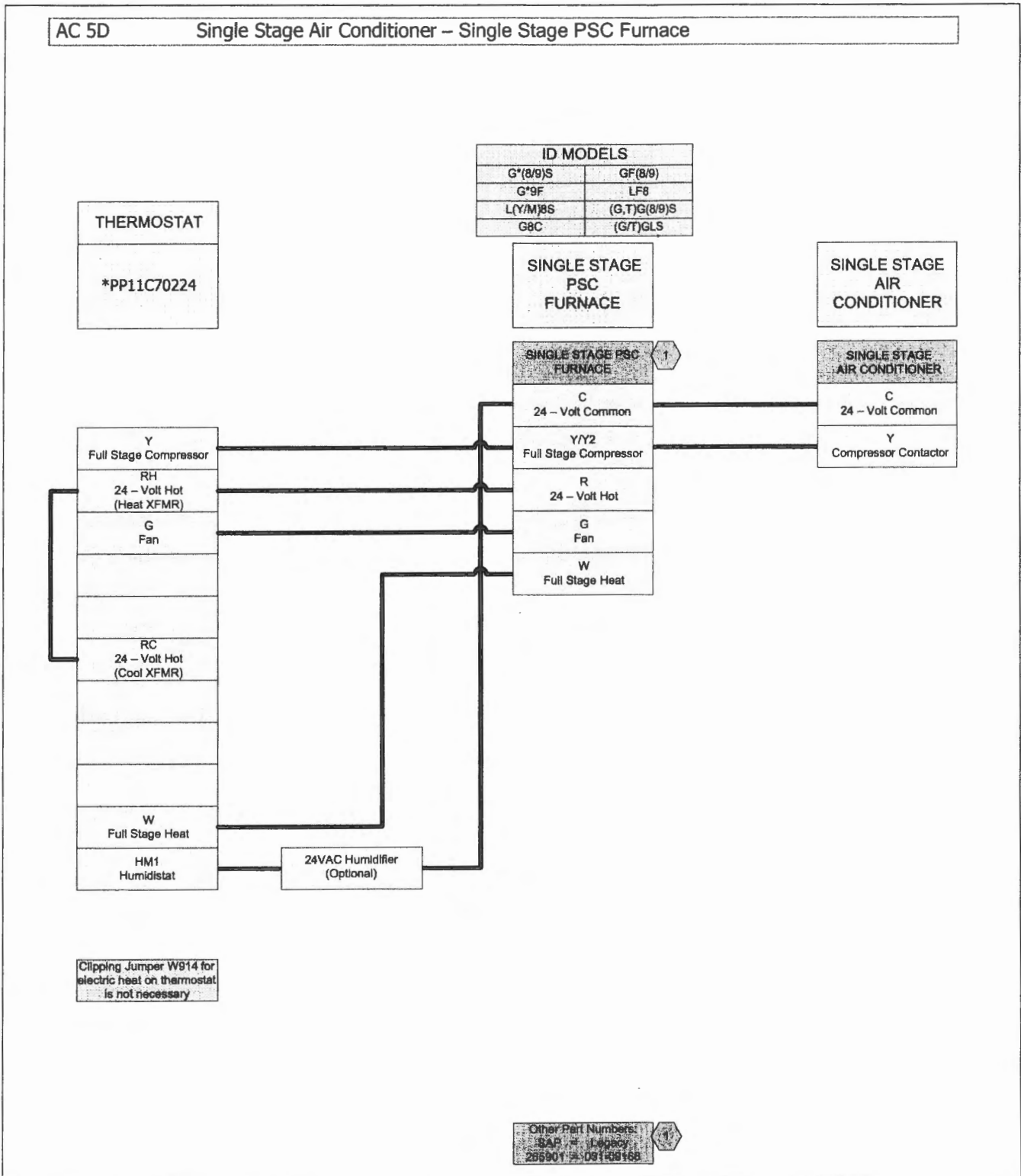


FIGURE 18: Thermostat Chart - Single Stage AC with Single Stage PSC Furnaces

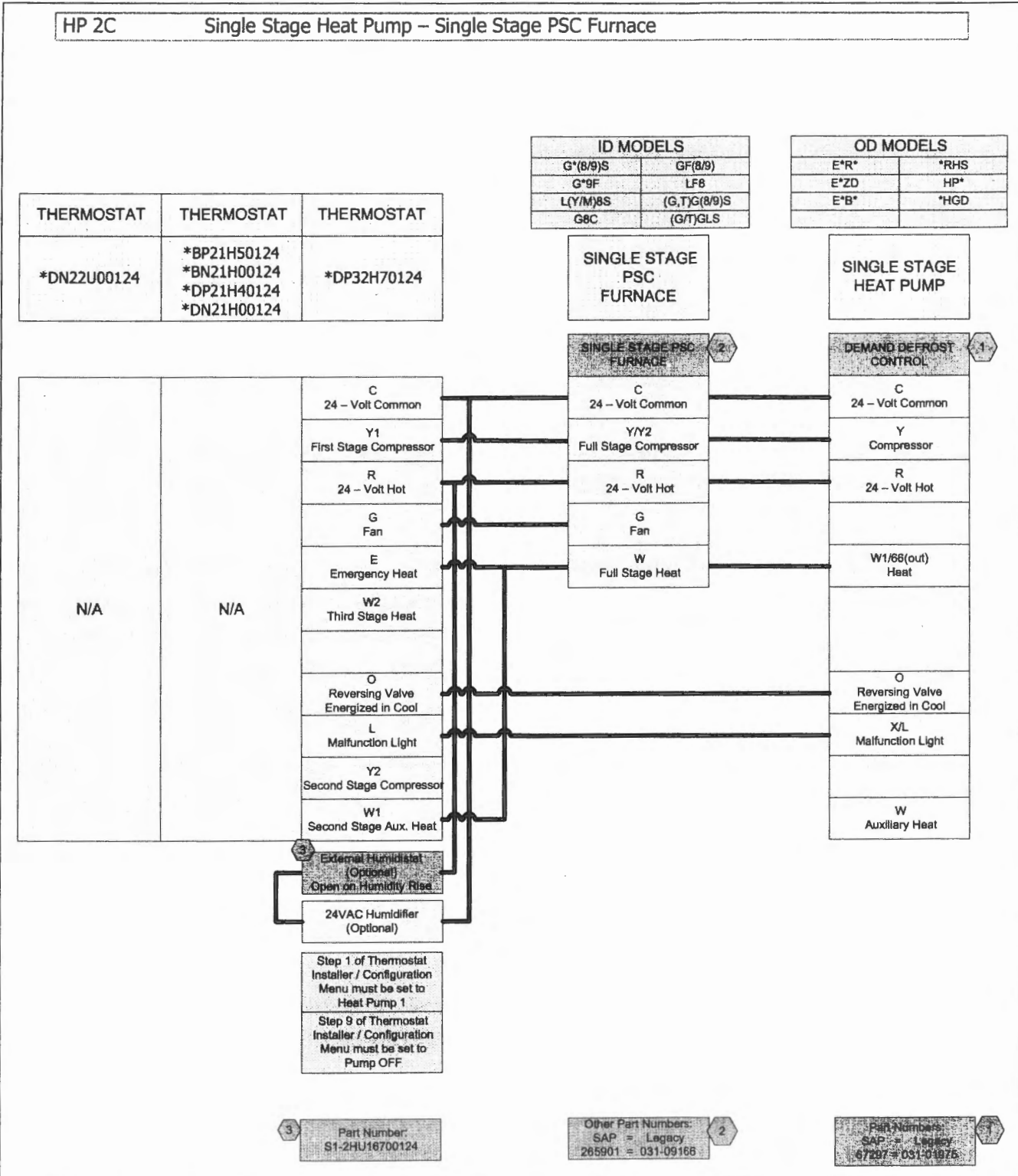


FIGURE 19: Thermostat Chart - Single Stage HP with Single Stage PSC Furnaces

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.

SECTION VI: TWINNING AND STAGING

In applications where more heating capacity or more airflow capacity is needed than what one furnace can deliver, twinning can be used to make two furnaces operate in tandem. When two furnaces are installed using the same duct system, it is very important that the two furnace circulating air blowers operate in unison. If one blower starts before the second blower, the duct system will become pressurized and the blower on the second furnace will turn backwards causing the second furnace to overheat, resulting in damage to the furnace. Twinning is used to make two furnaces operate in tandem, using one duct system, one room thermostat and causing both furnaces to turn on and off simultaneously.

WARNING

Before installing the relay and wiring, disconnect electrical power to both furnaces. Failure to cut power could result in electrical shock or equipment damage.

CAUTION

The relay must not be installed in any location where it could be exposed to water. If the relay has been exposed to water in any way, it must not be used.

TWINNING DUCT SYSTEM

Twinning furnaces must only be applied on a common duct system. A single air supply plenum must be used for both furnaces and coil(s). Separate plenums and supply ducts systems cannot be utilized. A single return air plenum, common to both furnaces must be used. It is suggested that a return platform be utilized, with bottom air entrance into each furnace. If a side entrance returns system is used, the common return duct must be divided equally so as to supply each furnace with an equal amount of return air.

Both furnaces must be identical models in both heating capacity and CFM capacity. Both furnaces must be operated on the same motor speed tap. See typical application, Figure 20.

If furnace staging is desired with two single stage furnaces on a common duct, where the gas burner on the first furnace operates on W1 and the gas burner on the second furnace operates on W2, then the use of an air-mixing device in the plenum to mix the air from both furnaces is strongly recommended. The mixing device must be installed before any ducts that supply air to occupied spaces. Twinning causes both indoor fans to operate simultaneously. If a mixing device is not used, any ducts that are connected down stream from the furnace that operates on W2, will be supplying cold air in the Heating mode to the occupied spaces unless W2 is energized.

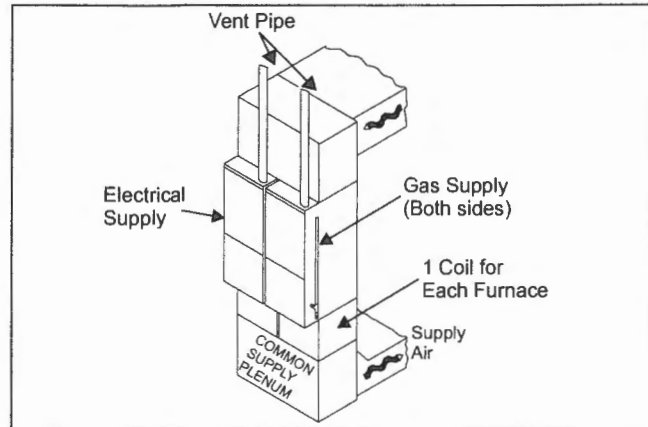


FIGURE 20: Typical Twinned Furnace Application

IMPORTANT

When two furnaces are twinned, typical system total airflow will be approximately 85% of additive individual furnaces, i.e., two 2000 CFM units will yield a total 3400 CFM.

CAUTION

If a return duct is connected to only one furnace (with a connection between the two furnaces) an imbalance in the airflow will occur and the furnace furthest from the return plenum will overheat.

GAS PIPING

Furnace gas supplies must be provided as specified with these instructions. Since the furnaces are side by side, with no space between, gas supplies must enter on the right and left respectively. All gas piping must be in accordance with the national fuel gas code, ANSI Z223.1, latest edition, and/or all local code or utility requirements.

TWINNING

In applications where more heating capacity or more airflow capacity is needed than what one furnace can deliver, twinning can be used to make two furnaces operate in tandem, using one duct system and one room thermostat. When one duct system is used for two furnaces, it is necessary that the two blowers operate in unison. The twinning function of the board in this furnace ensures that both blowers turn on and off simultaneously, and operate on the same blower speed.

The control in the furnace has the single-wire twinning feature. With this feature, a wire is connected between the TWIN terminal on one furnace board to the TWIN terminal on the second furnace board. The board then communicates the blower status from one furnace to the other along this wire. This communication makes the second furnace blower come on at the same time, and on the same speed, as the first furnace blower. To ensure stable communication, the common terminal of each control must be connected.

Twinning Instructions

Connect the control wiring as shown in Figure 21.

1. Connect the low voltage wiring from the wall thermostat to the terminal strip on the control board of Furnace #1.
2. Connect a wire from the TWIN terminal of Furnace #1 to the TWIN terminal of Furnace #2.
3. Install a separate 24V relay as shown in the diagram below. Use of this relay is required, as it ensures that the transformers of the two furnaces are isolated, thus preventing the possibility of any safety devices being bypassed.
4. Connect the 24V common wires of furnace #1 to the 24V common terminal of furnace #2.

Twinning Operation

Heating - On a call for heat (W signal) from the wall thermostat, both furnaces will start the ignition sequence and the burners on both furnaces will light. About thirty seconds after the burners light, the blowers on both furnaces will come on in heating speed. When the thermostat is satisfied, the burners will all shut off and, after the selected blower off delay time, both blowers will shut off at the same time. The twinning control ensures that both blowers come on and shut off at the same time.

Cooling - On a call for cooling (Y signal) from the wall thermostat, both furnace blowers will come on at the same time in cooling speed. When the thermostat is satisfied, both blowers will stay on for 60 seconds, then will shut off at the same time.

Continuous Fan - On a thermostat call for continuous fan (G signal), both furnace blowers will come on at the same time in cooling speed and will stay on until the G signal is removed.

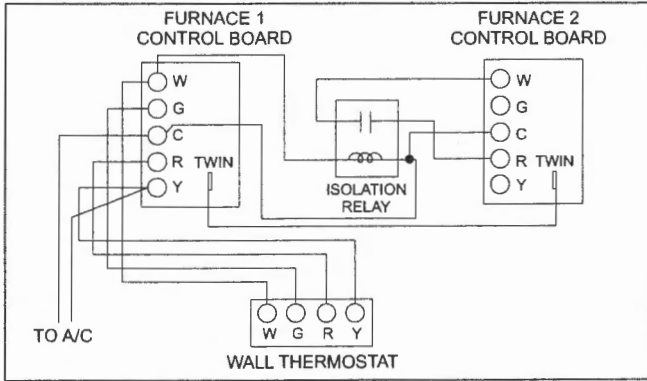


FIGURE 21: Twinning Wiring Diagram

STAGING

This control can also be used along with a two-stage wall thermostat to stage two twinned furnaces, making them operate like a single two-stage furnace. This allows only one furnace to supply heat during times when the heat output from one furnace is sufficient to satisfy the demand. When one duct system is used for two furnaces, it is necessary that the two blowers operate in unison. The twinning function of this board ensures that both blowers turn on and off simultaneously, and operate on the same blower speed. Even when only one furnace is supplying heat, both furnace blowers must run.

The twinning feature of this board can also be used for staging of two furnaces. With this feature, a single wire is connected between the TWIN terminal on one furnace board to the TWIN terminal on the second furnace board. The board then communicates the blower status from one furnace to the other along this wire. This communication makes the second furnace blower come on at the same time, and on the same speed, as the first furnace blower. To ensure stable communication, the common terminal of each control must be connected.

Staging Instructions

Connect the control wiring as shown in Figure 22.

1. Connect the low voltage wiring from the wall thermostat to the terminal strip on the control board of Furnace #1. For staging applications, the wire from thermostat W1 is connected to the W connection on the board on Furnace #1. The wire from thermostat W2 is connected to Furnace #2 through a separate relay, as described below.
2. Connect a wire from the TWIN terminal of Furnace #1 to the TWIN terminal of Furnace #2.
3. Install a separate 24V relay as shown in the diagram below. Use of this relay is required, as it ensures that the transformers of the two furnaces are isolated, thus preventing the possibility of any safety devices being bypassed.
4. Connect the 24V common between furnace #1 and furnace #2.

Staging Operation

Heating - On a call for first-stage heat (W1 signal) from the wall thermostat, Furnace #1 will start the ignition sequence and the burners will light. About thirty seconds after the burners light, the blowers on both furnaces will come on in heating speed. When the thermostat is satisfied, the burners will shut off and, after the selected blower off delay time, both blowers will shut off at the same time. On a call for second stage of heat, the burners of Furnace #2 will also light and both blowers will run. The twinning control ensures that both blowers come on and shut off at the same time.

Cooling - On a call for cooling (Y signal) from the wall thermostat, both furnace blowers will come on at the same time. When the thermostat is satisfied, both blowers will stay on for 60 seconds, then will shut off at the same time.

Continuous Fan - On a thermostat call for continuous fan (G signal), both furnace blowers will come on at the same time in cooling speed and will stay on until the G signal is removed.

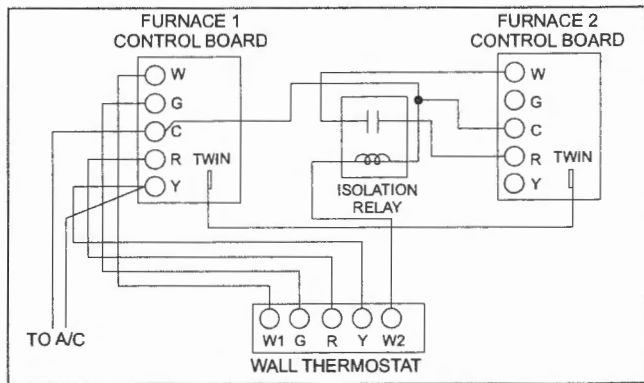


FIGURE 22: Staging Wiring Diagram

SECTION VII: 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 25 - 28 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 25 - 28), 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.

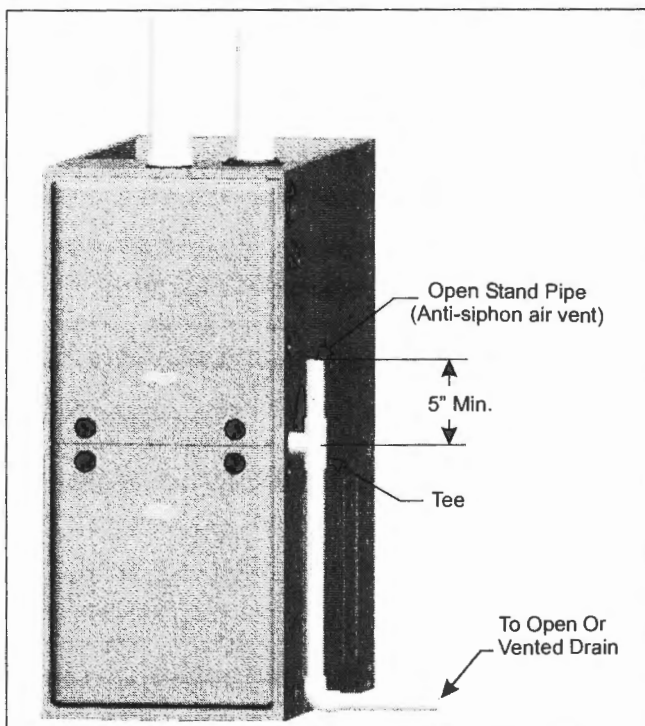


FIGURE 23: Typical. Condensate drain, vertical installation

The condensate will flow to the drain better if an open stand pipe is installed in the drain line. See Figure 23.

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.

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 24. This is true for all long horizontal venting in any furnace configuration. This will prevent the condensate from entering the furnace.

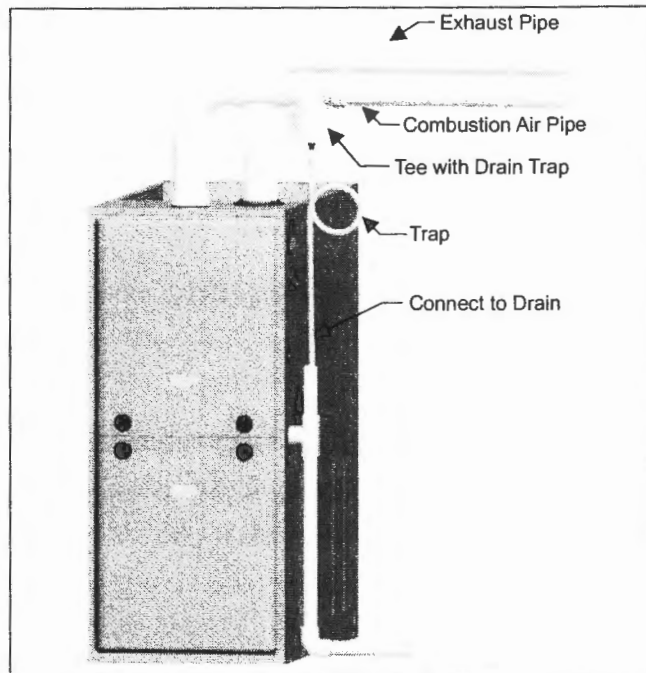


FIGURE 24: Typical. Combustion Pipe Drain Tee

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.

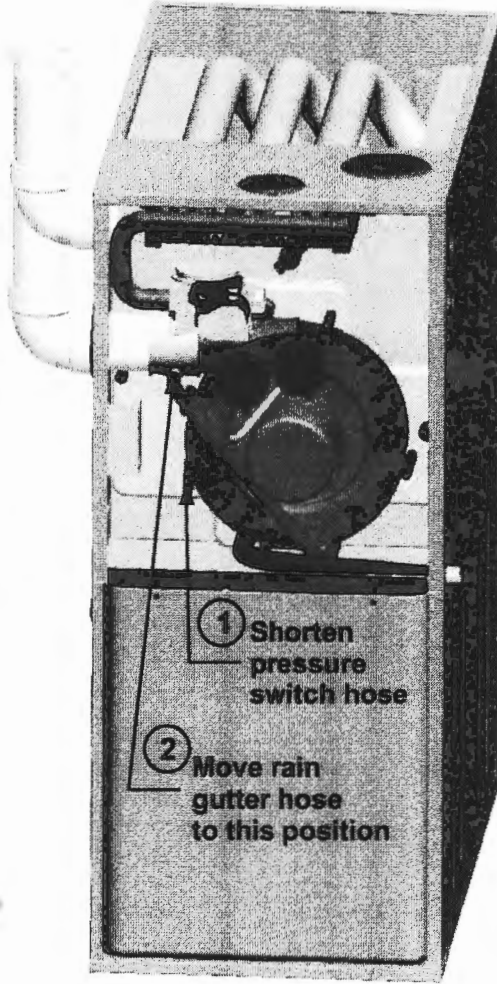
WARNING

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

FIGURE 25: Upflow Configuration

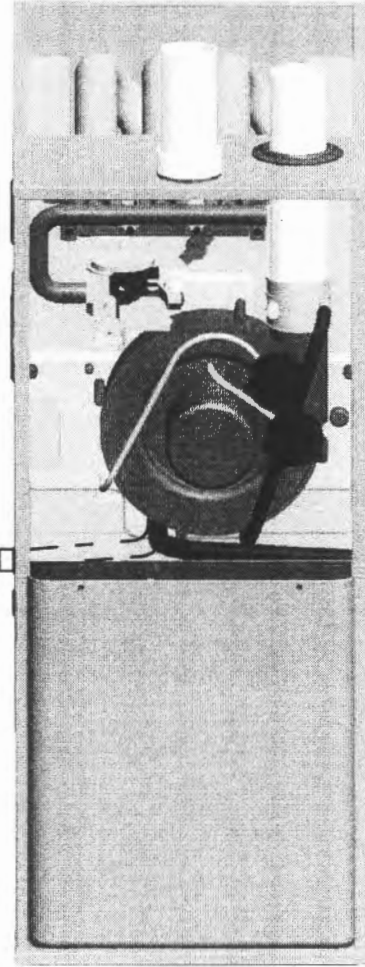
When drain hose routing changes are required, be sure to cap all un-used openings. If rerouting hoses - excess length should be cut off so that no sagging loops will collect and hold condensate, which will cause the furnace to not operate.

130 K Model does not have provisions for top venting, it must be vented through a side opening.



INDUCER ROTATED FOR LEFT SIDE VENTING (As required for 130K model)

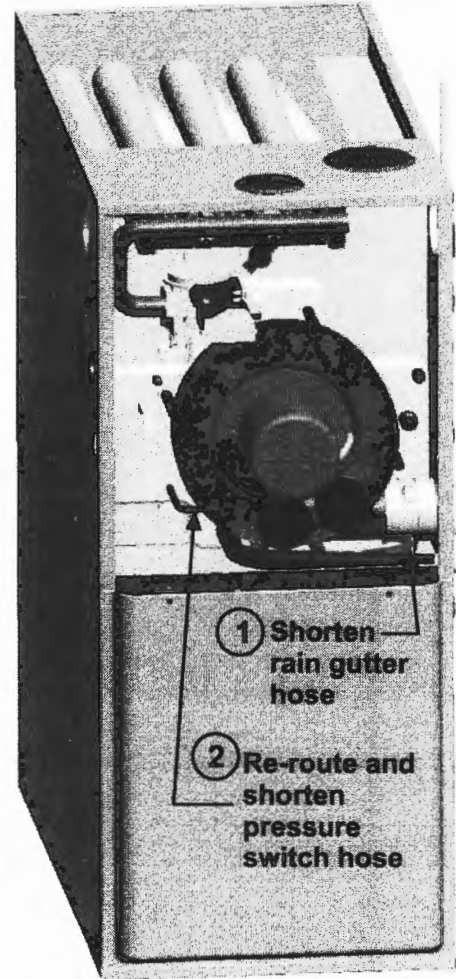
For 100, 120 & 130K input furnaces, the condensate drain is plumbed toward the left casing outlet from the factory.



UPFLOW AS RECEIVED (Except for 130K Model)

Condensate drain may exit cabinet on either side.

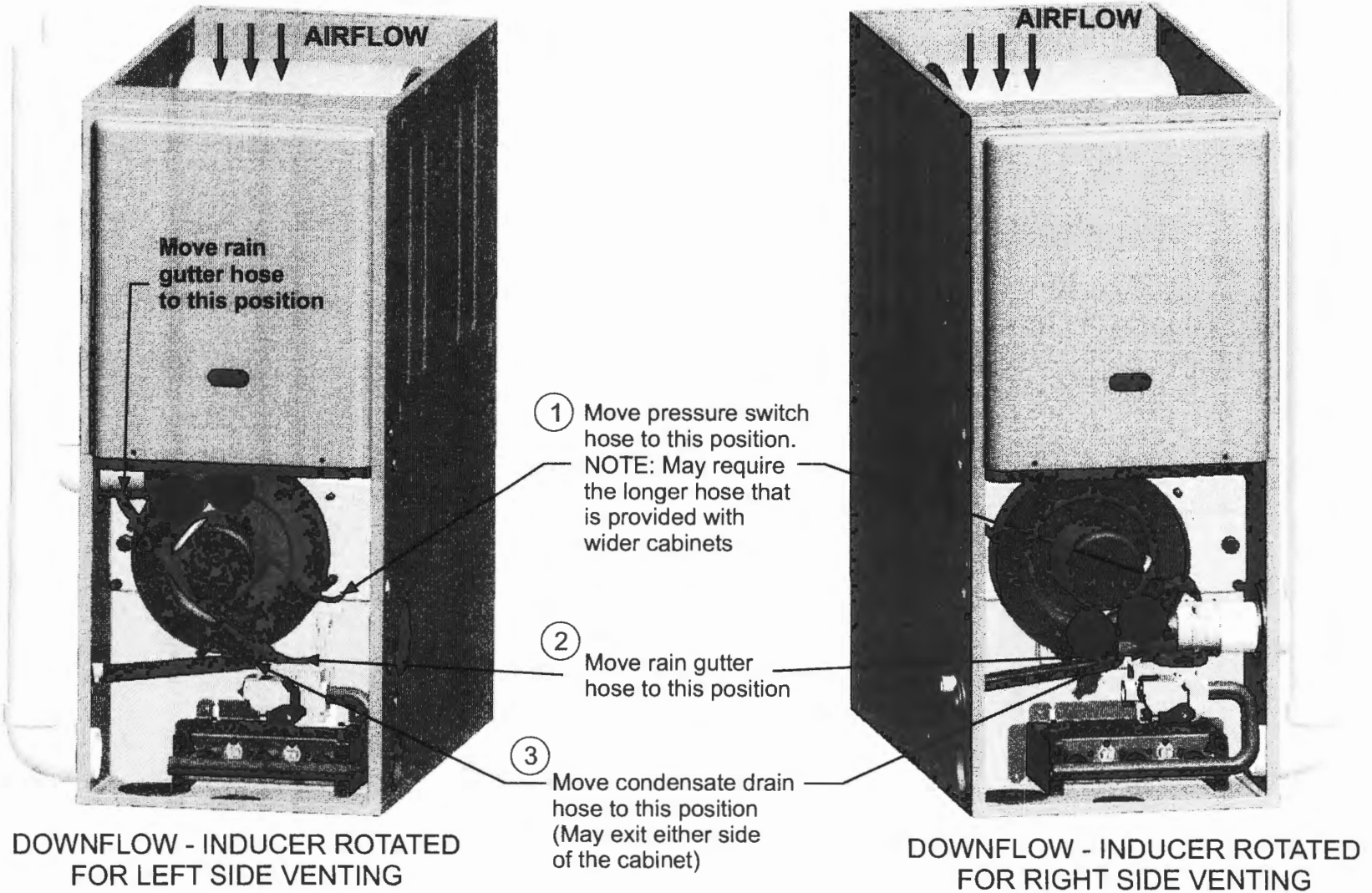
For 040, 060 & 080K input furnaces, the condensate drain is plumbed toward the right casing outlet from the factory.



INDUCER ROTATED FOR RIGHT SIDE VENTING

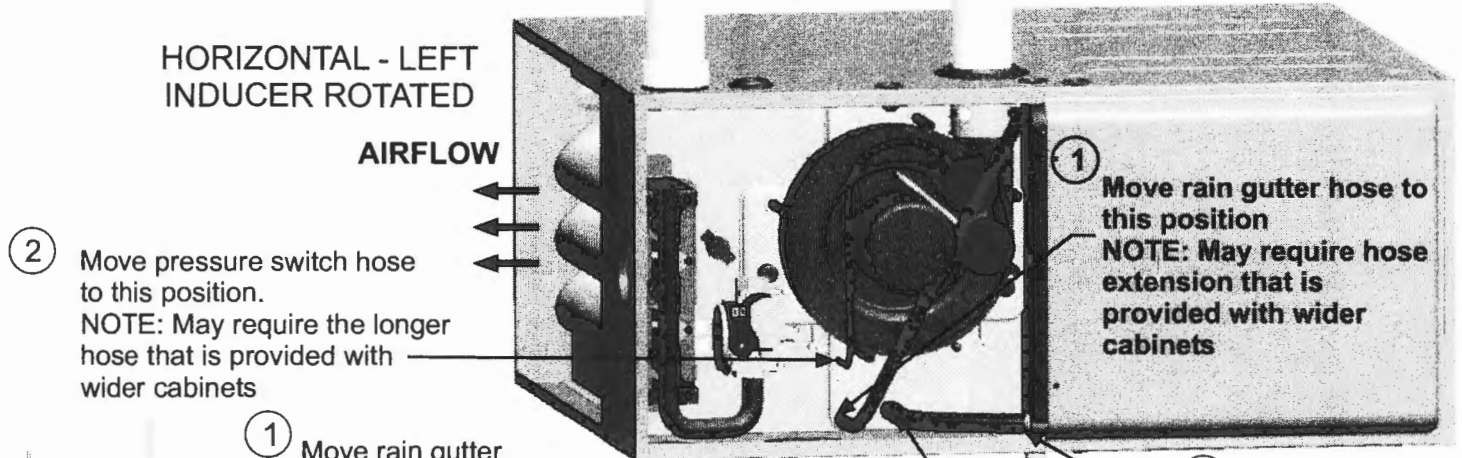
FIGURE 26: Downflow Configuration

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.



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.

HORIZONTAL - LEFT INDUCER ROTATED



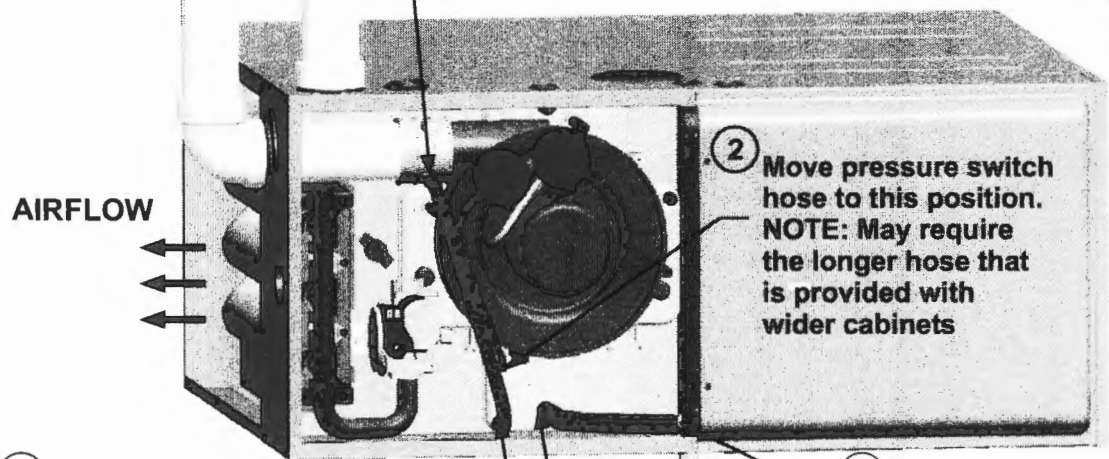
② Move pressure switch hose to this position.
NOTE: May require the longer hose that is provided with wider cabinets

① Move rain gutter hose to this position
NOTE: May require hose extension that is provided with wider cabinets

① Move rain gutter hose to this position

③ Move condensate drain hose to this position

④ Change condensate drain connection to the 90° fitting provided



③ Move rain gutter hose to this position
NOTE: May require hose extension that is provided with wider cabinets

② Move pressure switch hose to this position.
NOTE: May require the longer hose that is provided with wider cabinets

④ Move condensate drain hose to this position

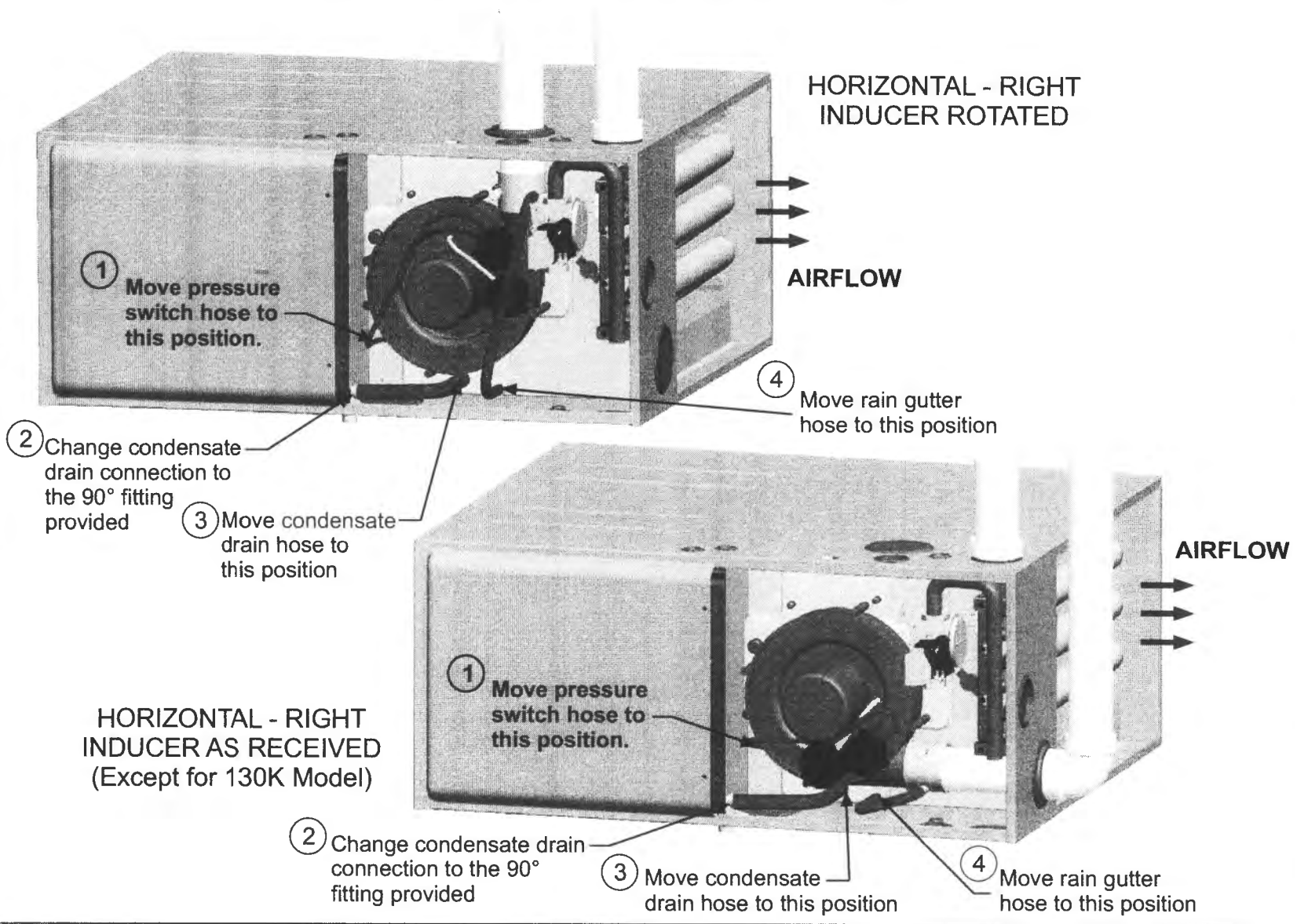
⑤ Change condensate drain connection to the 90° fitting provided

HORIZONTAL - LEFT INDUCER AS RECEIVED (Except for 130K Model)

FIGURE 27: Horizontal Left Configuration

FIGURE 28: Horizontal Right Configuration

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.



SECTION VIII: 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 7 lists the maximum equivalent length of pipe allowed for each model of furnace. The equivalent length of elbows is shown in Table 9. 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 7 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°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" (46 cm) of PVC pipe on the furnace.
10. Minimum vent length for all models is 5 feet (1.5 m).

TABLE 7: 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)
130,000	3 (7.6)	85 (25.9)
130,000	4 (10.2)	150 (45.7)

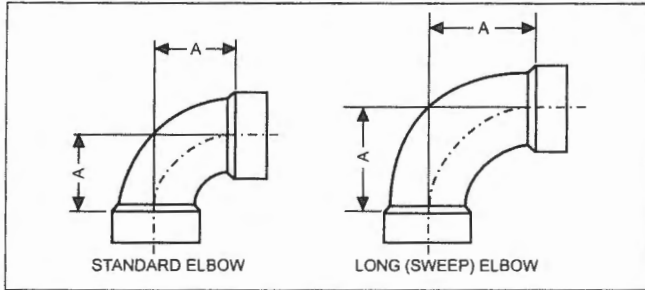


FIGURE 29: Dimensions

TABLE 8: 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 9: 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 90° elbows. Using 2" pipe and standard elbows, the total equivalent length will be:

$$\begin{array}{r}
 32 \text{ feet of 2" pipe} = 32 \text{ equivalent feet} \\
 5 - 90^\circ \text{ standard 2" elbows} = (5 \times 7) = 35 \text{ equivalent feet} \\
 \hline
 \text{Total} = 67 \text{ equivalent feet of 2" pipe}
 \end{array}$$

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

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

$$\begin{array}{r}
 32 \text{ feet of 2" pipe} = 32 \text{ equivalent feet} \\
 5 - 90^\circ \text{ sweep 2" elbows} = (5 \times 5) = 25 \text{ equivalent feet} \\
 \hline
 \text{Total} = 57 \text{ equivalent feet of 2" pipe}
 \end{array}$$

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:

$$\begin{array}{r}
 32 \text{ feet of 3" pipe} = 32 \text{ equivalent feet} \\
 5 - 90^\circ \text{ standard 3" elbows} = (5 \times 7) = 35 \text{ equivalent feet} \\
 \hline
 \text{Total} = 67 \text{ equivalent feet of 3" pipe}
 \end{array}$$

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

TABLE 10: 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 45° (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:

- Cut piping to the proper length beginning at the furnace.
- Deburr the piping inside and outside.
- Chamfer (bevel) the outer edges of the piping.
- Dry-fit the vent piping assembly from the furnace to the outside termination checking for proper fit support and slope.
- Dry-fit the combustion air piping assembly checking for proper fit, support and slope on the following systems:
 - Sealed combustion air systems from the furnace to the outside termination.
 - 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.

- 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.
- All joints must provide a permanent airtight and watertight seal.
- 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.
- 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.

VENT 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.

NOTICE

On 130K BTU models, there is no provision for the vent to exit the top of the cabinet, the vent must always exit one of the sides.

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 32 or 33.

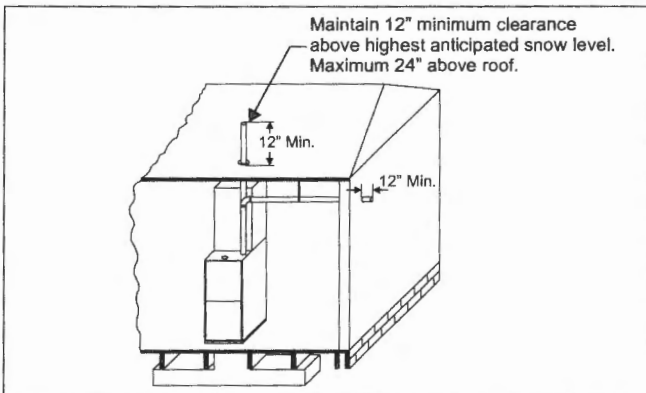


FIGURE 31: Termination Configuration - 1 Pipe

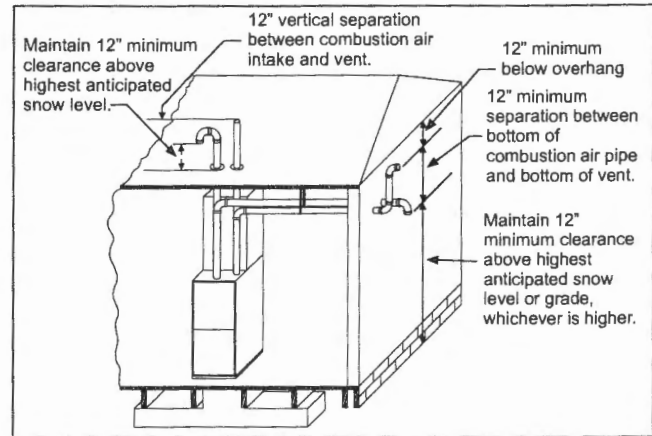


FIGURE 32: Termination Configuration - 2 Pipe

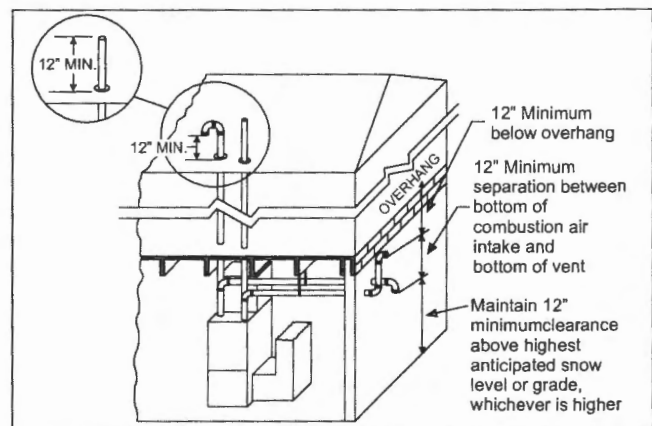


FIGURE 33: Termination Configuration - 2 Pipe Basement

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 31 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 31. 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 32 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 34 or 35. 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.

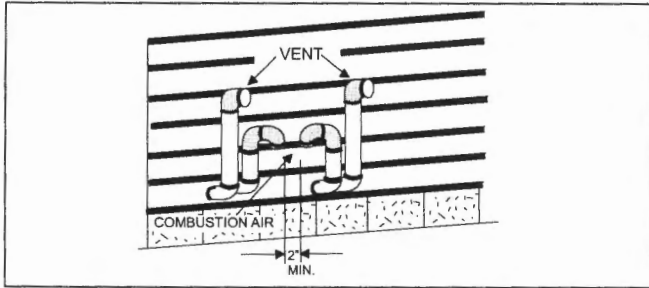


FIGURE 34: Double Horizontal Combustion Air Intake and Vent Termination

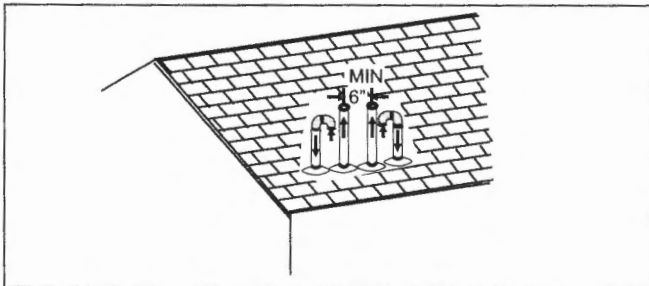


FIGURE 35: Double Vertical Combustion Air Intake and Vent Termination

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.

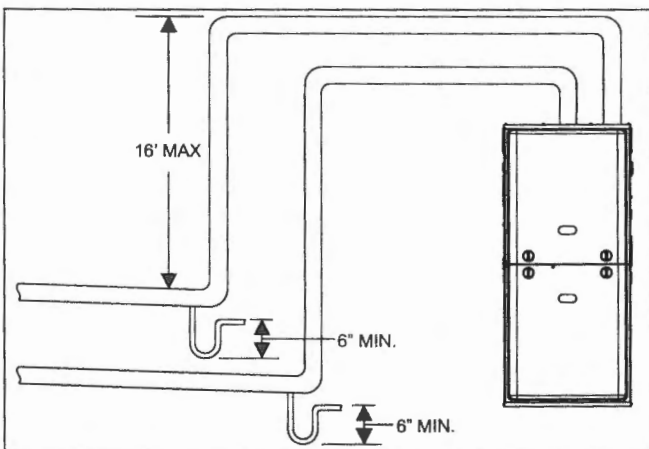


FIGURE 36: Downward Venting

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 36.
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 31 for vent terminations. Refer to "Ambient Combustion Air Supply" for proper installation. Refer to Figure 27.
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 39 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 36) 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 36) 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.

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."

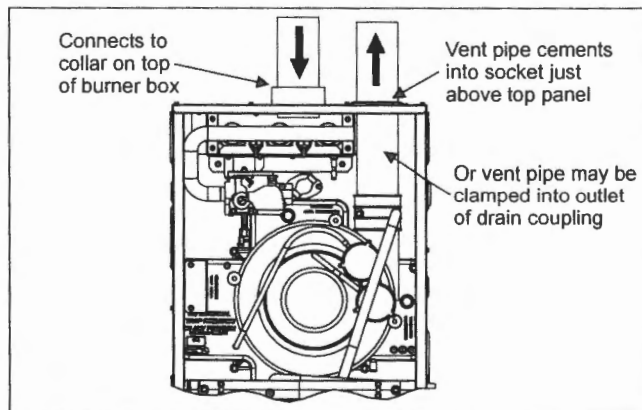


FIGURE 37: Direct Vent Air Intake Connection and Vent Connection

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 & 18" of pipe be attached to the furnace to prevent accidental blockage of the combustion air intake.

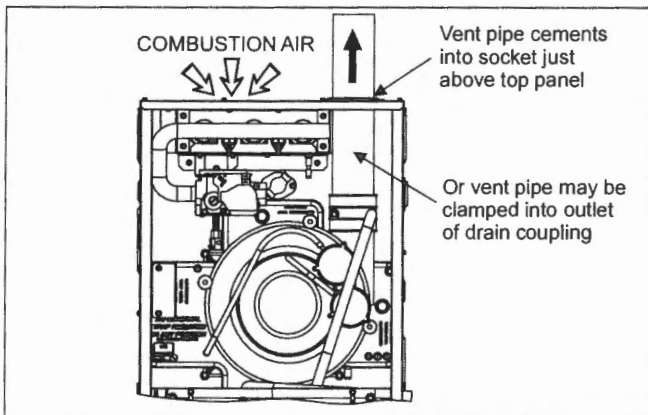


FIGURE 38: Combustion Airflow Path Through The Furnace Casing

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 m³) per 1,000 Btu/hr (0.293 kW/h) 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 m³) per 1,000 Btu/hr (0.293 kW/h) 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 Table11, to estimate free area.

Table 11: 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 12: 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)
130,000	130 in ² (838 cm ²)

Table 13: 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)
130,000	65 in ² (419 cm ²)	33 in ² (213 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

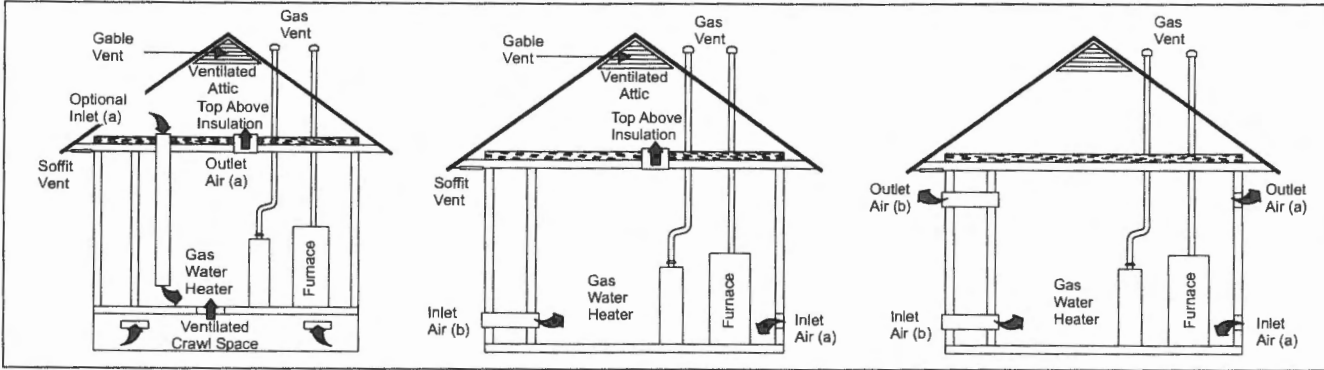


FIGURE 39: Outside and Ambient Combustion Air

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 in² (58.06 cm²) or larger. When a square or rectangular duct is used, its small dimension shall not be less than 3" (7.6 cm).
6. 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 inch per 3000 BTU per hour (322 cm² 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 11.

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 7 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 39 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.

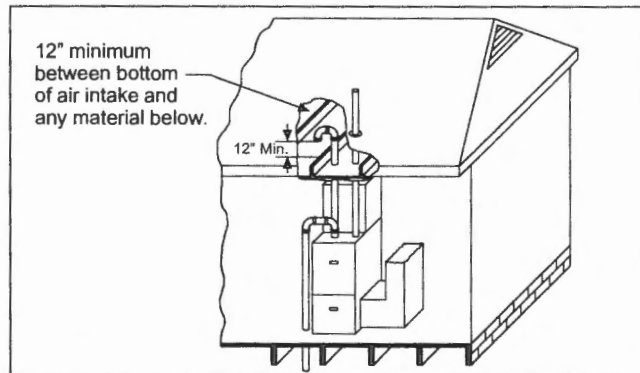


FIGURE 40: Attic and Crawl Space Combustion Air Termination

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 monoxide 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 CO₂ 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: An unsafe condition exists when the CO reading exceeds 40 ppm and the draft reading is not in excess of - 0.1" 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.

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 25-28 for details.

SECTION IX: 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/Ft³ (38.4 MJ/m³). 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.

Verify 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 14 for cubic feet of gas per hour.
5. Multiply cubic feet per hour by heating value (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 14: Gas Rate (CU FT/HR) at Full Input

Seconds For 1 Revolution	Size of Test Dial			Seconds For 1 Revolution	Size of Test Dial		
	1 Cu Ft	2 Cu Ft	5 Cu Ft		1 Cu Ft	2 Cu Ft	5 Cu Ft
10	360	720	1800	55	65	131	327
11	327	655	1636	56	64	129	321
12	300	600	1500	57	63	126	316
13	277	555	1385	58	62	124	310
14	257	514	1286	59	61	122	305
15	240	480	1200	60	60	120	300
16	225	450	1125	62	58	116	290
17	212	424	1059	64	56	112	281
18	200	400	1000	66	54	109	273
19	189	379	947	68	53	106	265
20	180	360	900	70	51	103	257
21	171	343	857	72	50	100	250
22	164	327	818	74	48	97	243
23	157	313	783	76	47	95	237
24	150	300	750	78	46	92	231
25	144	288	720	80	45	90	225
26	138	277	692	82	44	88	220
27	133	267	667	84	43	86	214
28	129	257	643	86	42	84	209
29	124	248	621	88	41	82	205
30	120	240	600	90	40	80	200
31	116	232	581	92	39	78	196
32	113	225	563	94	38	76	192
33	109	218	545	96	38	75	188
34	106	212	529	98	37	74	184
35	103	206	514	100	36	72	180
36	100	200	500	102	35	71	178
37	97	195	486	104	35	69	173
38	95	189	474	106	34	68	170
39	92	185	462	108	33	67	167
40	90	180	450	110	33	65	164
41	88	176	439	112	32	64	161
42	86	172	429	116	31	62	155
43	84	167	419	120	30	60	150
44	82	164	409	124	29	58	145
45	80	160	400	128	28	56	141
46	78	157	391	133	27	54	135
47	76	153	383	138	26	52	130
48	75	150	375	144	25	50	125
49	73	147	367	150	24	48	120
50	72	144	360	157	23	46	115
51	71	141	355	164	22	44	110
52	69	138	346	171	21	42	105
53	68	136	340	180	20	40	100
54	67	133	333				

ADJUSTMENT OF MANIFOLD GAS PRESSURE & INPUT 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 40 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 41 for connection details.

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

Table 15: 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 15, 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 41 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.

1. Refer to Figure 40 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 16: Nominal Manifold Pressure

NOMINAL MANIFOLD PRESSURE	
Natural Gas	3.5" w.c. (0.87 kPa)
Propane (LP) Gas	10.0" w.c. (2.488 kPa)

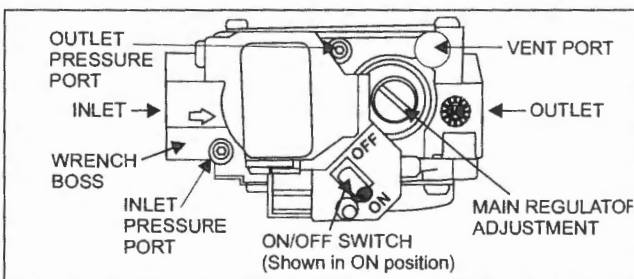


FIGURE 41: Gas Valve

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.

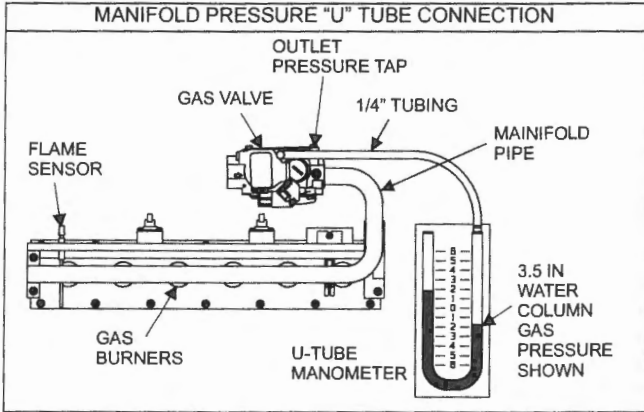


FIGURE 42: Reading Gas Pressure

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 6.

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 (1.8 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.

All direct-drive blowers have multi-speed motors. The blower motor speed taps are located on the furnace control board in the blower compartment. Refer to Figure 42, and the unit-wiring label to change the blower speed. To use the same speed tap for heating and cooling, the heat terminal and cool terminal must be connected using a jumper wire and connected to the desired motor lead. Place all unused motor leads on Park terminals. Two park terminals are provided.

⚠ CAUTION

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

ADJUSTMENT OF FAN CONTROL SETTINGS

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 42.

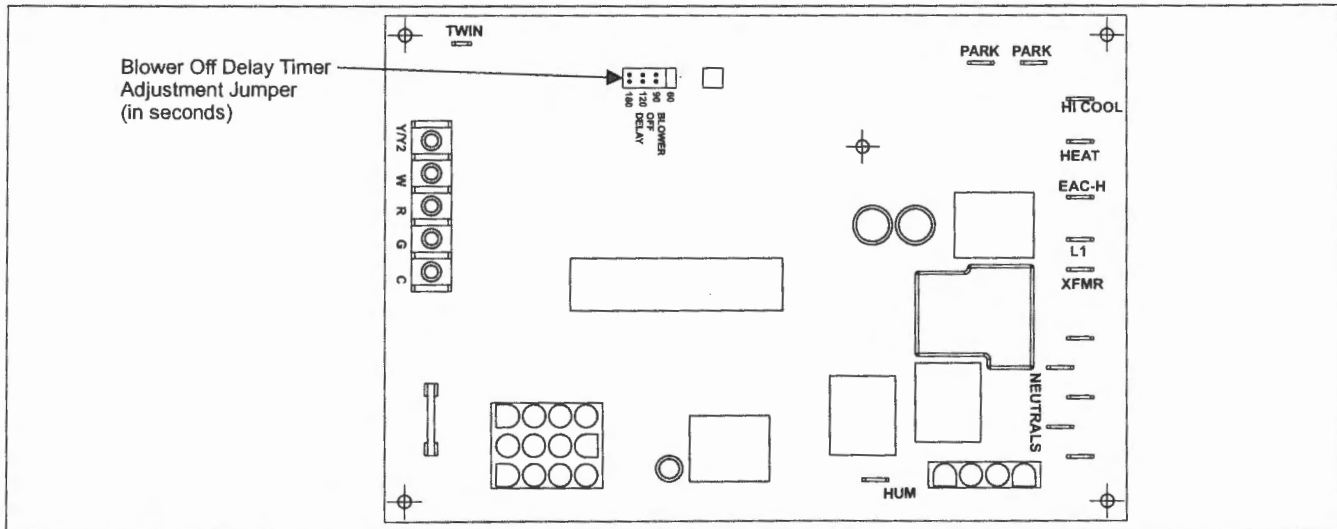


FIGURE 43: Furnace Control Board

Table 17: Blower Performance CFM - Any Position (without filter) - Bottom Return

Models Input/Airflow/Cabinet	Speed	Bottom Airflow Data (SCFM)									
		Ext. Static Pressure (in. H ₂ O)									
		0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
40/800/A	High	1128	1077	1035	996	950	891	842	781	708	646
	Medium High	934	909	867	834	818	780	745	696	631	584
	Medium Low	746	735	714	679	653	629	596	585	547	494
	Low	676	652	627	601	581	542	516	474	441	383
60/1000/A	High	1360	1290	1230	1165	1103	1043	983	925	820	776
	Medium High	1251	1198	1140	1089	1038	979	916	854	790	718
	Medium Low	1081	1062	1015	964	917	871	819	767	710	634
	Low	909	900	852	812	769	739	712	662	612	547
60/1200/B	High	1492	1442	1378	1325	1243	1176	1075	966	849	655
	Medium High	1236	1201	1161	1139	1082	1011	919	830	715	590
	Medium Low	986	950	961	916	872	831	757	703	600	510
	Low	824	795	783	744	713	659	624	554	489	389
80/1200/B	High	1597	1537	1484	1435	1370	1286	1230	1155	1075	925
	Medium High	1338	1307	1273	1223	1179	1123	1065	998	928	812
	Medium Low	1113	1094	1077	1043	1008	972	924	868	803	798
	Low	937	916	900	877	854	817	775	718	639	560
80/1600/C	High	1919	1865	1802	1738	1671	1600	1517	1414	1322	1201
	Medium High	1532	1533	1513	1499	1465	1416	1352	1283	1198	1084
	Medium Low	1232	1313	1291	1280	1250	1209	1207	1148	1055	937
	Low	826	821	853	858	838	817	794	776	760	711
80/2200/C	High	2529	2435	2338	2256	2162	2041	1920	1794	1654	1501
	Medium High	2166	2111	2070	2001	1927	1849	1719	1614	1499	1344
	Medium Low	1697	1685	1664	1631	1586	1531	1466	1393	1315	1185
	Low	1383	1377	1358	1336	1285	1244	1199	1147	1048	925
100/1600/C	High	1909	1880	1823	1776	1706	1637	1562	1474	1375	1252
	Medium High	1465	1463	1469	1485	1477	1416	1386	1324	1250	1114
	Medium	1190	1222	1216	1215	1224	1189	1158	1145	1087	996
	Low	787	834	819	836	819	810	790	761	690	707
100/2000/C	High	2284	2205	2114	2021	1934	1848	1752	1653	1505	1397
	Medium High	1967	1905	1824	1763	1712	1628	1551	1473	1379	1213
	Medium Low	1610	1563	1513	1480	1430	1367	1319	1261	1101	1012
	Low	1326	1304	1267	1232	1183	1143	1080	1003	871	798
120/1600/D	High	2020	1994	1958	1878	1805	1740	1647	1560	1445	1294
	Medium High	1551	1559	1549	1520	1494	1451	1383	1334	1253	1145
	Medium Low	1270	1267	1269	1269	1254	1227	1185	1121	1051	985
	Low	932	916	905	894	876	828	803	725	754	696
120/2000/D	High	2341	2245	2153	2072	1977	1876	1769	1642	1506	1306
	Medium High	2002	1952	1878	1823	1739	1657	1563	1458	1322	1185
	Medium Low	1615	1579	1533	1473	1430	1368	1282	1186	1091	953
	Low	1352	1295	1259	1245	1190	1141	1076	998	938	820
130/2000/D	High	2412	2329	2247	2173	2047	1980	1887	1777	1655	1511
	Medium High	2040	2004	1948	1876	1786	1738	1656	1562	1461	1314
	Medium Low	1614	1591	1549	1531	1459	1400	1335	1267	1180	1061
	Low	1327	1294	1257	1224	1198	1171	1124	1036	944	848

NOTES:

1. Airflow expressed in standard cubic feet per minute (CFM).

2. Motor voltage at 115 V.

Table 18: Blower Performance CFM - Any Position (without filter) - Left Side Return

Models Input/Airflow/Cabinet	Speed	Left Side Airflow Data (SCFM)									
		Ext. Static Pressure (in. H2O)									
		0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
40/800/A	High	1131	1091	1053	1003	965	921	862	800	733	659
	Medium High	982	959	935	887	846	795	745	675	628	595
	Medium Low	772	736	715	689	661	642	599	568	531	493
	Low	636	618	585	569	546	522	486	460	455	370
60/1000/A	High	1431	1375	1304	1244	1178	1109	1040	963	861	805
	Medium High	1280	1226	1171	1117	1059	1004	930	865	781	731
	Medium Low	1099	1050	1008	970	919	866	814	759	710	626
	Low	914	876	842	812	770	728	694	661	612	545
60/1200/B	High	1470	1406	1361	1309	1241	1155	1060	920	775	628
	Medium High	1211	1186	1139	1101	1042	980	896	796	681	545
	Medium Low	970	957	927	889	853	796	745	660	568	450
	Low	793	781	756	724	694	653	585	530	469	382
80/1200/B	High	1605	1562	1514	1454	1393	1330	1251	1169	1073	940
	Medium High	1372	1318	1280	1255	1205	1161	1093	1023	943	849
	Medium Low	1087	1073	1052	1003	993	953	897	843	775	709
	Low	916	896	881	854	831	802	757	708	642	574
80/1600/C	High	1956	1907	1846	1778	1717	1647	1573	1483	1353	1209
	Medium High	1543	1543	1516	1504	1477	1446	1382	1309	1202	1099
	Medium Low	1238	1241	1243	1241	1252	1242	1201	1140	1074	967
	Low	906	902	903	910	888	866	859	829	795	743
80/2200/C	High	2585	2492	2405	2321	2232	2137	2015	1902	1745	1577
	Medium High	2098	2067	2036	1982	1928	1860	1767	1670	1549	1331
	Medium Low	1619	1628	1614	1584	1545	1488	1424	1339	1216	1121
	Low	1338	1347	1327	1301	1262	1199	1138	1078	1019	938
100/1600/C	High	1828	1829	1789	1768	1727	1671	1601	1505	1390	1272
	Medium High	1422	1444	1437	1424	1396	1326	1301	1253	1200	1100
	Medium	1224	1229	1243	1234	1219	1193	1168	1135	1088	977
	Low	813	819	818	814	783	762	756	732	690	642
100/2000/C	High	2391	2286	2165	2079	2004	1934	1839	1692	1560	1366
	Medium High	1945	1878	1838	1782	1694	1642	1565	1451	1334	1163
	Medium Low	1549	1530	1495	1430	1431	1365	1284	1192	1097	1022
	Low	1256	1229	1189	1159	1089	1033	1008	950	871	784
120/1600/D	High	1998	1987	1914	1858	1798	1721	1629	1530	1417	1303
	Medium High	1512	1506	1492	1467	1441	1406	1342	1280	1206	1097
	Medium Low	1217	1219	1210	1185	1174	1148	1112	1063	1012	937
	Low	892	870	859	843	814	798	790	745	740	677
120/2000/D	High	2343	2253	2167	2071	1979	1881	1785	1668	1473	1351
	Medium High	1954	1892	1846	1781	1714	1637	1548	1429	1238	1171
	Medium Low	1596	1539	1511	1458	1399	1341	1254	1180	942	988
	Low	1299	1261	1229	1177	1111	1053	993	937	882	782
130/2000/D	High	2425	2336	2255	2157	2046	1966	1865	1758	1615	1420
	Medium High	1979	1959	1899	1825	1773	1686	1619	1516	1376	1225
	Medium Low	1582	1567	1540	1488	1443	1406	1336	1252	1146	1033
	Low	1305	1287	1239	1194	1159	1126	1062	1003	943	831

NOTES:

1. Airflow expressed in standard cubic feet per minute (CFM).
2. Return air is through side opposite motor (left side).
3. Motor voltage at 115 V.
4. Airflow through motor side (right side) may be slightly less than the data shown above.

SECTION X: 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 two 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 "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 XI: NORMAL OPERATION AND DIAGNOSTICS

NORMAL OPERATION SEQUENCE

The following describes the sequence of operation of the furnace. Refer to Owners Manual for component location.

Continuous Blower

Cooling/heating thermostats have a fan switch that has an ON and AUTO position. In the ON position the thermostat circuit is completed between terminals R and G. The motor will operate continuously on the speed tap wire that is connected to the "HI COOL" cooling terminal on the control board. To obtain a constant air circulation at lower flow rate, change the high-speed wire to another lower speed wire.

Intermittent Blower - Cooling

Cooling/heating thermostats have a fan switch that has an ON and AUTO position. In the AUTO position the thermostat circuit is completed between terminals R and G when there is a call for cooling. The motor will operate on the speed tap wire that is connected to the "HI COOL" cooling terminal on the control board. The fan off setting is fixed at 60 seconds to improve cooling efficiency.

Heating 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 42. 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 GREEN FLASH: Twinning error, incorrect 24V phasing or no power to twinned unit. Check twinning wiring. Confirm that both twinned units have power.

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 operate the supply air blower and inducer while the open limit condition exists. 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. Power will have to be cycled off and on to reset the control after the problem has been corrected. See "11 Red Flashes" description below.

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

5 RED FLASHES: This fault is indicated if the normally closed rollout switch opens. The rollout control is manually reset. 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 main limit switch has opened its normally-closed contacts and has remained open for more than five 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.

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.

<p>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)</p>
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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, then will resume the normal slow green flash after a five-second pause.

SECTION XII: REPLACEMENT PARTS LIST

DESCRIPTION
MOTOR
MOTOR, DIRECT DRIVE BLOWER
BLOWER, COMBUSTION
ELECTRICAL
CAPACITOR, RUN
SWITCH, LIMIT
CONTROL, FURNACE
IGNITER
SENSOR, FLAME
SWITCHES, PRESSURE
SWITCH, DOOR
TRANSFORMER
VALVE, GAS
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
HARNES, 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

REPLACEMENT PART CONTACT INFORMATION

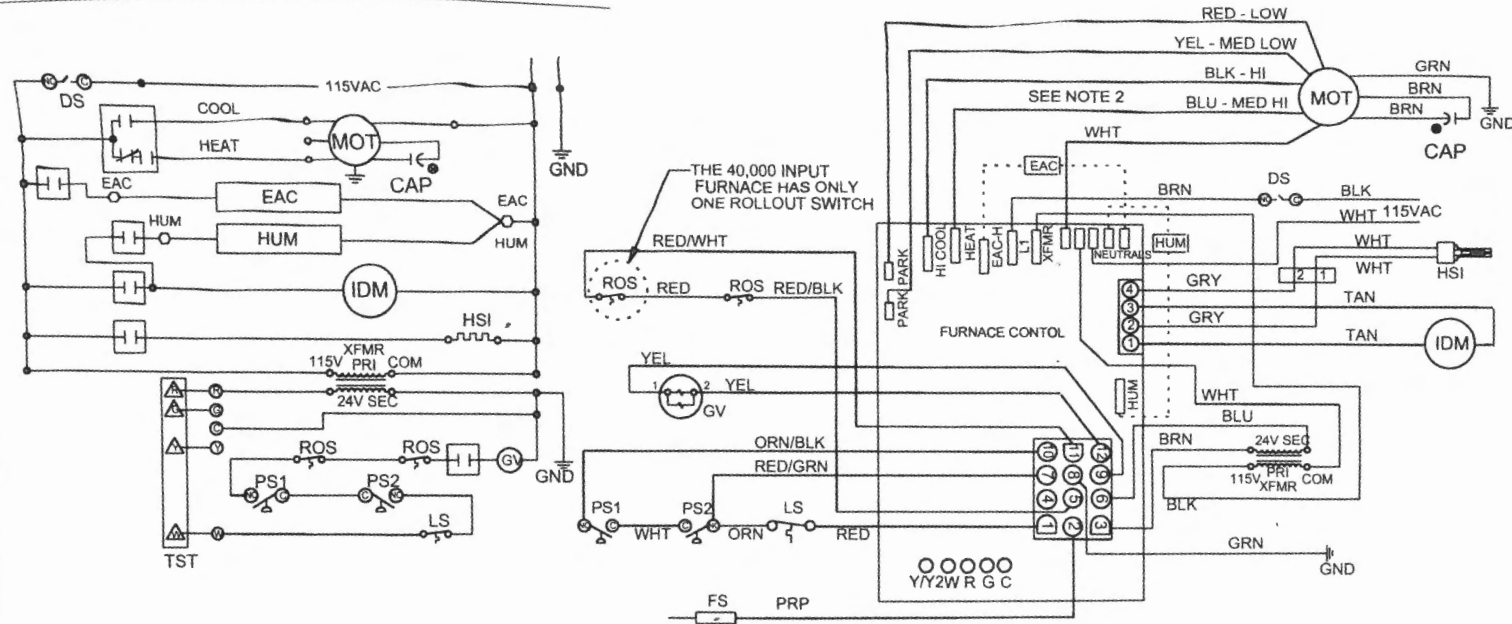
This is a generic parts list. To request a complete parts list, refer to the contact information below:

- 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**

FIGURE 44: Wiring Diagram

Wiring Diagram - 95% Single-Stage Furnace



Legend

- | | | |
|----------------------------------|------------------------------|--------------------|
| DS - Door switch | MOT - Circulating motor | LS - Limit switch |
| ROS - Rollout switch | IDM - Inducer motor | HUM - Humidifier |
| FS - Flame sensor | CAP - Capacitor | XFMR - Transformer |
| TST - Wall thermostat | HSI - Hot surface igniter | GV - Gas valve |
| PS1 - Pressure switch | EAC - Electronic air cleaner | |
| PS2 - Condensate pressure switch | | |

1. If any of the original wire as supplied with the furnace must be replaced, it must be replaced with wiring material having a temperature rating of at least 221 degrees F (105 degrees C).
2. Blower motor speed connections shown are typical, but may vary by model and application.

Legende

- | | | |
|---|-------------------------|-------------------------|
| DS - Commutateur de porte | MOT - Moteur soufflerie | TST - Thermostat |
| ROS - Commutateur de roulement | IDM - D'induct moteur | FS - Capteur de flamme |
| XFMR - Transformateur | GV - Soupape de gaz | CAP - Capaciteur |
| LS - Commutateur de limite | HUM - Humidificateur | EAC - Filtre électrique |
| HSI - Ignition de surface chaud | | |
| PS1 - Commutateur de pression | | |
| PS2 - Commutateur de pression, condensation | | |

1. Si l'un des fils d'origine fourni avec ce four doit être remplacé, il doit être remplacé avec le fil ayant un degré de température d'au moins 221 degrés F (105 degrés C).
2. Les connexions à grande vitesse du moteur du ventilateur indiqués sont typiques, mais peuvent varier selon le modèle et par application.

364665-UWD-F-0212

TUBE HEATER M# STG-100/30

Form ST-VM-OS-GQ-IOM-29
210080

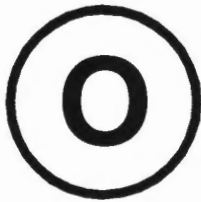
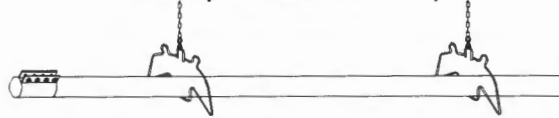
Solaronics, Inc.

GAS INFRA-RED HEATERS



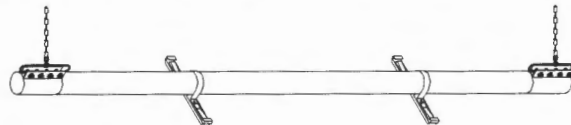
VERSAMOUNT (STG/U Systems)

- Black iron clamped tubes suspended by hangers



ORIGINAL STYLE (STG/U Systems)

- Black iron clamped tubes suspended by clamps



GLOBAL QUALITY (GQG/U Systems)

- Aluminized press-fit tubes suspended by hangers



GAS-FIRED LOW-INTENSITY INFRA-RED RADIANT TUBE HEATERS

FOR EITHER INDOOR OR OUTDOOR INSTALLATION. NOT FOR USE IN RESIDENTIAL DWELLINGS.

INSTALLATION, OPERATION, & MAINTENANCE INSTRUCTIONS

! WARNING !

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

FOR YOUR SAFETY

- If you smell gas: open windows; don't touch electrical switches, extinguish any open flames; evacuate the structure; call your gas supplier immediately.

WARNING – NOT FOR RESIDENTIAL USE

- Failure to comply with instructions could result in unsafe operation, property damage, personal injury, and/or death. A gas-fired appliance could expose you to substances in fuel or from fuel combustion, which have been determined by the State of California to cause cancer, birth defects or other reproductive harm. For industrial or commercial use only. Retain these instructions for future reference. Contact factory for further information.

IMPORTANT

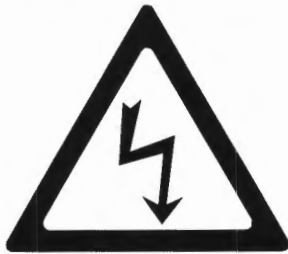
- Ensure the correct portions of these installation instructions are used based on the model of heater ordered and the type of tube mounting received since this manual contains instructions for three different types of heater mountings: (V) black iron clamped tubes suspended by hangers, (O) black iron clamped tubes suspended by clamps, and (Q) aluminized press-fit tubes suspended by hangers.
- Have a qualified electrician check the electrical supply circuit and wall receptacle are properly grounded and the electrical supply polarity is correct. The heater control is polarity sensitive and **will not operate** properly if the electrical supply is not wired correctly.

HAZARD INTENSITY LEVELS

- **DANGER:** Failure to comply will result in severe personal injury or death and property damage.
- **WARNING:** Failure to comply could result in severe personal injury or death and/or property damage.
- **CAUTION:** Failure to comply could result in minor personal injury and/or property damage.



WARNINGS



- Protect yourself and others by observing all safety information.

WARNING

FIRE OR EXPLOSION HAZARD

Can cause property damage, severe injury or death.

- Read manual carefully before installing, or servicing this equipment, or serious injury or death may result.
- Check minimum clearance to combustibles to make certain that heater is in a safe location. Combustible items located too close to the heater could cause a **serious fire hazard**. In storage areas, signs for maximum permissible stacking height to maintain clearance from the heater to combustible materials must be posted adjacent to the heater thermostats or in the absence of such thermostats in a conspicuous location.
- Operating these heaters in an atmosphere containing combustible dust or flammable vapors is dangerous and may potentially result in injury or death.
- Heaters must be oriented in such a way as to maintain minimum clearances to vehicles parked underneath them.
- These heaters expand and contract with each cycle. The installation of the gas connection and mounting hardware must accommodate this movement; otherwise, a fire or explosion hazard may occur.
- These heaters are equipped with an automatic ignition and does not contain a pilot. **DO NOT** attempt to light the burner manually, this could result in serious personal injury or fire hazard.

CAUTION




MECHANICAL HAZARD

































- **DO NOT** use high pressure to test the gas pipes with the burner still attached. This will cause damage to the controls within the burner requiring them to be replaced.
- If heater is being operated in an atmosphere with a negative pressure or an atmosphere containing contaminants, an outside combustion air supply is required. Failure to provide outside combustion air may allow excessive heat to back up to the blower wheel and bearings severely shortening service life.
- Correct inlet pressure is important to efficiency and long lasting operation of the burner.
- The burner, tubing, and accessories expand and contract with each cycle. The system must be installed so that the mounting hardware and gas line will accommodate these changes.
- All models of these tube heaters include a turbulator, which **must** be located inside the **last** 10-foot (3.0 m) tube. [Note: 15-foot (4.6 m) models have the 10-foot (3.0 m) tube with turbulator before the 5-foot (1.5 m) tube.]
- Before servicing the burner or removing the cover panel, all electrical and gas supplies must be disconnected.
- Give consideration to construction such as partitions, storage racks, hoists, etc., and their relation to the installation of the heater.
- These heaters must be installed and serviced **ONLY** by trained and qualified gas installation and service personnel.

IMPORTANT

- Failure to follow these instructions may result in property damage, injury or death.
- These heaters **cannot** be used in the following environments: explosion-proof or residential living/sleeping quarters.
- These heaters **may or may not** be used in the following environments: enclosed swimming pool, process heating, or contaminated atmosphere applications.
- **Contact factory if in any doubt.**

TABLE OF CONTENTS

- This instruction manual may not cover all details or variations in this equipment, or cover every possible situation to be met in connection with installation, operation, or maintenance. Should problems arise that are not covered sufficiently in these instructions, the purchaser is advised to contact the factory's engineering department for further information.
- The following symbols indicate appropriate pages for each model contained in this manual.
 -  The white "V" in a black square indicates models with black iron clamped tubes suspended by hangers.
 -  The "O" in a circle indicates models with black iron clamped tubes suspended by clamps.
 -  The "Q" in a hatched or gray triangle indicates models with aluminized press-fit tubes suspended by hangers.

Model Symbols	SECTION TITLES – summary of information included	Page(s)
	WARNINGS – safety precautions and important safety information	2
	TABLE OF CONTENTS	3
	GENERAL INFORMATION AND INSTALLATION CODES – certifications, local approvals, installation codes and warnings, and gas/rating conversion	4
	CANADIAN CODES – codes applicable to installations in Canada and variances from this manual	5
	CLEARANCE TO COMBUSTIBLES – minimum distances from heater to combustible materials	6
	MOUNTING CONSIDERATIONS – minimum heater mounting heights, distances, angles and spacing, and high altitude considerations	7
	OVERVIEW DRAWINGS – overview of combustion air supply, exhaust venting and installation	8-9
	COMBUSTION AIR SUPPLY – outdoor air supply, maximum length of air supply pipe, air supply cap specifications and indoor air supply	10
	EXHAUST VENTING – outdoor exhaust venting, maximum length of exhaust vent pipe, vent cap specifications and unvented (indoor venting) use and clearances	11
	ELECTRICAL SUPPLY AND THERMOSTATIC CONTROL – electrical ratings, thermostat arrangements and electrical supply and thermostatic control wiring diagrams	12
	OPERATION AND SHUTDOWN – sequence of operation, validation lights and shutdown	13
	BURNER WIRING – electrical connection diagram and electrical schematic ladder diagram for burner	14-15
	GAS SUPPLY AND GAS PRESSURE – gas supply piping, inlet pressure and manifold pressure	16
	STARTUP – procedures, burner diagram and ignitor diagram	17
	MAINTENANCE – procedures with safety precautions	18
	TROUBLESHOOTING – symptoms, possible causes and corrective actions	19
	REPLACEMENT PARTS – exploded view of burner and part descriptions	20
	WINDY CONDITION NOTES – methods for suspending heater where windy conditions are expected	21
	U-TUBE INSTALLATION – horizontal or angled mounting of U-tube heaters	22
	HEATER CONFIGURATIONS – possible arrangements of heat exchangers; reflector options	23
	MODEL DIFFERENCES – distinguish heater model ordered and received from other models	24
	BASIC CONFIGURATIONS – straight and U-tube configurations with component identification	25
	COMBUSTION CHAMBERS – BLACK IRON CLAMPED TUBES SUSPENDED BY HANGERS – specifications of combustion chambers	26
	HEAT EXCHANGERS – BLACK IRON CLAMPED TUBES SUSPENDED BY HANGERS – specifications of middle and exhaust end heat exchangers	27
	INSTALLATION – BLACK IRON CLAMPED TUBES SUSPENDED BY HANGERS – preparation and instructions	28-29
	COMBUSTION CHAMBERS – ALUMINIZED PRESS-FIT TUBES SUSPENDED BY HANGERS – specifications of combustion chambers with the "GQ" prefix	30
	HEAT EXCHANGERS – ALUMINIZED PRESS-FIT TUBES SUSPENDED BY HANGERS – specifications of middle and exhaust end heat exchangers with the "GQ" prefix	31
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	PRESS-FIT TUBE ASSEMBLY TIPS – helpful tips to assemble press-fit tubes	34-35
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	HEAT EXCHANGERS – BLACK IRON CLAMPED TUBES SUSPENDED BY CLAMPS – specifications of middle and exhaust end heat exchangers with the "O" suffix	37
	INSTALLATION – BLACK IRON CLAMPED TUBES SUSPENDED BY CLAMPS – preparation and instructions	38-39



GENERAL INFORMATION AND INSTALLATION CODES

ATTENTION

Mount a copy of these instructions adjacent to heater and retain a copy for future reference.

These heaters **MUST** be installed and serviced **ONLY** by trained and qualified gas installation and service personnel. The installing contractor must be familiar with all the various requirements and is responsible for installing each heater in compliance with these instructions and all applicable codes of all authorities having jurisdiction, local, state, provincial and national.

GENERAL INFORMATION

These heaters are CSA International Design Certified and manufactured for either indoor or outdoor installation in compliance with American National Standard for Gas-Fired Low-Intensity Infrared Heaters ANSI Z83.20/CSA 2.34-latest edition. An Outdoor Kit is required for outdoor use. If you have any questions call factory before attempting installation. These heaters are approved for commercial and industrial installation only.

A limited number of excerpts from various standards and codes are outlined in the following instructions.

UL LISTING

These heaters are design certified by CSA International for compliance with ANSI Standard Z83.20-latest edition. CSA International is the appropriate agency as they specialize in gas appliances while Underwriters Laboratories (UL) specialize in electric appliances. If UL were to design certify the heaters, it would be to the same ANSI Standard. Certification by UL is not required, as it would be redundant.

LOCAL APPROVALS

These heaters have local approvals by such governing bodies as: New York City (A Series: MEA 232-95-E Vol. 2; B and C Series MEA 417-86-E Vol. 5; MB Series MEA 233-95-E Vol. 2; MC Series 233-95-E Vol. 2); City of Minneapolis, Minnesota (#05444); the Commonwealth of Massachusetts; and the State of Nebraska.

INSTALLATION CODES

All installations must be in accordance with local codes and the National Fuel Gas Code, ANSI Z223.1 / NFPA 54-latest edition. In locations used for the storage of combustible materials, signs shall be posted to specify the maximum permissible stacking height to maintain required clearances from the heater to the combustibles. Where unvented infrared heaters are used, natural or mechanical means shall be provided to supply and exhaust [combustion and ventilation air at a rate of] at least [4 CFM per 1000 BTUH] 4 ft³/min/1000 Btu/hr (0.38m³/min/kW) input of installed heaters. Exhaust openings for removing flue products shall be above the level of the heaters.

The heater, when installed, must be electrically grounded in accordance with the National Electric Code, ANSI/NFPA 70-latest edition. All electrical work must conform to the National Electrical Code ANSI / NFPA 70-latest edition. The installation must meet the requirements of the Occupational Safety and Health Act (OSHA) which requires OSHA approved service and safety access to the systems after they are installed.

AIRCRAFT HANGARS

These overhead heaters are suitable for use in aircraft hangars when installed in accordance with the Standard on Aircraft Hangars, ANSI / NFPA 409-latest edition, and are so marked. In aircraft storage and service areas, heaters shall be installed at least 3 m (10 ft) above the upper surface of wings or of the engine enclosures of the highest aircraft that might be housed in the hangar. The measurement shall be made from the wing or engine enclosure, whichever is higher from the floor, to the bottom of the heater. In shops, offices, and other sections of aircraft hangars communicating with aircraft storage or servicing areas, the bottom of the heaters shall be installed not less than 2.4 m (8 ft) above the floor. In all hangars, suspended or elevated heaters shall be located in spaces where they shall not be subject to injury by aircraft, cranes, movable scaffolding, or other objects. Provisions shall be made to ensure accessibility to suspended heaters for recurrent maintenance purposes.

REPAIR GARAGES

These overhead heaters are suitable for use in repair garages when installed in accordance with the Code for Motor Fuel Dispensing Facilities and Repair Garages, NFPA 30A-latest edition (formerly the Standard for Repair Garages NFPA 88B) and are so marked. Heat-producing appliances using gas fuel listed for use in garages shall be permitted to be installed in lubrication rooms, service rooms, or fuel dispensing areas where Class I liquids are dispensed or transferred, provided the equipment is installed at least 2.4 m (8 ft) above the floor.

! WARNING !

An overhead heater should be installed so that the minimum clearances marked on the heater will be maintained from vehicles parked below the heater. (ANSI Z83.20, section 1.26.3.e.)

PARKING STRUCTURES

These overhead heaters are suitable for use in parking structures when installed in accordance with the Standard for Parking Structures, NFPA 88A-latest edition, and are so marked. Unless otherwise permitted ... all flames associated with heating equipment shall be located a minimum of 500 mm (18 in.) below the floor-ceiling assembly or 500 mm (18 in.) above the floor.

MATERIAL SAFETY DATA SHEETS (MSDS)

These heaters comply with the US Superfund Amendments and Reauthorization ACT (SARA) Title III. No Material Safety Data Sheets are required.

GAS/RATING CONVERSION OF INSTALLED HEATER

Conversions of gas type and BTUH ratings are possible. Identify model and serial numbers from the serial plate located on the exterior of the burner. Identify the length of radiant tubing. Review the BASIC SYSTEM CONFIGURATIONS section to determine if system components in addition to burner parts are needed to convert the heater. Contact the factory for approved parts and instructions.

CANADIAN CODES

- The information on this page applies specifically to installations in Canada.

INSTALLATION CODES

- These infrared heaters are CSA International Design Certified and manufactured for either indoor or outdoor installation in compliance with the Standard for Gas-Fired Low-Intensity Infrared Heaters CSA 2.34-latest edition. If you have any questions call factory before attempting installation. These heaters are certified for unvented or vented use.
- The installation must conform with local building codes or, in the absence of local codes, with the current Canadian Natural Gas and Propane Installation Code, CAN/CSA B149.1. Canadian authorities having jurisdiction should be consulted, before installations are made, to verify applicable local codes and installation procedures.
- An infrared heater shall be protected against physical damage.
- An unvented infrared heater shall not be installed in any location where a flammable vapour, combustible dust or fibres, or an explosive mixture is present.
- An unvented infrared heater shall not be installed in a residential or care or detention occupancy building.
- An unvented infrared heater shall be provided with mechanical ventilation for combustion and ventilation air
 - (1) that is so located that products of combustion from each heater are effectively removed outdoors;
 - (2) that has a ventilation volume of at least [3 CFM per 1000 BTUH] 300 cfm (142 dm³/s) for each 100 000 Btuh (30 kW) input or fraction thereof; and
 - (3) is sufficient to maintain the level of carbon dioxide at less than 5000 ppm measured 6 ft (2m) above the work area.
- An unvented heater shall have the ventilation system so interlocked that any reduction of the volume of airflow required in the above note for a heater or group of heaters will cause the shutdown of that heater or group of heaters.
- An unvented infrared heater shall not be installed in an exit passageway or stairway within 8 ft (2.5 m) measured horizontally from an exit door.
- An infrared heater shall be provided with clearance from combustible materials as certified and indicated on the heater.
- A vented infrared heater shall be installed in accordance with the certified markings and the manufacturer's certified installation instructions.
- A tube-type infrared heater shall only be connected with a Type I hose connector that is (1) certified as being in compliance with CSA Standard CAN/CGA-8.1; and (2) of a length of 36 +/- 6 in (90 +/- 15 cm).
- If an external electrical source is utilized, the heater, when installed, must be electrically grounded in accordance with the current Canadian Electric Code, CAN/CSA C22.1.
- The electrical connection shall comply with the local codes or, in the absence of local codes, with the current Canadian Electrical Code, CAN/CSA C22.1, Part I and Part II, and Electrical Features of Fuel Burning Equipment, CAN/CSA C22.2 No. 3.
- Vent terminal clearances shall be in accordance with the current Canadian Natural Gas and Propane Installation Code, CAN/CSA B149.1. A horizontal vent shall not terminate less than 6 feet (1.8 m) from a combustion air inlet or another appliance, 3 feet (900 mm) from any other building opening or any gas service regulator, or 7 feet (2.1 m) above grade and shall not terminate directly above a gas utility meter or gas service regulator.
- Manual shut-off valves shall be used as specified in the current Canadian Natural Gas and Propane Installation Code, CAN/CSA B149.1. A manual shut-off valve shall be of the plug, ball, or eccentric type and it shall not be subjected to either a temperature or a pressure greater than its certified rating. A readily accessible manual shut-off valve shall be installed to control the supply of gas to each appliance and the valve shall be located, in either the drop or riser, as close as possible to the valve train of a commercial and industrial type appliance.

AIRCRAFT HANGARS

- These overhead heaters are suitable for use in aircraft hangars when installed in accordance with the current Canadian Natural Gas and Propane Installation Code, CAN/CSA B149.1.
- A heater located in an aircraft storage or servicing area shall be installed so that no portion of an aircraft that can occupy the area that is within the clearance to combustible material, as marked on the heater rating plate.
- When an infrared heater is installed in either a repair or shop area that communicates with an aircraft hangar, the minimum clearance from the floor to the infrared heater shall be 8 ft (2.4m).
- An infrared heater shall not be located in an area of an aircraft hangar where it can be subjected to physical damage by aircraft, cranes, movable scaffolding, or other objects.

GARAGES

- These overhead heaters are suitable for use in garages when installed in accordance with the current Canadian Natural Gas and Propane Installation Code, CAN/CSA B149.1.
- The minimum clearance from the radiant face of the infrared heater to the upper surface of the highest vehicle shall not be less than the certified clearance from combustible material as indicated on the heater [installed in a garage or a car wash]. Provision shall be made to maintain these minimum specified clearances by an interlock that shuts off the gas supply until the required clearances have been re-established, a protective bar, or a device that provides a warning when the clearances are not being maintained.
- Where an infrared heater is installed in a garage and the clearance from combustible material cannot be maintained when the vehicle is raised on a hoist, an electrical interlock shall be provided to shut off the burner and prevent its operation until the required clearance has been re-established.

▲ WARNING ▲

- An overhead heater should be installed so that the minimum clearances marked on the heater will be maintained from vehicles parked below the heater. (CSA 2.34, section 1.26.3.e.)



CLEARANCE TO COMBUSTIBLES*

<p>CLEARANCES FOR ALL HEATERS* inches (cm)</p> <p><u>TOP OF REFLECTOR</u> 12 (31)</p> <p><u>END OF BURNER</u> 12 (31)</p> <p><u>END OF U-BEND</u> 68 (173)</p>	<p style="text-align: center;">CLEARANCES DEPENDENT ON REFLECTOR ANGLE</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>0° Angle</p> </div> <div style="text-align: center;"> <p>1°-30° Angle</p> </div> <div style="text-align: center;"> <p>31°-45° Angle</p> </div> </div> <ul style="list-style-type: none"> T = Top, F = Front, B = Below, R = Rear. Reflector width = 15.75" (40 cm) Top, Front, and Rear clearances are measured from reflector. Below clearance is measured from bottom of tube. Clearance to combustibles* measurements are given in inches (cm). Only models suspended by clamps can use 31° - 45° reflector angles.
---	---

SERIES	INPUT MBTUH (kW)	0° TO 30° REFLECTOR ANGLE			31° TO 45° REFLECTOR ANGLE		
		FRONT	REAR	BELOW	FRONT	REAR	BELOW
A	40 (12)	40 (102)	40 (102)	40 (102)	40 (102)	12 (31)	40 (102)
	45 (13)						
MB B	50 (15)	24 (61)	24 (61)	60 (152)	na	na	na
	55 (16)						
	60 (18)						
B	65 (19)	24 (61)	24 (61)	60 (152)	na	na	na
	70 (21)						
B MC	75 (22)	32 (82)	32 (82)	72 (183)	na	na	na
	80 (23)						
	85 (25)						
	90 (26)						
B / MC / C	95 (28)	48 (122)	48 (122)	82 (209)	70 (189)	12 (31)	82 (209)
MC / C	100 (29)						
C	105 (31)	58 (148)	58 (148)	92 (234)	80 (203)	12 (31)	92 (234)
	110 (32)						
	115 (34)						
	120 (35)	68 (173)	68 (173)	102 (259)	90 (229)	12 (31)	102 (259)
	125 (37)						
	130 (38)						
C	135 (40)	68 (173)	68 (173)	102 (259)	90 (229)	12 (31)	102 (259)
	140 (41)						
	145 (42)						
	150 (44)						
	155 (45)						
	160 (47)						
	165 (48)						
170 (50)							
175 (51)							
C	180 (53)	68 (173)	68 (173)	102 (259)	90 (229)	12 (31)	102 (259)
	185 (54)						
	190 (56)						
	195 (57)						
	200 (59)						

- *MINIMUM CLEARANCES** specified in these tables must be maintained to combustible and other materials which may be damaged by temperatures 90°F above (50°C above) ambient room temperature. See heater's rating / serial plate for input BTUH rating and clearance to combustibles. These clearances to combustibles are specified on each heater's serial plate. In locations used for the storage of combustible materials, signs must be posted to specify the maximum permissible stacking height to maintain required clearances from the heater to the combustibles. (ANSI Z223.1/NFPA 54) Gas and electrical supply lines shall not be located within the minimum clearances to combustibles. na = not applicable.
- Carefully examine materials surrounding the heater. The stated clearance to combustibles represents a surface temperature of 90°F above (50°C above) room temperature. Building materials with a low heat tolerance (such as plastic, vinyl siding, canvas, tri-ply, etc.) may be subject to degradation at lower temperatures and can be discolored or damaged. It is the installer's responsibility to assure that adjacent materials are protected from degradation.
- Fire sprinkler heads must be located at an appropriate distance from the heater. This distance may exceed the published clearance to combustibles. Certain applications will require the use of high temperature sprinkler heads or relocation of the heaters. Sprinkler systems containing propylene glycol or other flammable substances are not to be used in conjunction with this heater without careful consideration for and avoidance of potential fire or explosion hazards. For further information consult NFPA 13. Always observe applicable state and local codes.

MOUNTING CONSIDERATIONS

- Clearance to combustible materials must be maintained.
- Mounting heights lower than the recommended **Minimum Height** may be used if personnel are not kept directly under heater.
- The **Distance From Wall** measurement provides the most effective heat dispersion balance between the floors and walls.
- There is practically no limitation on a maximum mounting height, however, the higher the heater is mounted the less radiant heat is felt at the floor directly below the heater.
- By design, a straight infrared radiant tube heater will produce more heat at the burner end than at the exhaust end. Locate the burner end where more heat is desired.

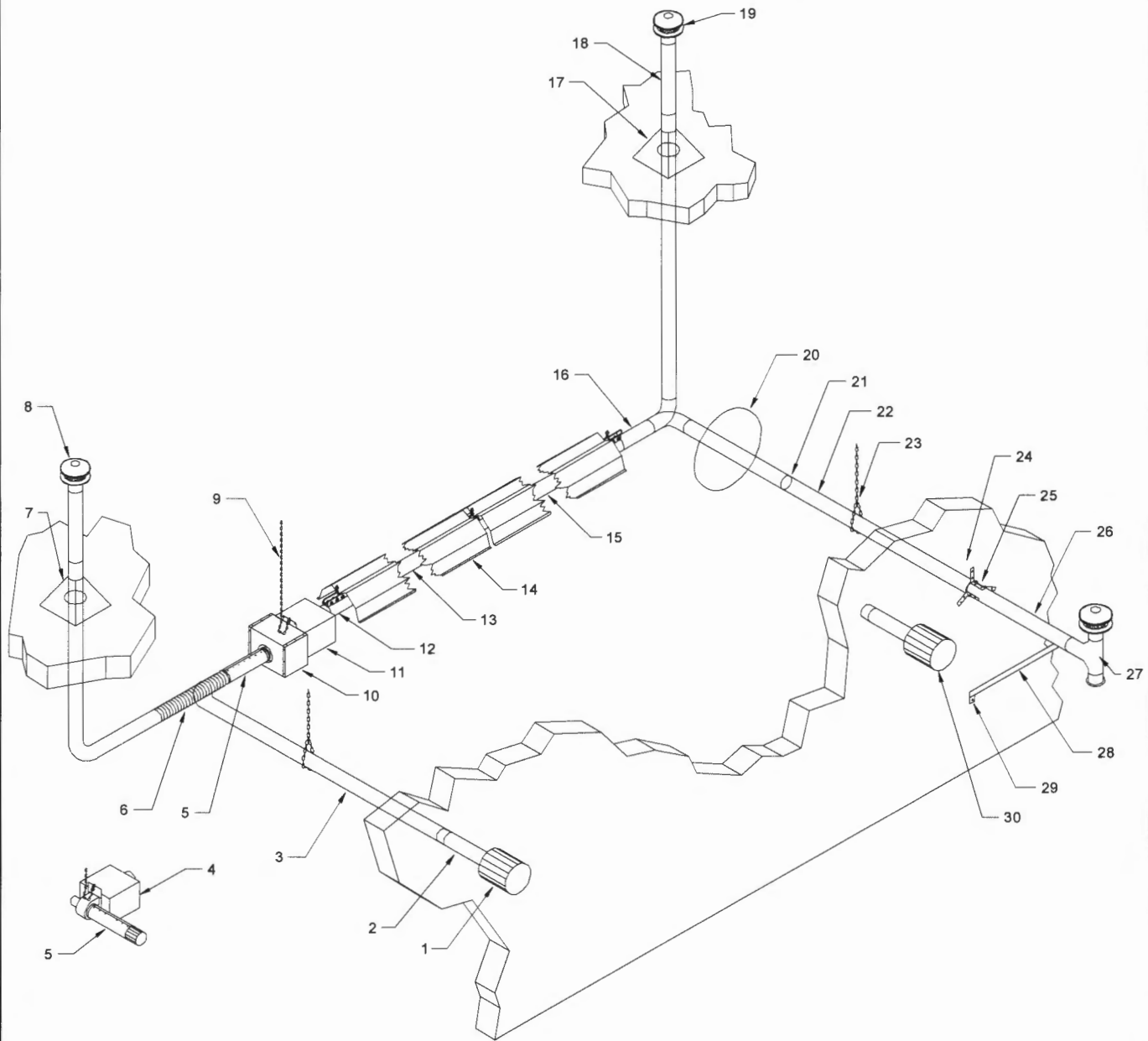
Reflector:	Standard				Parabolic				Standard & Parabolic
Mounting Angle:	Horizontal	30° - 45°	Horizontal	30° - 45°	Horizontal	30° - 45°	Horizontal	30° - 45°	Horizontal & 30° - 45°
Input MBTUH (kW)	Minimum Height feet (m)		Distance From Wall feet (m)		Minimum Height feet (m)		Distance From Wall feet (m)		Max. Distance Between Rows feet (m)
40 (12)	9.5 (2.9)	7.5 (2.3)	6 (1.8)	1 (0.3)	11.5 (3.5)	9.5 (2.9)	4 (1.2)	1 (0.3)	80 (24.4)
45-50 (13-15)	10.0 (3.0)	8.0 (2.4)	6 (1.8)	1 (0.3)	12.0 (3.7)	10.0 (3.0)	4 (1.2)	1 (0.3)	80 (24.4)
55-60 (16-18)	10.5 (3.2)	8.5 (2.6)	6 (1.8)	1 (0.3)	12.5 (3.8)	10.5 (3.2)	4 (1.2)	1 (0.3)	80 (24.4)
65-75 (19-22)	11.0 (3.4)	9.0 (2.7)	8 (2.4)	1 (0.3)	13.0 (4.0)	11.0 (3.4)	6 (1.8)	1 (0.3)	80 (24.4)
80-85 (23-25)	11.5 (3.5)	9.5 (2.9)	8 (2.4)	1 (0.3)	13.5 (4.1)	11.5 (3.5)	6 (1.8)	1 (0.3)	90 (27.4)
90-95 (26-28)	12.0 (3.7)	10.0 (3.0)	8 (2.4)	1 (0.3)	14.0 (4.3)	12.0 (3.7)	6 (1.8)	1 (0.3)	95 (29.0)
100-105 (29-31)	12.5 (3.8)	10.5 (3.2)	8 (2.4)	1 (0.3)	14.5 (4.4)	12.5 (3.8)	6 (1.8)	1 (0.3)	95 (29.0)
110-115 (32-34)	13.0 (4.1)	11.0 (3.4)	12 (3.7)	1 (0.3)	15.0 (4.6)	13.0 (4.1)	9 (2.7)	1 (0.3)	100 (30.5)
120 (35)	13.5 (4.1)	11.5 (3.5)	12 (3.7)	1 (0.3)	15.5 (4.7)	13.5 (4.1)	9 (2.7)	1 (0.3)	100 (30.5)
125 (37)	14.0 (4.3)	12.0 (3.7)	12 (3.7)	1 (0.3)	16.0 (4.9)	14.0 (4.3)	9 (2.7)	1 (0.3)	105 (32.0)
130 (38)	14.5 (4.4)	12.5 (3.8)	12 (3.7)	1 (0.3)	16.5 (5.0)	14.5 (4.4)	9 (2.7)	1 (0.3)	105 (32.0)
135-140 (40-41)	15.0 (4.6)	13.0 (4.0)	12 (3.7)	1 (0.3)	17.0 (5.2)	15.0 (4.6)	9 (2.7)	1 (0.3)	105 (32.0)
145 (42)	15.5 (4.7)	13.5 (4.1)	12 (3.7)	1 (0.3)	17.5 (5.3)	15.5 (4.7)	9 (2.7)	1 (0.3)	105 (32.0)
150 (44)	16.0 (4.9)	14.0 (4.3)	12 (3.7)	1 (0.3)	18.0 (5.5)	16.0 (4.9)	9 (2.7)	1 (0.3)	105 (32.0)
155-160 (45-47)	16.5 (5.0)	14.5 (4.4)	13 (4.0)	1 (0.3)	18.5 (5.6)	16.5 (5.0)	10 (3.0)	1 (0.3)	105 (32.0)
165-170 (48-50)	17.0 (5.2)	15.0 (4.6)	13 (4.0)	1 (0.3)	19.0 (5.8)	17.0 (5.2)	10 (3.0)	1 (0.3)	110 (33.5)
175-180 (51-53)	17.5 (5.3)	15.5 (4.7)	14 (4.3)	1 (0.3)	19.5 (5.9)	17.5 (5.3)	11 (3.4)	1 (0.3)	110 (33.5)
185-190 (54-56)	18.0 (5.5)	16.0 (4.9)	14 (4.3)	1 (0.3)	20.0 (6.1)	18.0 (5.5)	11 (3.4)	1 (0.3)	115 (35.1)
195-200 (57-59)	18.5 (5.6)	16.5 (5.0)	15 (4.6)	1 (0.3)	20.5 (6.2)	18.5 (5.6)	12 (3.7)	1 (0.3)	115 (35.1)

HIGH ALTITUDE

- High altitude is any altitude greater than 2000 feet (610 m) above sea level.
- These heaters are manufactured for use at the specific altitude range stated on the heater serial plate. Do not install heater if it is not rated for the correct altitude. Contact factory if in doubt.



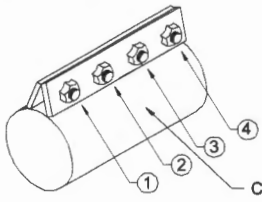
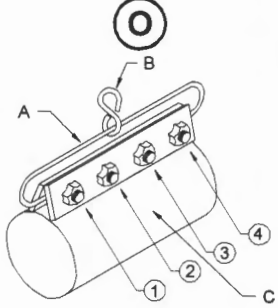
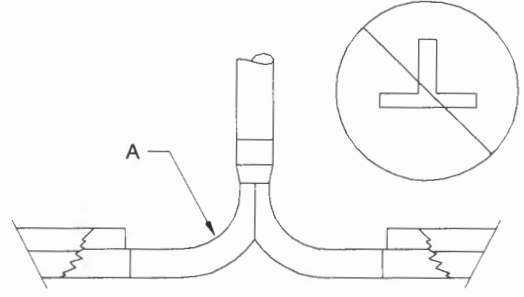

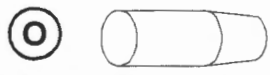
OVERVIEW DRAWINGS (1 OF 2)



LEGEND FOR OVERVIEW DRAWINGS

- | | |
|--|---|
| <ol style="list-style-type: none"> 1. Air supply wall vent cap (accessory) 2. B-vent adaptor (accessory) 3. Combustion air supply piping (by others) 4" (10cm) single-wall stainless or galvanized steel sheet metal pipe with seam at top or schedule 40 PVC pipe. Combustion air supply piping must not exceed 35 linear feet (10m)* for 40 to 125 MBTUH (12-37kW) heaters or must not exceed 40 linear feet (12m)* for 130 to 200 MBTUH (38-59kW). *Each 90° elbow inserted in the combustion air system is equivalent to 10 linear feet (3m). No more than two 90° elbows are allowed. Support as necessary. | <ol style="list-style-type: none"> 4. Burner without blower enclosure. Minimum clearance 12" (30cm) 5. Inlet air sleeve (accessory) with seam at top for use with outdoor air supply 6. Flexible duct (accessory) 7. Roof flashing (by others) 8. Air supply roof vent cap (accessory) must be 6" (15cm) higher than snow depth. <p>Legend continued on the next page.</p> |
|--|---|

OVERVIEW DRAWINGS (2 OF 2)

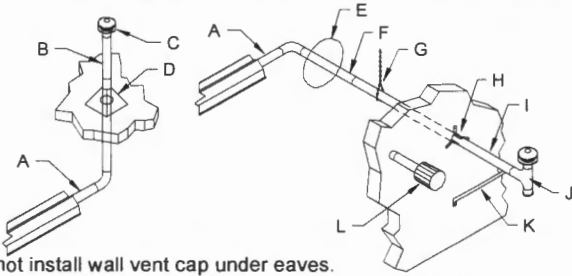
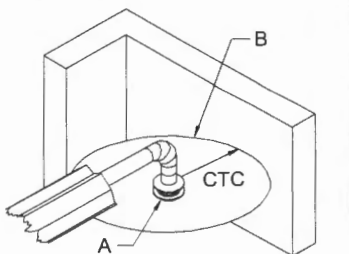
LEGEND FOR OVERVIEW DRAWINGS - CONTINUED	TUBE CLAMP
<p>9. Safety chain (by others). Distance from suspension point to top of burner cover plus 6" (15cm) equals the length of the safety chain. Safety chain and mounting chain must be 1/0 tenso and have a minimum working load rating of 200 lbs. (90kg). S-hooks must be 1/4" (6mm) diameter steel wire, 3/4" (19mm) inside hook diameter, 350 lb. (159kg) pull test.</p> <p>10. Blower enclosure (accessory)</p> <p>11. Burner. Minimum clearance 12" (30cm)</p> <p>12. Tube clamp</p> <p>13. Combustion chamber</p> <p>14. Reflector</p> <p>15. Heat exchanger</p> <p>16. Vent pipe adaptor (accessory). Not used with press-fit tubes.</p> <p>17. Roof flashing (by others)</p> <p>18. B-vent pipe adaptor (by others)</p> <p>19. Roof vent cap (accessory)</p> <p>20. Clearance to combustibles is 18" (46cm) for the entire length of exhaust vent piping.</p> <p>21. All indoor exhaust vent joints require the use of RTV silicone adhesive sealant to prevent hot flue gas leakage into the building (use a sheet metal pipe and crimper for joining identical size sheet metal pipes). Use three (3) #6 sheet metal screws (SMS) per vent pipe joint. Vent pipe seam should be on top with one SMS on top and one SMS 120° from top on each side.</p> <p>22. Exhaust vent piping (by others) 4" (10cm) single-wall galvanized steel sheet metal pipe (seam must be at top) or other factory-approved materials. Exhaust vent piping must not exceed 35 linear feet (10m)* for 40 to 125 MBTUH (12-37kW) heaters or must not exceed 40 linear feet (12m)* for 130 to 200 MBTUH (38-59kW). *Each 90° elbow inserted in the venting system is equivalent to 10 linear feet (3m). No more than two 90° elbows are allowed.</p> <p>23. Non-combustible support (by others) every 5 or 6 feet (1.5 or 1.8m) apart and adequate for the piping weight.</p> <p>24. For combustible walls only require use of a 2" (51mm) clearance non-combustible ventilating metal thimble (by others). For non-combustible walls only use a 4.25" (108mm) diameter hole for 4" (10cm) pipe and add non-combustible protection around the hole if necessary.</p> <p>25. Angle brace (accessory) three (3) 90° brackets equally spaced.</p> <p>26. 24" (61cm) minimum clearance above or beyond the highest structure or surface within 10 feet (3m) of the vent.</p> <p>27. Wall venting kit (accessory)</p> <p>28. Wall brace (accessory)</p> <p>29. Use appropriate fastener (by others) for attaching wall brace to building material.</p> <p>30. Wall vent cap (accessory) alternate</p>	<div style="display: flex; justify-content: space-around;"> <div style="width: 45%;"> <p style="text-align: center;"><u>Black Iron Models Suspended by Hangers</u></p> <p style="text-align: center;">V</p>  </div> <div style="width: 45%;"> <p style="text-align: center;"><u>Models Suspended by Clamps</u></p> <p style="text-align: center;">O</p>  </div> </div> <ul style="list-style-type: none"> Tighten all tube clamp nuts on all tube clamps. Tighten nuts a half turn at a time, in a 2, 3, 4, 1 sequence, where 1 is always closest to the burner. Tighten nuts with a torque wrench until the flanges of the clamp touch and 65 ft.-lbs. (88 Nm) is achieved at each nut to assure proper seating of the clamps' inner sleeve. Do not pinch the clamp hanger between the flanges, when hanger provided. <p>LEGEND</p> <p>A. Clamp hanger (when provided). Do not pinch the clamp hanger between the flanges!</p> <p>B. Hook of clamp hanger must be closed (when hanger provided)</p> <p>C. Internal tube clamp stop (not shown)</p> <p style="text-align: center;">OPTIONAL COMMON VENTING</p>  <ul style="list-style-type: none"> Never use a straight through tee. Both heaters must be controlled by the same thermostat. <p>LEGEND</p> <p>A. Y-coupler 4" x 4" x 5" (10cm x 10cm x 10cm) (accessory)</p> <p style="text-align: center;">VENT PIPE ADAPTOR</p> <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <ul style="list-style-type: none"> 4" (10cm) sheet metal stub standard with black iron models suspended by hangers. <p style="text-align: center;">V</p>  </div> <div style="width: 45%;"> <ul style="list-style-type: none"> 4" (10cm) steel connector accessory for models suspended by clamps. <p style="text-align: center;">O</p>  </div> </div>
<p>CAUTION</p> <ul style="list-style-type: none"> The first twenty (20) feet (6m) of radiant tube extending from the burner MUST be installed straight. There is one exception. A U-Tube heater may have a 180-degree U-bend interposed AFTER the first ten (10) feet (3m). Electrical supply wiring diagrams are in the ELECTRICAL SUPPLY AND THERMOSTATIC CONTROL section. Gas supply piping diagrams are in the GAS SUPPLY AND GAS PRESSURE section. 	



COMBUSTION AIR SUPPLY

GENERAL NOTES	MAXIMUM LENGTH OF AIR SUPPLY PIPE
<ul style="list-style-type: none"> • Untaminated atmospheric air for combustion may come from either outdoors or indoors (from within the building). • Installation of combustion air supply must comply with the instructions, drawings, and installation notes provided in this section. 	<p>35 linear feet (10 m)* for 40 to 125 MBTUH (12 – 37 kW) models. 40 linear feet (12 m)* for 130 to 200 MBTUH (38 – 59 kW) models.</p> <p>*Each 90-degree elbow inserted in the venting system is equivalent to 10 linear ft. (3 m). *Each 45-degree elbow inserted in the venting system is equivalent to 5 linear ft. (1.5 m).</p> <p>A maximum of two 90-degree elbows or their equivalent are allowed (e.g. one 90-degree elbow plus two 45-degree elbows; or four 45-degree elbows, etc.)</p>
OUTDOOR AIR SUPPLY	OUTDOOR AIR SUPPLY THRU-THE-WALL DIAGRAM
<ul style="list-style-type: none"> • Untaminated atmospheric air for combustion may come from either outdoors or indoors (from within the building). • Installation of combustion air supply must comply with the instructions, drawings, and installation notes provided in this section. • In buildings contaminated with excessive dust or dirt, or containing substances which when combined with flame and exhaust products result in corrosive gasses or those under a negative pressure, or high humidity areas, combustion air must come from outdoors. • Outdoor air supply may be accomplished by bringing in air through piping from either the roof or wall as the drawings illustrate. • When combustion air is supplied from outdoors, the heater must also be vented to the outdoors (EXCEPT high humidity environments consult factory). • The roof venting cap used for inlet air cap (roof), inlet air wall cap or inlet air box (wall) must be located at least three (3) feet (91 cm) away from any vent termination and in a manner to prevent blockage by snow. • Components supplied by others must be identical to those specified in this manual and be Metalbestos brand, or equal, for the roof vent cap; and Simpson Dura-Vent, or equal, for the wall vent cap. NO SUBSTITUTIONS. • Single wall 4" (10 cm) diameter stainless or galvanized sheet metal pipe or schedule 40 PVC is recommended for combustion air supply piping. • It may be desirable to insulate piping with 1 inch (2.5 cm) of pipe insulation to eliminate condensation from warm inside air. • DO NOT use collapsible material for combustion air supply, as it will restrict the proper amount of combustion air from being supplied to the burner. • An optional blower enclosure extends the burner housing to enclose the blower. The outdoor air piping is then attached to the enclosure, isolating the outside of the blower and motor from contaminants. 	
INDOOR AIR SUPPLY	LEGEND FOR OUTDOOR AIR SUPPLY DIAGRAMS
<ul style="list-style-type: none"> • When combustion air is to be taken from inside a tightly closed building, an opening to the outdoors must be installed to supply the burner with sufficient air for combustion. • For every 4,000 BTUH (1.17 kW) input of the total input of ALL gas-fired equipment, one (1) square inch (6.45 cm²) or more of free area opening must be provided. • The openings should be located above the heaters to reduce the effect of drafts. • Do not draw combustion air into the heater from attic space or another tightly closed room. There is no guarantee adequate air will be supplied. 	<ul style="list-style-type: none"> A. Blower B. Air orifice plate C. Blower enclosure (accessory) D. Inlet air collar (accessory) E. Inlet air sleeve (accessory) with seam at top F. Hose clamp (accessory) G. Flexible duct (accessory) H. Combustion air supply piping (by others) 4" (10cm) single-wall stainless or galvanized steel sheet metal pipe with seam at top or schedule 40 PVC pipe. See maximum length above. I. Support as necessary (by others) J. B-vent adaptor (accessory) K. Air supply wall vent cap (accessory) requires B-vent adaptor L. Roof flashing (by others) M. Air supply roof vent cap (accessory)
	OUTDOOR AIR SUPPLY THRU-THE-ROOF DIAGRAM

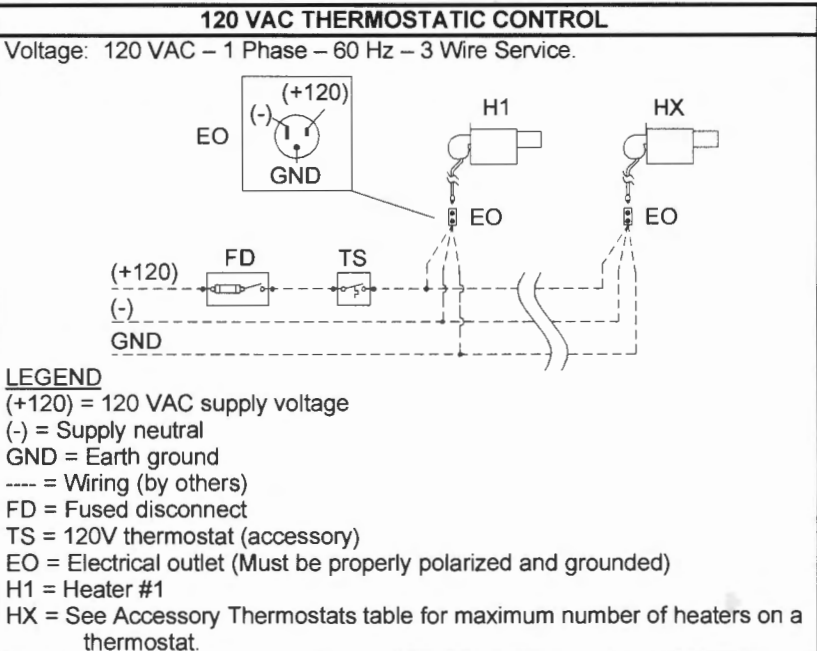
EXHAUST VENTING

OUTDOOR EXHAUST VENTING	MAXIMUM LENGTH OF EXHAUST VENT PIPE			
<ul style="list-style-type: none"> A heater operating with positive vent static pressure and a vent gas temperature that avoids excessive condensate production in the vent is classified as a Category III Vented Appliance. This heater may be vented through the roof or use horizontal venting thru-the-wall singularly or in conjunction with no more than one other heater with a single thermostat. To vent more than two heaters together consult the factory. Use 4-inch (10cm) single-wall stainless or galvanized steel sheet metal pipe with seam at top (or other factory approved materials) for exhaust vent piping. Use RTV silicone adhesive sealant liberally at all vent pipe joints. Use three (3) #6 sheet metal screws per vent pipe joint – 120° apart starting at the top. Recommend 1-inch (25mm) thick pipe insulation wrapped around single wall sheet metal vent pipe. By code, the use of dual wall pipe for outdoor venting is limited to appliances with neutral or negative pressures. Local authorities may waive this provision since the heaters are approved for indoor venting with proper exhaust and leakage due to condensation being greatly reduced. Be certain to get approval for either type of vent piping from local authorities. Vent pipes must be well supported with non-combustible supports every 5 or 6 feet (1.5 or 1.8m) due to the extra stress that occurs during expansion of the unit when operating. Vent caps must be identical to, or equal to, the Metalbestos brand for roof venting or Simpson Dura-Vent brand for horizontal venting thru-the-wall. This is critical to the heater's operation and to maintain CSA certification. NO SUBSTITUTIONS. Do not vent heater between buildings less than 10 feet (3m) apart or above public walkways, doors or windows. 	<p>35 linear feet (10m)* for 40 to 125 MBTUH (12–37 kW) models. 40 linear feet (12m)* for 130 to 200 MBTUH (38–59 kW) models.</p> <p>*Each 90-degree elbow inserted in the venting system is equivalent to 10 linear feet (3 m). *Each 45-degree elbow inserted in the venting system is equivalent to 5 linear feet (1.5 m).</p> <p>A maximum of two 90-degree elbows or their equivalent are allowed (e.g. one 90-degree elbow plus two 45-degree elbows; or four 45-degree elbows, etc.)</p>			
	DISTANCES OF OUTDOOR EXHAUST VENT FROM:			
	ITEM	BELOW Inches (cm)	HORIZONTAL Inches (cm)	ABOVE Inches (cm)
	Door	na	48 (122)	na
Window	48 (122)	12 (30)	na	
Gravity Air Inlet	na	na	12 (30)	
Forced Air Inlet Within 10 ft. (3.0 m)	na	na	36 (91)	
Grade	na	na	12 (30)	
Gas & Electric Meters, Regulators & Relief Valves	na	48 (122)	na	
THRU-THE-ROOF OR WALL OUTDOOR EXHAUST VENTING				
 <ul style="list-style-type: none"> Do not install wall vent cap under eaves. Roof vent cap must be 6" (15cm) higher than snow depth. 				
LEGEND				
<ul style="list-style-type: none"> A. Vent pipe adaptor (accessory) B. B-vent pipe adaptor (accessory) C. Roof vent cap (accessory) D. Roof flashing (by others) E. Clearance to combustibles is 18" (46cm) for the entire length of vent pipe F. Exhaust vent piping (by others) 4" (10cm) single-wall stainless or galvanized steel sheet metal pipe with seam on top. See maximum length above. G. Non-combustible support (by others) every 5 or 6 feet (1.5 or 1.8m) apart. H. Angle brace (accessory) three (3) pieces equally spaced. I. 24" minimum clearance above or beyond the highest structure or surface within 10 feet (3m) of the vent. J. Wall venting kit (accessory) K. Wall brace (accessory) L. Wall vent cap (accessory) alternate 				
IMPORTANT				
<ul style="list-style-type: none"> Systems with clamped tubes suspended by separate hangers use a factory-supplied sheet metal Vent Pipe Adaptor to connect venting to exhaust end of tube. Use RTV silicone adhesive sealant and three (3) self-drilling screws to attach. Systems with clamped tubes suspended by clamps may use an accessory steel Vent Pipe Connector to avoid crushing sheet metal venting. 				
UNVENTED (INDOOR VENTING)				
<ul style="list-style-type: none"> Where unvented infrared heaters are used, natural or mechanical means shall be provided to supply and exhaust at least [4 CFM per 1,000 BTUH] 4 ft³/min per 1000 Btu/hr (.38 m³/min/kW) input of installed heaters. (ANSI 2223.1/NFPA 54.) In Canada see CANADIAN CODES section. Flue products contain about 1 liter of water per 100 MBTU of natural gas, which can condense on cold surfaces. Increased ventilation decreases condensation. Exhaust openings for removing flue products shall be above the level of the heaters. Where all combustion air is provided by a mechanical air supply system, the combustion air shall be supplied from outdoors at the minimum rate of 0.35 ft³/min per 100 Btu/hr (0.034 m³/min per kW) for all appliances located within the space. Where exhaust fans are installed, additional air shall be provided to replace the exhausted air. Each appliance served shall be interlocked to the mechanical air supply system to prevent main burner operation where the mechanical air supply system is not in operation. Combustion air must not be provided directly from outdoors to the burner. For exceptions see COMBUSTION AIR SUPPLY section. 				
UNVENTED (INDOOR VENTING) CLEARANCES				
<ul style="list-style-type: none"> CLEARANCE TO COMBUSTIBLES (CTC*) must be maintained from exhaust end of heater. 				
INPUT MBTUH (kW) 40 to 60 (12 - 18) 65 to 100 (19 - 29) 105 to 125 (31 - 37) 130 to 150 (38 - 44) 155 to 175 (45 - 51) 180 to 200 (53 - 59)	CTC* 10" (25 cm) 30" (76 cm) 38" (97 cm) 48" (122 cm) 58" (147 cm) 68" (173 cm)			
<ul style="list-style-type: none"> Minimum clearance from ceiling is 15" (38cm) measured from top of reflector. 				
LEGEND				
<ul style="list-style-type: none"> A. Indoor venting kit B. Combustible objects must not be within radius of CTC. CTC. Clearance to combustibles is measured from end of the indoor venting kit. 				



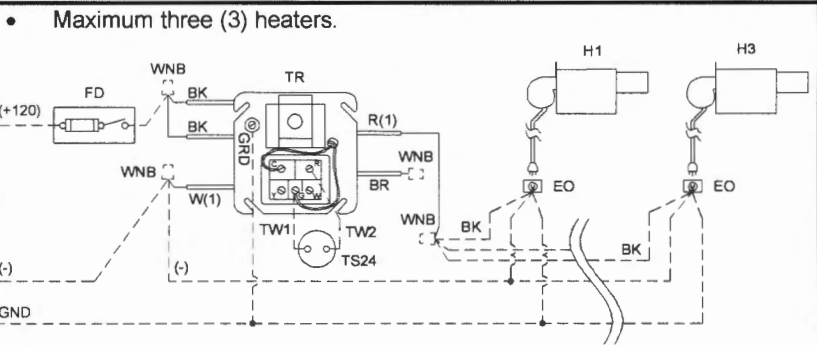
ELECTRICAL SUPPLY AND THERMOSTATIC CONTROL

- ELECTRICAL SUPPLY**
- Voltage: 120 VAC – 1 phase – 60 Hz.
 - Maximum Amps: 3.0 (1.33 actual full load amps).
 - Flame safety: Electronic.
 - Ignition: Direct Spark.
 - Wiring must conform to the latest edition of the National Electric Code (ANSI/NFPA 70) or local code legally authorized.
 - Have a qualified electrician check that the electrical supply circuit and wall receptacle are properly grounded and that the electrical supply polarity is correct. The heater control is polarity sensitive and will not operate properly if the electrical supply is not wired correctly.
 - Electrical power takeoff must be connected to a separately fused circuit with a disconnect, and must be properly polarized and grounded to the heater's power cord.
 - Do not run wiring over the heaters or in direct view of radiant heat.
 - If any of the wiring supplied must be replaced use type 16 AWG (1.0mm²), or equivalent with 2/64" (.08cm) insulation and a minimum insulation temperature of 302°F (150°C).



- GENERAL INSTALLATION NOTES**
- Locate the thermostat as specified in the heating plan.
 - If it is not in the heating plan, follow the instructions provided with the thermostat.
 - If instructions are not provided with the thermostat, locate it four to five feet above the floor where it will not be directly affected by the heat from the heater, outside drafts, or the sun.
 - A location that best represents the average temperature of the room is the most desirable.
 - If two heaters are installed on a common exhaust vent they must be controlled by the same thermostat.

24 VAC THERMOSTATIC CONTROL WITH TRANSFORMER RELAY



CAUTION – 24VAC THERMOSTAT

DO NOT try to connect more than three burners to a 24 VAC thermostat. The transformer relay is rated to operate only three heaters safely. Failure to do so may cause serious bodily harm or property damage.

ACCESSORY THERMOSTATS

Thermostat	Volts AC	Amps	Maximum Number of Heaters
132026-4	120	22.0	7
132486	120	16.0	5
0002-42-157	120	16.0	5
132700	24	.15-1.0	3*
0002-42-122	24	2.5	3*
0002-42-121	24	1.5	3*

* When installing these heaters to any thermostat, the installer should allow for 3 amps per heater as the blower tends to use more electricity than its rating during its start-up period. This is why all of the 24 VAC thermostats must be connected to a 120 VAC transformer relay, which will safely support only three heaters.

Caution: The brown wire is not used, but will be electrically hot at times. Protect personnel and the circuit by screwing on a wire nut.

OPERATION AND SHUTDOWN

SEQUENCE OF OPERATION

1. Thermostat calls for heat.
2. 120 VAC is applied to the blower and validation light PL-1 indicates power is ON.
3. Air flow switch closes contacts after it senses an increase in air pressure due to fan reaching operational speed.
4. Validation light PL-2 indicates combustion air supply and exhaust venting backpressure is normal.
5. Ignition Detection Control (IDC) is turned on and begins a pre-purge time period.
6. A spark is developed at the igniter and the gas valve is opened to the first step of its two step operation.
7. Burner ignites and 5 seconds later the gas valve steps up to its operating position. DC electrical current flows from sensing electrode through flame to ground.
8. IDC senses flame presence, turns OFF spark, gas continues flowing through valve.
9. Validation light PL-3 indicates normal burner operation.
10. During first trial-for-ignition period or upon any flame outage at sensing electrode, the IDC responds and begins sparking within 0.8 seconds. A 15-second trial-for-ignition period begins to re-light the burner. If flame is re-established, normal operation resumes. If the burner does not light after first try, the inter-purge sequence is completed between trials to re-light the burner. If the burner fails to light (10DX-117) or after third trial (35-725), IDC will de-energize the valve and go into lockout mode.
11. For lockout recovery, reset thermostat below ambient temperature or disconnect electrical power supply for five (5) seconds.
12. If the flame does fail during ignition or normal operation, it is detected by the flame sensor rod, and the IDC then closes the gas valve locking out the system until the thermostat is cycled to the OFF position.
13. When the thermostat is satisfied, the whole system is de-energized until another call for heat.
14. When installing or servicing this heater, wait at least 5 minutes between attempts for ignition.

VALIDATION LIGHTS

- 1 Light On:** The PL-1 light illuminated indicates 120 VAC has reached the blower and a call for heat has been made.
- 2 Lights On:** The PL-1 and PL-2 lights illuminated indicates the blower has come up to speed and the air flow switch electrical contacts closed sending 120 VAC to the Ignition Detection Control (IDC).
- 3 Lights On:** The PL-1, PL-2 and PL-3 lights illuminated indicates the IDC is sending 120 VAC to the gas valve to cause it to open permitting gas to flow the burner.

SHUTDOWN

- To shutdown the heater for **a week or less**, switch off the electrical supply to the heater.
- To shutdown the heater for **more than one week**, switch off the electrical supply to the heater and turn off the gas supply at the gas isolation valve.



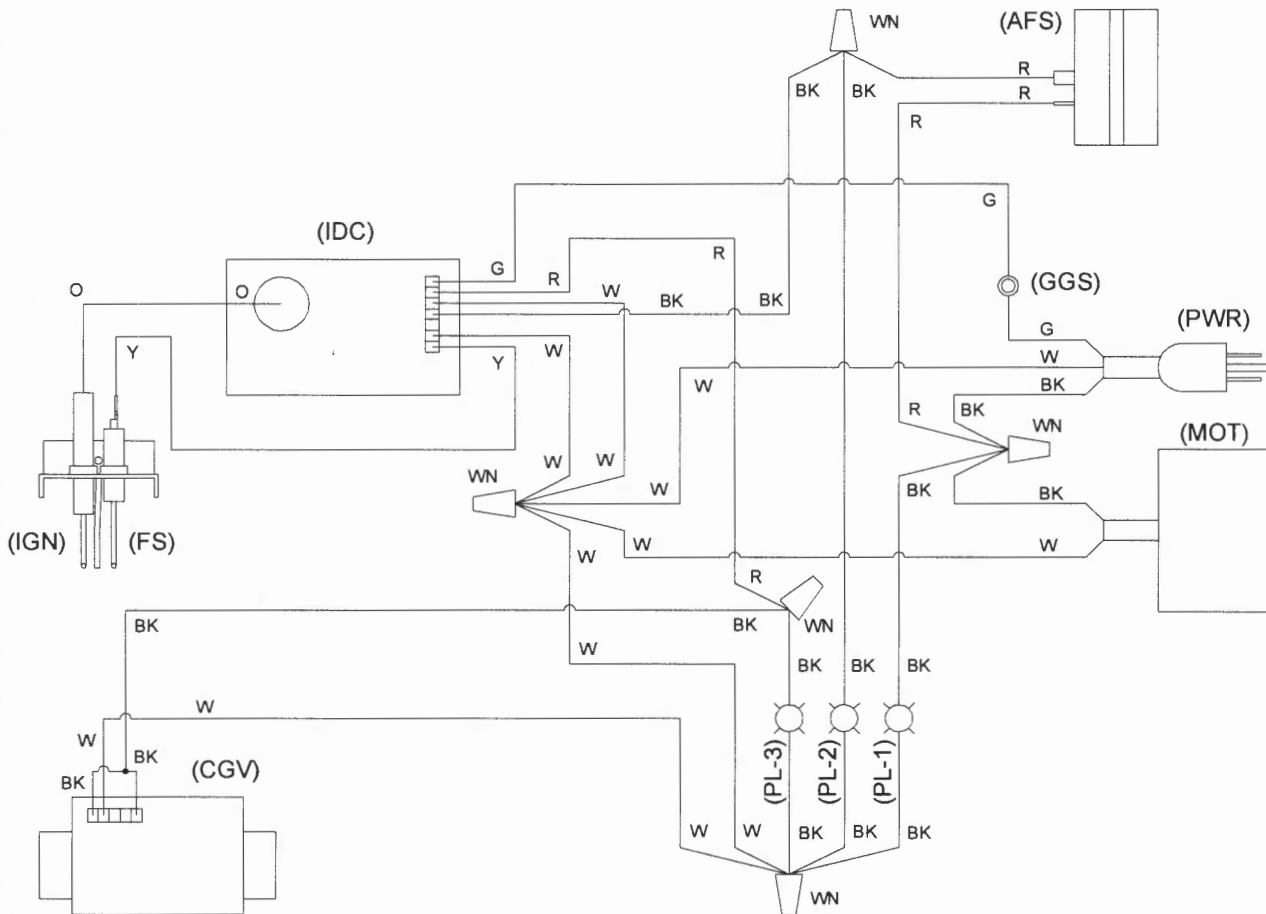
BURNER WIRING (1 OF 2)

ELECTRICAL CONNECTION DIAGRAM

120 VAC – 60 HZ – 1 PHASE

HEATER MAXIMUM CURRENT DRAW = 3.0 AMPS.

TOTAL HEATER POWER CONSUMED = 360 VA



If any of the original wire as supplied with the appliance must be replaced, it must be replaced with wiring material having a temperature rating of at least 302°F (150°C) and shall have a minimum size of 16 AWG (1.0mm²).

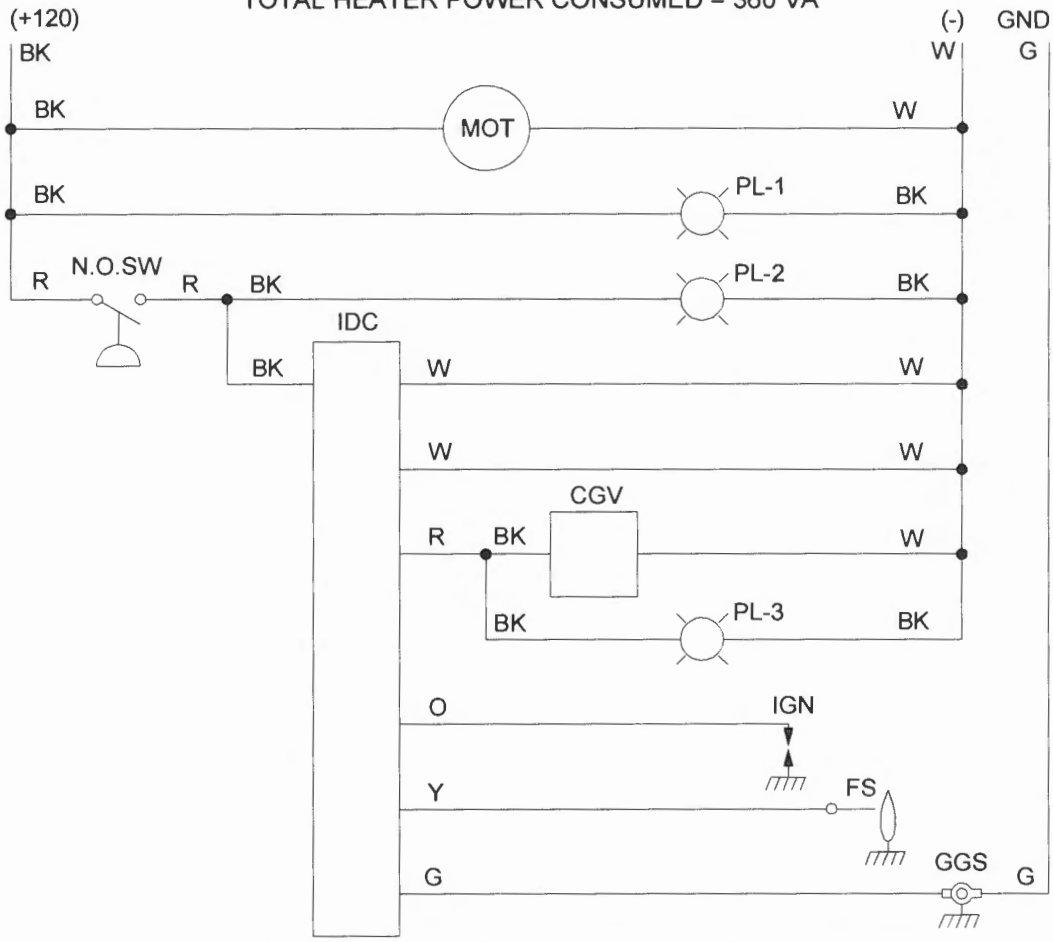
LEGEND

- PWR = Power supply cord, not provided when blower enclosed (120 VAC – 1 phase – 60 Hz – 3 wire service)
- GGG = Green ground screw
- MOT = Motor for blower
- AFS = Airflow switch
- IDC = Ignition detection control
- CGV = Combination gas valve
- IGN = Ignitor
- FS = Flame sensor
- WN = Wire nut
- G = Green wire – Ground
- R = Red wire – 120V from ignition detection control to combination gas valve, 120V to and from airflow switch
- W = White wire – Supply neutral
- BK = Black wire – 120V supply power, 120V to blower motor, 120V to combination gas valve, Validation lights
- Y = Yellow wire – Flame sense
- O = Orange wire – High voltage ignition
- PL-1 = Validation light 1 – 120V going to motor for blower
- PL-2 = Validation light 2 – 120V going to ignition detection control
- PL-3 = Validation light 3 – 120V going to combination gas valve

BURNER WIRING (2 OF 2)

ELECTRICAL SCHEMATIC LADDER DIAGRAM

120 VAC – 60 HZ – 1 PHASE
 HEATER MAXIMUM CURRENT DRAW = 3.0 AMPS.
 TOTAL HEATER POWER CONSUMED = 360 VA



If any of the original wire as supplied with the appliance must be replaced, it must be replaced with wiring material having a temperature rating of at least 302°F (150°C) and shall have a minimum size of 16 AWG (1.0mm²).

LEGEND

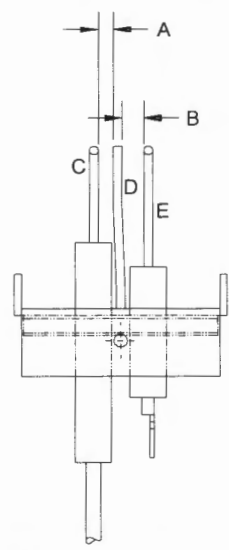
- (+120) = 120 VAC supply voltage
- (-) = Supply neutral
- GND = Earth ground
- BK = Black wire
- W = White wire
- G = Green wire
- MOT = Motor for blower
- PL-1 = Validation light 1 – 120V going to motor for blower
- N.O.SW = Normally opened switch – closes on rising pressure
- R = Red wire
- PL-2 = Validation light 2 – 120V going to ignition detection control
- IDC = Ignition detection control
- CGV = Combination gas valve
- PL-3 = Validation light 3 – 120V going to combination gas valve
- IGN = Grounded spark ignitor
- O = Orange wire – high voltage
- FS = Flame sensor
- Y = Yellow wire
- GGS = Green ground screw



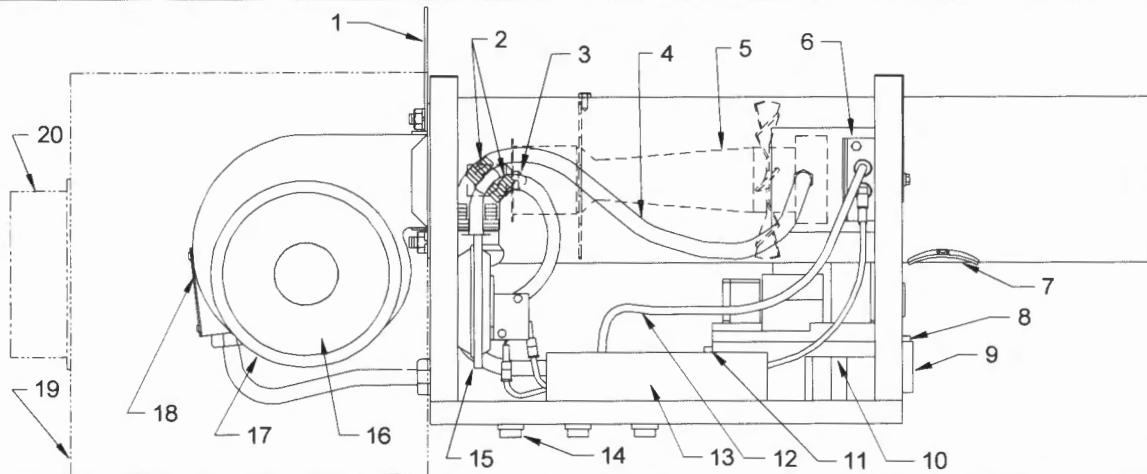
GAS SUPPLY AND GAS PRESSURE

GAS SUPPLY PIPING		INLET GAS PRESSURE																																	
<ul style="list-style-type: none"> Gas piping must be installed in accordance with local codes and/or the National Fuel Gas Code, ANSI Z223.1 / NFPA 54-latest edition. All pipe connections must have pipe joint compound, resistant to LP/propane gas action. Piping must have drip leg and a ground joint union. Local codes may require shut-off cock ahead of the drip leg. Use only agency approved flexible gas connector furnished with heater. See WARNING. Use swing or swivel joint in addition to rigid piping if local codes prohibit use of a flexible gas connector. Installer provide 1/8" NPT plugged tapping for inlet test point connection immediately upstream of gas connection to heater. Isolate regulators, flexible gas connectors, and heaters during high-pressure leak testing. All gas lines must be purged of air before startup. 		<ul style="list-style-type: none"> Inlet gas pressure must be measured on the inlet side of the valve at the inlet test point (IP). Remove plug from the inlet test point, connect to manometer. Inlet gas pressure must conform to the following: 																																	
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WARNING		IMPORTANT																																	
<ul style="list-style-type: none"> Connector must be installed in a "D" configuration. Use only the 24" (61cm) or 36" (91cm) long connector of 1/2" (13 mm) nominal ID that was furnished with the heater. Stress from expansion and contraction of heater may cause excessive wear on the gas connection. It is important to maintain dimensions on drawing below. 		<ul style="list-style-type: none"> Inlet gas pressure at inlet test point (IP) cannot be more than 14 inches of Water Column (WC) (35 cm WC) confirmed by actual field test. (Heater on or off.) 14 in. WC \cong 1/2 PSI \cong 35 cm WC \cong 35 mbar \cong 3.5 kPa. 																																	
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<ul style="list-style-type: none"> Use only water or red oil manometer to make measurements – NOT A DIAL GAUGE. Make ALL measurements and adjustments when this heater and ALL other gas burning equipment connected to the same gas meter are operating at maximum capacity. 		<ul style="list-style-type: none"> The gas control will operate on nat. or LP gas settings indicated on the heaters serial plate. Set inlet pressure first. Fluctuations in inlet pressure can alter manifold pressure. See drawing below for manifold pressure adjustment locations. Loosen set screw, or remove plug from manifold test point (MP); connect to manometer. Remove the slotted cap screw covering the manifold adjustment. Turn adjustment screw clockwise to increase pressure or counterclockwise to decrease pressure. Screw may require a flat head screwdriver or a 3/32" (2.38mm) hex key. 																																	
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GAS CONNECTOR – INCORRECT POSITIONS																																			
<p>CAUTION: Excessive torque on the burner gas inlet pipe or manifold may cause damage to burner. Always use two (2) wrenches when making pipe connections. Check for leaks with non-corrosive gas leak detection fluid. DO NOT USE FLAMES! Thoroughly rinse with clean water to remove leak detection fluid.</p>																																			

STARTUP

STARTUP PROCEDURES	SPARK IGNITOR												
<ul style="list-style-type: none"> • CAUTION: Verify electrical supply is shut off before removing burner cover. Verify gas supply is shut off before removing gas pipe plugs and connecting manometers to measure gas pressures. • IMPORTANT: Check serial plate for requirements and factory settings. Check and, if necessary, adjust the inlet gas pressure BEFORE checking the manifold gas pressure. Then adjust the manifold gas pressure, if necessary. • Remove the burner cover by removing the 4 sheet metal screws from the topside of the burner cover. • Remove the 1/8 NPT pipe plug from the inlet test point (IP) and connect manometer. See the GAS SUPPLY AND GAS PRESSURE section. • Loosen, Do Not Remove, the set-screw, or remove the 1/8 NPT pipe plug from the manifold test point (MP) on the gas valve (break the tamper seal) and connect manometer. See the GAS SUPPLY AND GAS PRESSURE section. • Some models have a shutoff dial on the gas valve. Depress the dial on the gas valve, and make sure the gas valve is in the ON position. • Turn on the electrical and gas supply and set the thermostat above the ambient room temperature, to call for heat. • Measure the inlet gas pressure and the manifold gas pressure. • For proper sequence of operation see the OPERATION AND SHUTDOWN section. • If heater does not operate normally, see the TROUBLESHOOTING section. • Once startup testing is complete, turn off electrical and gas supply, remove the manometer connections and replace the 1/8 NPT pipe plugs or tighten the set-screws into the inlet and manifold test points. Turn on electrical and gas supply and check again for gas leaks. See the GAS SUPPLY AND GAS PRESSURE section. • Cycle the heater several times by means of the thermostat, allowing at least five minutes between cycles. If the heater operates normally, replace the burner cover and screws. • If the heater is vented directly outdoors, observe and verify the flue gases exiting from the exhaust vent are not impinging on building materials or equipment. See the EXHAUST VENTING section. 	 <table border="1"> <thead> <tr> <th>Item</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>Spark gap 5/32" (.156") (4.0 mm) +/- 1/32" (.031") (.8 mm)</td> </tr> <tr> <td>B</td> <td>Sensor gap .208" (5.3 mm) reference</td> </tr> <tr> <td>C</td> <td>Spark electrode</td> </tr> <tr> <td>D</td> <td>Ground prong</td> </tr> <tr> <td>E</td> <td>Flame sensor</td> </tr> </tbody> </table>	Item	Description	A	Spark gap 5/32" (.156") (4.0 mm) +/- 1/32" (.031") (.8 mm)	B	Sensor gap .208" (5.3 mm) reference	C	Spark electrode	D	Ground prong	E	Flame sensor
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BURNER DIAGRAM



Item	Description	Item	Description	Item	Description
1	Safety chain bracket	8	Inlet test point (IP)	15	Air flow switch
2	Tubing adapters	9	Gas inlet 1/2" NPT	16	Air orifice plate
3	Main orifice	10	Gas valve	17	Inlet air collar accessory
4	Vinyl tubing	11	Manifold test point (MP)	18	Blower
5	Burner core assembly	12	Ignition lead wire	19	Blower motor enclosure accessory
6	Ignitor bracket	13	Ignition detection control (IDC)	20	Inlet air collar accessory
7	Observation port	14	Validation lights		

AIR FLOW SWITCH TUBING CONNECTIONS

- The switch "P1" or "+" or "HIGH" side tube goes toward the blower side.
- The switch "P2" or "-" or "LOW" side tube goes toward the ignitor side.



MAINTENANCE

- **FOR SAFETY REASONS, *BEFORE* PERFORMING ANY MAINTENANCE, DISCONNECT AND LOCKOUT THE ELECTRICAL SUPPLY, INCLUDING THE THERMOSTAT, BY POSITIVE MEANS.**
- All maintenance and/or repair ***MUST*** be performed by someone trained and qualified to work on gas and electrical equipment.
- Annual maintenance done prior to the beginning of each heating season is all that is usually necessary.
- In dirty, dusty, or wet atmospheres, it may be necessary to examine and perform needed maintenance at additional times during the heating season. Experience will dictate the frequency.
- Radiant tubes, combustion air ducting, and exhaust venting should be inspected to make sure that: suspension points are secure, tube clamp nuts are tight, heater is level, chains are plumb and taut (except for burner safety chain), vent pipe joints are properly sealed, "S" hooks are crimped closed, there is no excessive exterior buildup of dust or dirt, and make sure there are no restrictions such as bird or insect nests in the combustion air or vent piping or their terminations.
- Reflectors should be inspected to make sure they are clean and secure, as detailed in the INSTALLATION section. If dirty, reflectors should be removed and washed with isopropyl alcohol, Simple Green, or buffed with mild rubbing compound.
- On U-tube systems, the U-bend reflector support nuts should be inspected to make sure they are tight.
- Inspect the inside of the blower housing for excessive dust or dirt buildup on the impeller wheel and make sure the air orifice and the inlet air collar are properly attached. Check that the blower can come up to full speed.
- Remove the cover by removing the 4 sheet metal screws on top of the cover.
- Remove the ignitor by removing **ONLY** the end where the vinyl tubing is attached to the ignitor bracket; the fitting to which the vinyl tubing was connected; the ignition lead wire from the ignition detection control; and the sheet metal screw holding the ignitor bracket to the burner housing wall.
- Remove the ignitor carefully; its' electrodes make a ninety degree turn to the right.
- Clean the ignitor's porcelain insulation and check for cracks and proper gaps (see STARTUP section).
- Within the interior of the burner tube, examine the burner nozzle, primary air holes, main orifice and surrounding area for build up of dust or dirt. Clean if necessary.
- Reinstall the ignitor by following the previous instructions in reverse order.
- Examine the ignition detection control for overheating (warped plastic housing, discoloration, etc.)
- A visual inspection of gas valve, airflow switch, and wiring is adequate.
- Inside each clear vinyl tube used for air flow sensing is a small snubber (aluminum cylinder piece). Visually inspect for cleanliness.
- Clean any surfaces needed and correct any situations found in disrepair.
- Replace the cover and sheet metal screws.
- The blower motor is of the permanently lubricated type and requires no additional lubrication.
- Double check that the area under the heater is kept clear and free from combustible materials, gasoline, and other flammable vapors and liquids.
- Reconnect electrical supply and cycle the heater several times using the thermostat allowing five (5) minutes between cycles for proper operation.
- **WARNING: Do not operate heater with any part bypassed, with any part failed or in any possible situation that may compromise safety. Personal injury, death, and/or property damage could result.**

TROUBLESHOOTING

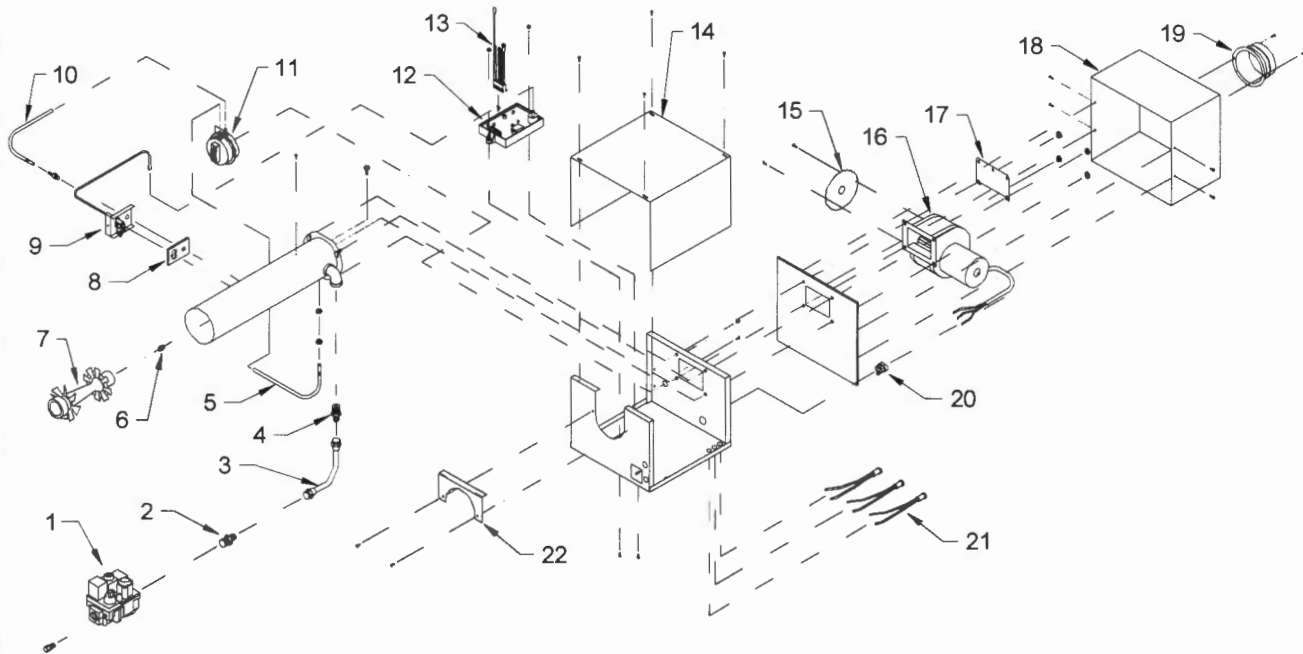
<ul style="list-style-type: none"> • Check for symptoms and possible causes in the order presented from the top of this chart to the bottom. • The symptoms and possible causes are in a logical progressive order as in a flow chart. 		
SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION
New installation.	1. Heaters not isolated during high pressure leak testing.	1. Replace combination gas valves on each heater.
	2. All gas lines not completely bled of air.	2. Disconnect flex hose at each heater until gas is present. Connect flex hose and leak test.
	3. Gas supply regulator reversed.	3. Remove and install properly.
	4. Electrical supply line voltage & neutral polarity reversed.	4. Correct electrical supply polarity.
Gas odor.	1. Gas pipe joints loose.	1. Check joints with soap solution, tighten as needed.
Blower / PL-1 light does not come on when system energized.	1. Power supply fuse defective.	1. Replace fuse.
	2. 120 VAC not reaching heater.	2. Check thermostat and wiring and fix.
	3. Blower defective.	3. Replace blower.
Pressure switch does not close / PL-2 light does not come on.	1. Inlet or exhaust piping not the proper size and length. (Refer to manual.)	1. Replace piping as required.
	2. Inlet or exhaust termination fittings not to factory specifications.	2. Replace fittings as required.
	3. Inlet or exhaust blocked.	3. Clear blockage.
	4. Airflow tubing or snubber orifice blocked in one or both tubes.	4. Clear blockage.
	5. Blower wheel dirty or damaged or rattles.	5. Clean or repair wheel or replace blower.
	6. Airflow pressure switch defective.	6. Replace airflow pressure switch.
Ignitor does not spark / PL-3 light does not come on.	1. 120 VAC not reaching the Ignition Detection Control (IDC) due to loose wire or connector.	1. Repair loose wire or connector.
	2. High-voltage wire loose or damaged.	2. Secure high-voltage wire or replace ignitor.
	3. Ignition Detection Control (IDC) defective.	3. Replace IDC box.
Burner does not ignite. (There are three trials-for-ignition before the IDC goes into lockout).	1. Gas supply not turned on.	1. Open all manual gas supply valves.
	2. Ignitor not sparking at the tips.	2. Measure spark gap and adjust gap as necessary to 5/32" [0.156" (3.96mm)].
	3. Ignitor not sparking at correct gap.	3. Replace ignitor.
	4. Gas inlet pressure not correct. (See serial plate). Gas inlet piping not sized correctly.	4. Replace inlet gas piping with correct size pipe.
	5. Gas inlet pressure not correct. (See serial plate). Gas supply regulator not set correctly.	5. Adjust gas supply regulator to set inlet pressure to proper level. (See serial plate).
	6. Gas supply regulator sticking.	6. Replace gas supply regulator.
	7. Combination gas valve not in the ON position.	7. Turn combination gas valve to the ON position.
	8. Ignition Detection Control (IDC) not sending 120VAC to combination gas valve.	8. Replace IDC box.
	9. Combination gas valve defective.	9. Replace combination gas valve.
	10. Combination gas valve outlet (manifold) pressure not correct. (See serial plate).	10. Adjust combination gas valve regulator to set inlet (manifold) pressure to proper level.
	11. Main or sub gas orifice blocked by spider web, etc.	11. Clear blockage.
	12. Gas orifice(s) or air orifice size not correct.	12. Install correct size gas orifice(s) or air orifice.
Spark does not stop when the burner ignites.	1. Power supply not grounded to a true earth ground.	1. Install a true earth ground to the power supply.
	2. Flame sensor wire loose or damaged.	2. Secure flame sensor wire or replace wire harness to IDC box.
	3. Flame signal not at least -17 VDC or flame signal not at least 1 mA DC current measured in series.	3. Check gas inlet and manifold pressures compared to the possible causes in the previous symptom where the burner does not ignite.
	4. Ignition Detection Control (IDC) is defective.	4. Replace IDC box.
Burner does not stay lit until the thermostat is satisfied.	1. Flame sensor wire is loose or damaged.	1. Replace wire harness to IDC box.
	2. Ground connection to IDC loose.	2. Tighten ground connection to IDC.
	3. Electrical supply line voltage & neutral polarity reversed.	3. Correct electrical supply polarity.
	4. Inlet or exhaust partially blocked.	4. Clear blockage.
	5. 90-degree elbow at blower inlet.	5. Add 12" long inlet air stub at blower inlet.
	6. Airflow pressure switch erratic or defective.	6. Consult factory or replace airflow pressure switch.
	7. Flame signal not at least -17 VDC or flame signal not at least 1 mA DC current measured in series.	7. Check gas inlet and manifold pressures compared to the possible causes in the previous symptom where the burner does not ignite.
	8. Ignition Detection Control (IDC) defective.	8. Replace IDC box.
Heater will not turn off.	1. Thermostat defective.	1. Replace thermostat.



REPLACEMENT PARTS

! WARNING !

- Any substitutions of factory-installed parts without prior written permission may result in unsafe operation, property damage, personal injury, death, voids CSA design certification, and manufacturer's warranty.

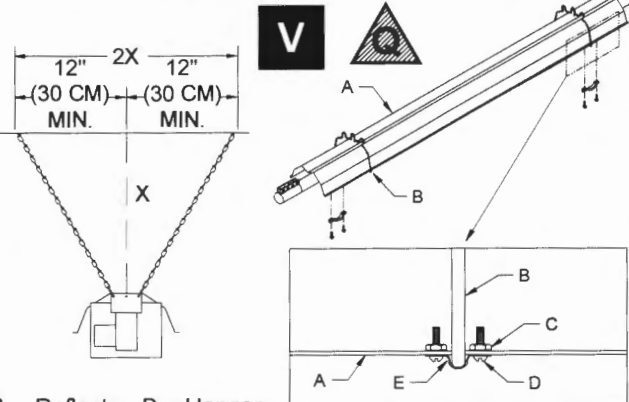
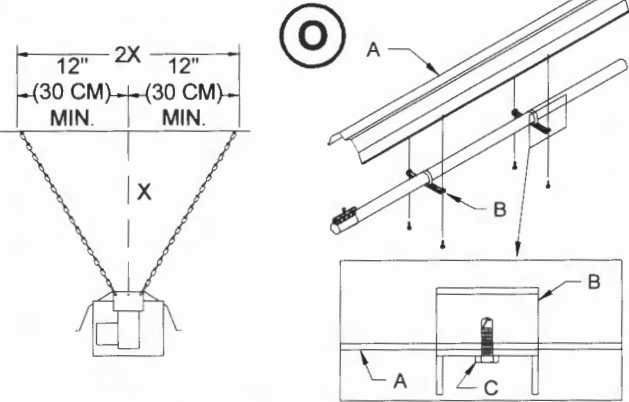
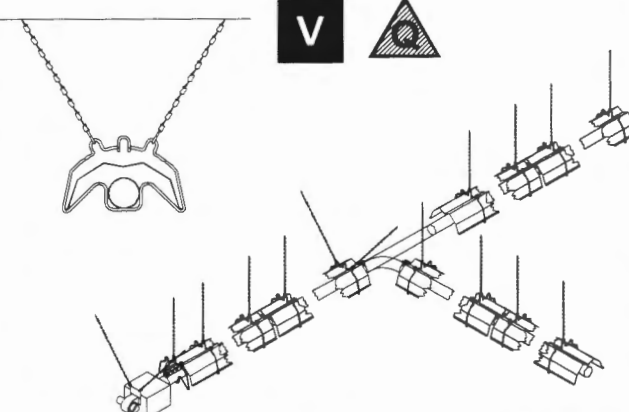
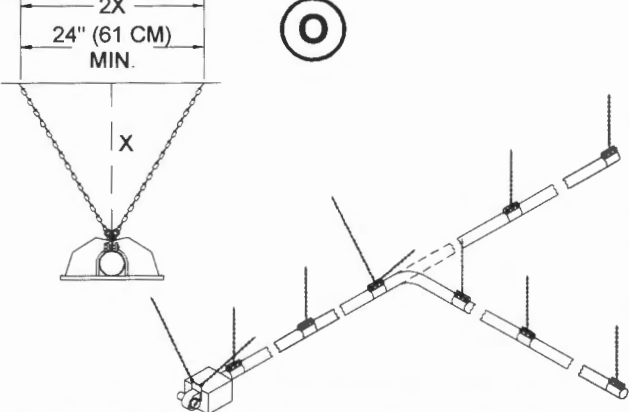
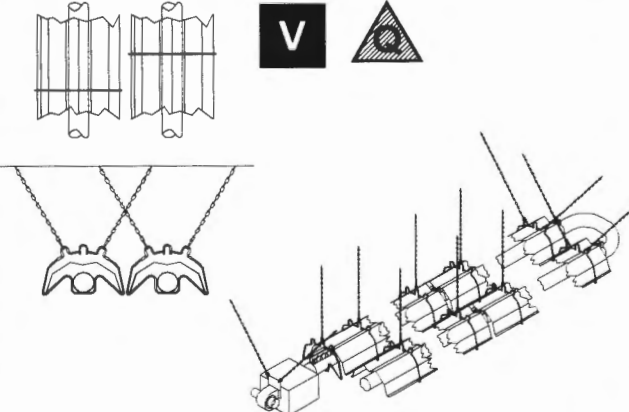
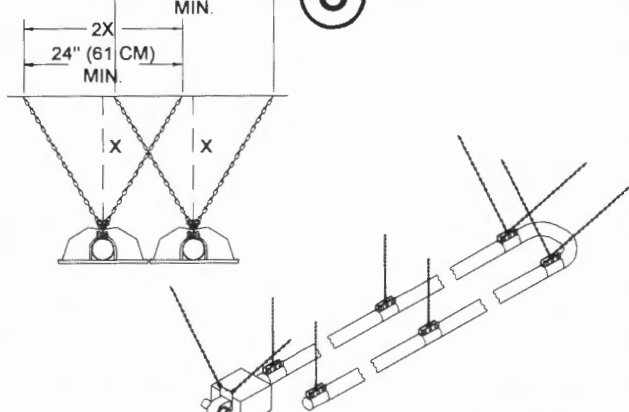


- | | |
|---|---|
| 1. Gas valve | 11. Air flow switch |
| 2. Brass union fitting (at valve) | 12. Ignition detection control (IDC) |
| 3. Gas manifold assembly with flare nuts | 13. Wire harness assembly |
| 4. Brass union fitting (at burner tube) (contains subsidiary gas orifice when required) | 14. Burner cover |
| 5. Vinyl tubing for inlet air assembly with snubber insert (to blower side) | 15. Air orifice plate |
| 6. Main gas orifice | 16. Blower motor |
| 7. Burner core | 17. Safety chain bracket |
| 8. Ignitor gasket | 18. Blower enclosure accessory |
| 9. Three prong electrode spark ignitor | 19. Inlet air collar accessory (may be used on blower when blower not enclosed) |
| 10. Vinyl tubing for back pressure assembly with snubber insert (to ignitor side) | 20. Strain relief bushing |
| | 21. System monitoring validation light |
| | 22. Burner tube holding bracket |

- Due to continuous product improvement, please provide model number and serial number prior to ordering replacement parts to assure safe repairs and maintenance.

WINDY CONDITION NOTES

- The following methods will aid in suspending the heater more securely where windy conditions are expected such as near loading dock or airplane hangar doors, or outdoor areas.

MODELS SUSPENDED BY HANGERS	MODELS SUSPENDED BY CLAMPS
<p>BURNER AND REFLECTOR SECURING</p> <ul style="list-style-type: none"> Fasten reflectors to hangers with loop straps, screws and keps nuts; one per hanger, at opposite corners.  <p>A = Reflector, B = Hanger, C = Keps nuts, D = Screw, E = Loop strap</p>	<p>BURNER AND REFLECTOR SECURING</p> <ul style="list-style-type: none"> Fasten reflectors to reflector support brackets with tek screws or other positive means.  <p>A = Reflector, B = Bracket, C = Tek screw.</p>
<p>STRAIGHT OR L-SHAPED TUBE CONFIGURATION</p> <ul style="list-style-type: none"> The distance between the second chain configurations should be no less than 20 feet (6 m) where possible. 	<p>STRAIGHT OR L-SHAPED TUBE CONFIGURATION</p> <ul style="list-style-type: none"> The distance between the second chain configurations should be no less than 20 feet (6 m) where possible. 
<p>U-TUBE CONFIGURATION</p> <ul style="list-style-type: none"> Hangers must be staggered for a U-tube heater installed for windy conditions. 	<p>U-TUBE CONFIGURATION</p> 



U-TUBE INSTALLATION

- A heater may be installed in a U-Tube configuration with its radiant tubes horizontal or with the heat exchanger angled above the combustion chamber as illustrated below.
- When radiant tubes are horizontal, reflectors may be individually rotated from 0 to 30 degrees or from 0 to 45 degrees depending on the model installed. See the CLEARANCE TO COMBUSTIBLES section for the reflector rotation angles permitted for each model.
- The U-Bend Reflector is an optional accessory shown below.

MODELS SUSPENDED BY HANGERS	MODELS SUSPENDED BY CLAMPS
HORIZONTAL MOUNTING	HORIZONTAL MOUNTING
<div style="text-align: right; margin-bottom: 10px;"> </div>	<div style="text-align: right; margin-bottom: 10px;"> </div>
ANGLED MOUNTING	ANGLED MOUNTING
<p>A. Do not exceed 7.5" (19cm)</p> <div style="text-align: right; margin-bottom: 10px;"> </div>	<p>A. Do not exceed 7.5" (19cm)</p> <div style="text-align: right; margin-bottom: 10px;"> </div>



BASIC CONFIGURATIONS

Black iron clamped tubes suspended by hangers components are designated without any prefix or suffix, i.e. "C9".
Black iron clamped tubes suspended by clamps components are designated with an "O" suffix, i.e. "C9O".
Aluminized press-fit tubes suspended by hangers components are designated with a "GQ" prefix, i.e. "GQC9".
 Aluminized press-fit tube heaters do not have MC series models.
A metal turbulator is always in the LAST 10-foot (3.0m) long tube section.

NOTE: These are the recommended configurations for your heater. Contact the factory with any questions.

LEGEND: L : LP/Propane gas, N : Natural gas, ▶ : Burner, U : 180° U-Bend.

STRAIGHT TUBE				HEATER COMPONENTS			
Input MBTUH (kW)	Length ft (m)	Series	Gas Type	▶	Combustion Chamber	Heat Exchangers	Exhaust End
40 (12)	10 (3.1)	A	N/L	▶	C9	----	----
40 (12)	15 (4.6)	A	N/L	▶	C9	----	H6
40 – 60 (12 – 18)	20 (6.1)	A	N/L	▶	C2	----	H1
65 – 85 (19 – 25)	20 (6.1)	MB	N(L)	▶	C2	----	H9(H1)
65 – 85 (19 – 25)	25 (7.6)	MB	N(L)	▶	C2	H6	H9(H1)
65 – 100 (19 – 29)	30 (9.1)	B	N/L	▶	C2	H2	H5
105 – 130 (31 – 38)	30 (9.1)	MC	N - only	▶	C4	H2	H1
65 – 100 (19 – 29)	35 (10.6)	B	N/L	▶	C2	H2 H6	H5
105 – 130 (31 – 38)	35 (10.6)	MC	N - only	▶	C4	H2 H6	H1
65 – 100 (19 – 29)	40 (12.2)	B	N/L	▶	C2	H2 H2	H5
105 – 120 (31 – 35)	40 (12.2)	B	N/L	▶	C4	H2 H2	H5
125 (37)	40 (12.2)	B	N - only	▶	C4	H2 H2	H5
125 (37)	40 (12.2)	C	L - only	▶	C4	H2 H2	H5
130 – 150 (38 – 44)	40 (12.2)	C	N/L	▶	C4	H2 H2	H5
100 (29)	45 (13.7)	B	N/L	▶	C2	H2 H2 H6	H5
105 – 120 (31 – 35)	45 (13.7)	B	N/L	▶	C4	H2 H2 H6	H5
125 (37)	45 (13.7)	B	N - only	▶	C4	H2 H2 H6	H5
125 (37)	45 (13.7)	C	L - only	▶	C4	H2 H2 H6	H5
130 – 150 (38 – 44)	45 (13.7)	C	N/L	▶	C4	H2 H2 H6	H5
100 (29)	50 (15.2)	B	N/L	▶	C2	H2 H2 H2	H5
105 – 120 (31 – 35)	50 (15.2)	B	N/L	▶	C4	H2 H2 H2	H5
125 (37)	50 (15.2)	B	N - only	▶	C4	H2 H2 H2	H5
125 (37)	50 (15.2)	C	L - only	▶	C4	H2 H2 H2	H5
130 – 200 (38 – 59)	50 (15.2)	C	N/L	▶	C4	H2 H2 H2	H5
150 – 200 (44 – 59)	55 (16.8)	C	N/L	▶	C4	H2 H2 H2 H6	H5
150 – 200 (44 – 59)	60 (18.3)	C	N/L	▶	C4	H2 H2 H2 H2	H5
150 – 200 (44 – 59)	65 (19.9)	C	N/L	▶	C4	H2 H2 H2 H2 H6	H5
150 – 200 (44 – 59)	70 (21.3)	C	N/L	▶	C4	H2 H2 H2 H2 H2	H5
U-TUBE				HEATER COMPONENTS			
Input MBTUH (kW)	Length ft (m)	Series	Gas Type	▶	Combustion Chamber	Heat Exchangers	Exhaust End
40 (12)	15 (4.6)	A	N/L	▶	C9	U	H6
40 – 60 (12 – 18)	20 (6.1)	A	N/L	▶	C2	U	H1
65 – 85 (19 – 25)	20 (6.1)	MB	N(L)	▶	C2	U	H9(H1)
65 – 100 (19 – 29)	30 (9.1)	B	N/L	▶	C2	H6 U H6	H5
105 – 130 (31 – 38)	30 (9.1)	MC	N - only	▶	C4	H6 U H6	H1
65 – 100 (19 – 29)	40 (12.2)	B	N/L	▶	C2	H2 U H2	H5
105 – 120 (31 – 35)	40 (12.2)	B	N/L	▶	C4	H2 U H2	H5
125 (37)	40 (12.2)	B	N - only	▶	C4	H2 U H2	H5
125 (37)	40 (12.2)	C	L - only	▶	C4	H2 U H2	H5
130 – 150 (38 – 44)	40 (12.2)	C	N/L	▶	C4	H2 U H2	H5
100 (29)	50 (15.2)	B	N/L	▶	C2	H2 H6 U H6 H2	H5
105 – 120 (31 – 35)	50 (15.2)	B	N/L	▶	C4	H2 H6 U H6 H2	H5
125 (37)	50 (15.2)	B	N - only	▶	C4	H2 H6 U H6 H2	H5
125 (37)	50 (15.2)	C	L - only	▶	C4	H2 H6 U H6 H2	H5
130 – 200 (38 – 59)	50 (15.2)	C	N/L	▶	C4	H2 H6 U H6 H2	H5
150 – 200 (44 – 59)	60 (18.3)	C	N/L	▶	C4	H2 H2 U H2 H2	H5
150 – 200 (44 – 59)	70 (21.3)	C	N/L	▶	C4	H2 H2 H6 U H6 H2 H2	H5

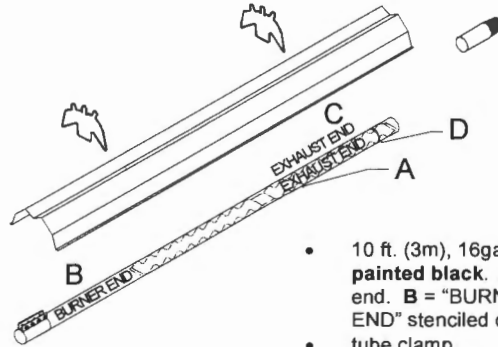


COMBUSTION CHAMBERS

BLACK IRON CLAMPED TUBES SUSPENDED BY HANGERS

C9

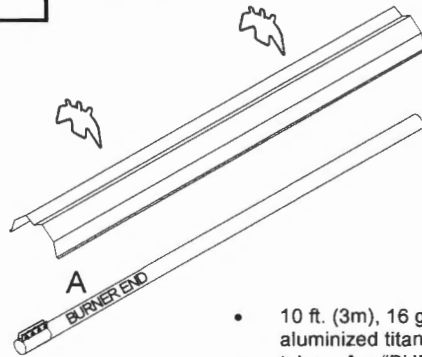
40 MBTUH (10 and 15 ft. units only)
[12 kW (3.0 and 4.6 m only)]



- 10 ft. (3m), 16ga. (1.7mm) aluminized titanium alloy steel tube **painted black**. **A** = "C9"-turbulator factory installed in exhaust end. **B** = "BURNER END" stenciled on tube, **C** = "EXHAUST END" stenciled on tube. **D** = White tape on exhaust end
- tube clamp
- 10 ft. (3m) aluminum reflector
- (2) tube/reflector hangers
- vent pipe adaptor

C2

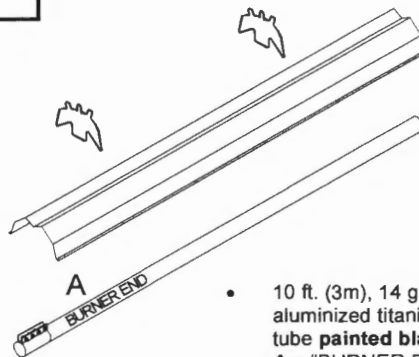
40 thru 60 MBTUH (20 ft. unit only)
[12-18 kW (6.1 m only)]
65 thru 100 MBTUH [19-29 kW]



- 10 ft. (3m), 16 ga. (1.7mm) aluminized titanium alloy steel tube. **A** = "BURNER END" stenciled on tube
- tube clamp
- 10 ft. (3m) aluminum reflector
- (2) tube/reflector hangers

C4

105 thru 200 MBTUH [31-59 kW]



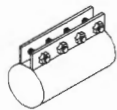
- 10 ft. (3m), 14 ga. (2.1mm) aluminized titanium alloy steel tube **painted black**. **A** = "BURNER END" stenciled on tube.
- tube clamp
- 10 ft. (3m) aluminum reflector
- (2) tube/reflector hangers

TYPICAL PARTS

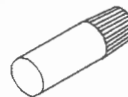
10 ft. (3m) reflector [length approx. 119" (302cm)]



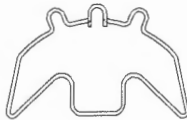
Tube clamp



Vent pipe adaptor



Tube/reflector hanger

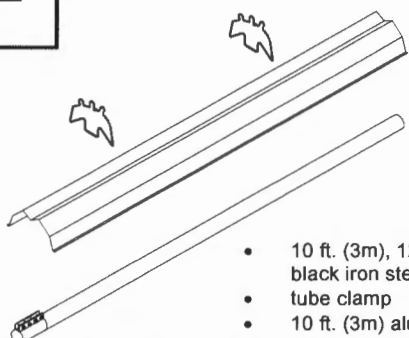


HEAT EXCHANGERS

BLACK IRON CLAMPED TUBES SUSPENDED BY HANGERS

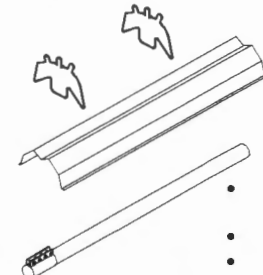
MIDDLE HEAT EXCHANGER COMPONENTS

H2 65 thru 200 MBTUH (30 thru 70 ft units) [19-59 kW (9.1-21.3 m)]



- 10 ft. (3m), 12 ga. (2.8mm) black iron steel tube
- tube clamp
- 10 ft. (3m) aluminum reflector
- (2) tube/reflector hangers

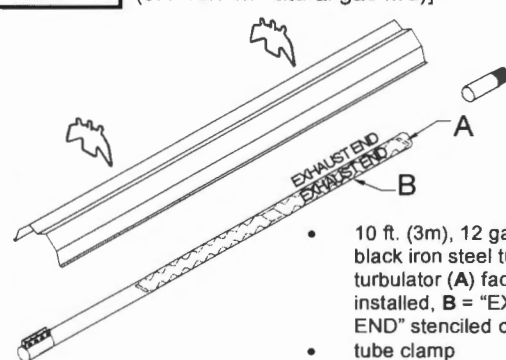
H6 40 MBTUH [ONLY 15 ft end tube] [12 kW (ONLY 4.6 m end tube)]
65 thru 200 MBTUH (25 thru 70 ft units) [19-59 kW (7.6-21.3 m)]



- 5 ft. (1.5m), 12 ga. (2.8mm) black iron steel tube
- tube clamp
- 5 ft. (1.5m) aluminum reflector
- (2) tube/reflector hangers

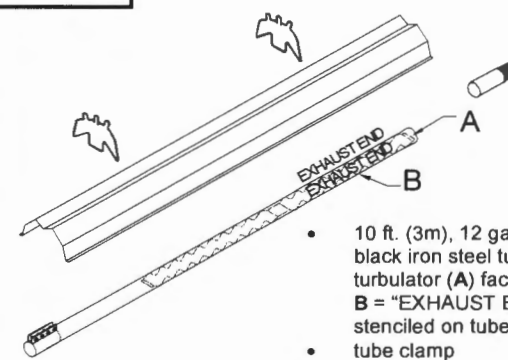
EXHAUST END HEAT EXCHANGER COMPONENTS

H1 40 thru 60 MBTUH (20 ft unit) [12-18 kW (6.1 m)], 65 thru 85 MBTUH (20 and 25 ft propane gas MB units) [19 -25 kW (6.1 and 7.6 m propane gas MB units)], 105 thru 130 MBTUH (30 and 35 ft natural gas MC units) [31-38 kW (9.1-10.7 m natural gas MC)]



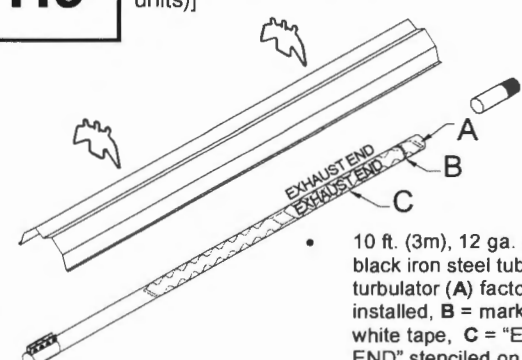
- 10 ft. (3m), 12 ga. (2.8mm) black iron steel tube with H1-turbulator (A) factory installed, B = "EXHAUST END" stenciled on tube
- tube clamp
- 10 ft. (3m) aluminum reflector
- (2) tube/reflector hangers
- vent pipe adaptor

H5 65 thru 200 MBTUH (excluding 20 and 25 ft MB units, and 30 and 35 ft MC units) [19-59 kW (excluding 6.1 and 7.6 m MB, and 9.1 and 10.7 m MC)]



- 10 ft. (3m), 12 ga. (2.8mm) black iron steel tube with H5-turbulator (A) factory installed, B = "EXHAUST END" stenciled on tube
- tube clamp
- 10 ft. (3m) aluminum reflector
- (2) tube/reflector hangers
- vent pipe adaptor

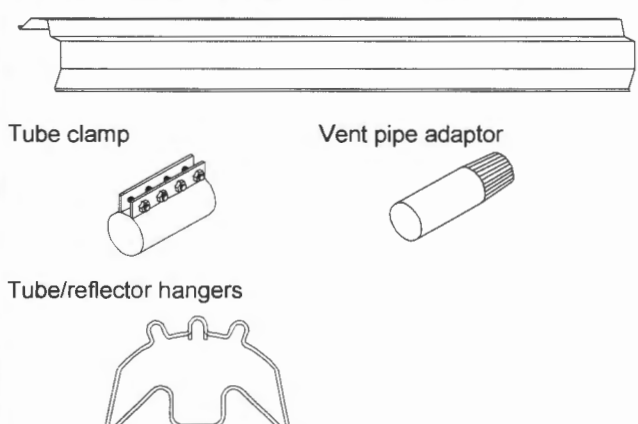
H9 65 thru 85 MBTUH (20 and 25 ft natural gas MB units) [19 -25 kW (6.1 and 7.6 m natural gas MB units)]



- 10 ft. (3m), 12 ga. (2.8mm) black iron steel tube with H9-turbulator (A) factory installed, B = marked with white tape, C = "EXHAUST END" stenciled on tube
- tube clamp
- 10 ft. (3m) aluminum reflector
- (2) tube/reflector hangers
- vent pipe adaptor

TYPICAL PARTS

10 ft. (3m) reflector [length approx. 119" (302cm)]



Tube clamp

Vent pipe adaptor

Tube/reflector hangers

INSTALLATION

BLACK IRON CLAMPED TUBES SUSPENDED BY HANGERS (1 OF 2)

CAUTION

- **DO NOT** use gas piping or electrical conduit to provide any type of support for the heater's suspension.
- Means of suspension **MUST BE** able to support twice the weight of the heater, securely fastened to the building's structure, and allow for expansion during its operation.
- Chain for suspension **MUST BE** 12 in. (31cm) minimum in length and be 1/0 TENSO with a minimum working load rating of 200 lbs. (90.7 kg).
- The "S" hook **MUST BE** Chicago Hardware no. 5 or equal and carry a 70 pound (32kg) maximum load.

STEP

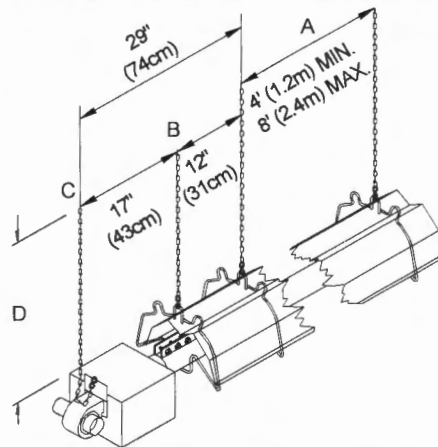
1

- To maintain straightness over the length of the system use a taut string in the planning of suspension points. Make true right angles if 90-degree elbows are used.
- Check the BASIC CONFIGURATIONS section for the general orientation of components matching the model number of your system.
- Identify all components in the COMBUSTION CHAMBERS – BLACK IRON CLAMPED TUBES SUSPENDED BY HANGERS and HEAT EXCHANGERS – BLACK IRON CLAMPED TUBES SUSPENDED BY HANGERS sections.
- U-type systems use a 180-degree U-bend. See U-TUBE INSTALLATION section.

STEP

2

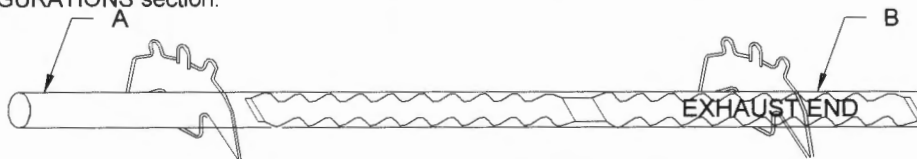
- Install chain for suspension of tubes and reflectors.
- Each tube section requires two (2) hangers.
- **A** = The suspension points for each 10-foot (3m) tube should be a minimum of 4 feet (1.2m) and a maximum of 8 feet (2.4m) apart.
- **B** = Install a chain to be positioned at the joint between the combustion chamber and the burner.
- **C** = Install an additional suspension point, for a required safety chain at the back of the burner box located 17 in. (43cm) from the joint between the combustion chamber and the burner. The burner safety chain should have an additional 6 in. (15cm) of length added to allow for slack.
- **D** = Install tube/reflector hangers. Slip one end of the S-hook through the last chain link and the other end through the tube/reflector hanger.
- All suspension chains must be plumb and vertical.
- **IMPORTANT: Crimp both ends of the S-hook closed!**



STEP

3

- Lift the exhaust end heat exchanger [or combustion chamber C9 on a 40 MBTUH (11.7 kW) 10-foot (3.0 m) unit] into place with the weld seam facing up (**A**) and suspend it in the tube/reflector hangers already in position. The exhaust end heat exchanger is marked "EXHAUST END" (**B**) except for a 40 MBTUH (11.7 kW) 15-foot (4.6 m) unit where the last 5-foot (1.5 m) tube H6 is unmarked. The designation of the exhaust end tube (H5, H6, H9 or H1) is determined by burner size and system length as per the BASIC CONFIGURATIONS section.

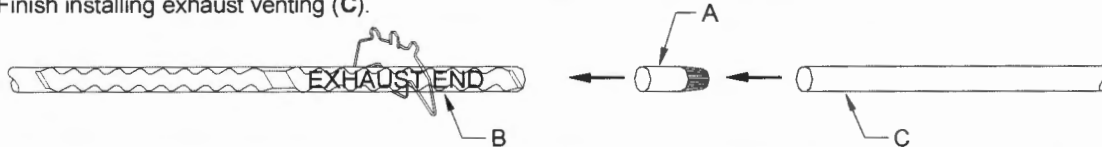


A = Weld seam of tube to be on top, **B** = "EXHAUST END" stenciled on tube.

STEP

4

- Install a tube clamp on the end **opposite** of the end marked "EXHAUST END". Orient clamp bolts on top.
- **Make sure the tube is inserted tight against the center stop inside the tube clamp.**
- Install factory supplied 4 in. (10.2 cm) Vent Pipe Adaptor (**A**) onto the end of the tube stenciled "EXHAUST END" (**B**). Use RTV silicone adhesive sealant and three (3) self-drilling screws to attach.
- Finish installing exhaust venting (**C**).



A = Vent pipe adaptor, **B** = "EXHAUST END" stenciled on tube, **C** = Exhaust venting.

CAUTION: MB & MC SERIES

- All burner covers are yellow, except for the MB and MC Series, which are white. The MB and MC burners **must be used** with the H1 or the H9 (end marked with white tape) exhaust end heat exchanger. **NO EXCEPTIONS.** Improper operation may result if this is not followed. See BASIC CONFIGURATIONS section.

INSTALLATION

BLACK IRON CLAMPED TUBES SUSPENDED BY HANGERS (2 OF 2)

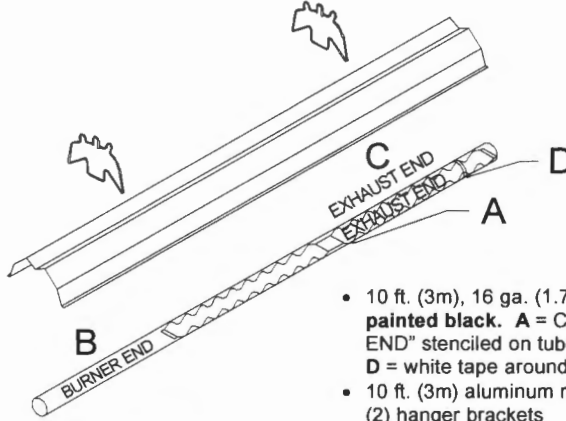
<p>STEP</p> <p>5</p>	<ul style="list-style-type: none"> Lift the remaining heat exchanger(s), for heaters longer than 25 feet (7.6 m), into place with the weld seam facing up in the tube/reflector hangers previously installed. Insert the end of the tube into the tube clamp of the previously hung heat exchanger. Be certain that the tube is inserted to the stop inside the tube clamp. Tighten the tube clamp, sufficiently but not permanently, to make sure it does not come loose during installation. Install a tube clamp on the end of each heat exchanger after it is installed. Install the reflector(s) inside the hangers. (Gloves are suggested so as not to soil the shiny underside.) 	
<p>STEP</p> <p>6</p>	<ul style="list-style-type: none"> Lift the combustion chamber, for heaters of 20 feet (6.1 m) or more, into place with the weld seam facing up in the tube/reflector hangers previously installed so that the end of the tube stenciled "BURNER END" (A) is where the burner will be installed. The combustion chamber is aluminized steel [C2, (C4 painted black)]. Insert the other end into the tube clamp on the previous heat exchanger. Be certain that the tube is inserted to the center stop in the clamp. Tighten the tube clamp, sufficiently but not permanently, to make sure it does not come loose during installation. Install a tube clamp on the burner end of the combustion chamber after it is installed. Install the reflector inside the hangers. (Gloves are suggested so as not to soil the shiny underside.) 	<p>A = "BURNER END" stenciled on tube.</p>
<p>STEP</p> <p>7</p>	<ul style="list-style-type: none"> Install a tube/reflector hanger around the center of this tube clamp on the burner end of the combustion chamber. This hanger will provide the main support for the burner. Lift the burner into place and suspend it by inserting the S-hook of the safety chain (A) into the center hole of the safety chain bracket (B), and then crimp both ends of the hook closed. Insert the burner tube into the tube clamp at the burner end of the combustion chamber. Make sure the burner tube is inserted against the center stop inside of the tube clamp. The safety chain for the burner has 6" (15 cm) of slack. It is NOT taut. Then, tighten the clamp as described in step 8. A hanger (C) is used at the middle of the first tube clamp. <p>A = Safety chain, B = Safety chain bracket, C = Hanger.</p>	
<p>STEP</p> <p>8</p>	<ul style="list-style-type: none"> Tighten all tube clamp nuts on all tube clamps. Tighten nuts a half turn at a time, in a 2, 3, 4, 1 sequence, where 1 is always closest to the burner (A). Tighten nuts with a torque wrench until the flanges of the clamp touch and 65 ft.-lbs. (88 Nm) is achieved at each nut to assure proper seating of the clamps' inner sleeve. <p>A = Always closest to burner.</p>	
<p>STEP</p> <p>9</p>	<ul style="list-style-type: none"> Reflectors must not be angle mounted more than 30° from horizontal for 65 to 125 MBTUH (19 – 37 kW) or 45° from horizontal for 40 to 60 or 130 to 200 MBTUH (12 – 18 or 38 – 59 kW). If located near a large doorway or in an area affected by wind, see the WINDY CONDITION NOTES section. 	
<p>CAUTION</p>		<p>IMPORTANT</p>
<ul style="list-style-type: none"> Make sure all chains are plumb and vertical to prevent damage to tubes. 	<ul style="list-style-type: none"> Connect the gas supply as instructed in the GAS SUPPLY AND GAS PRESSURE section. Connect the electrical supply as instructed in the ELECTRICAL SUPPLY AND THERMOSTATIC CONTROL section. 	



COMBUSTION CHAMBERS ALUMINIZED PRESS-FIT TUBES SUSPENDED BY HANGERS

GQC9

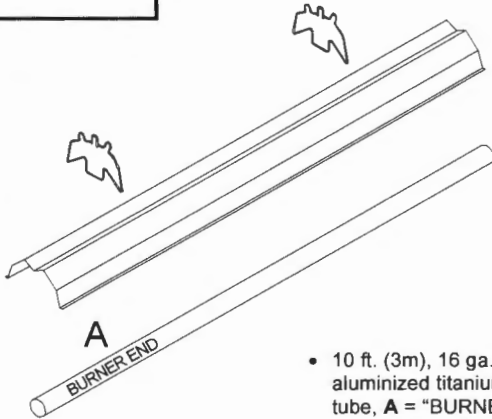
40 MBTUH (10 and 15 ft. units only)
[12 kW (3 and 4.6m only)]



- 10 ft. (3m), 16 ga. (1.7mm) aluminized titanium alloy steel tube **painted black**. **A** = C9-turbulator factory installed, **B** = "BURNER END" stenciled on tube, **C** = "EXHAUST END" stenciled on tube, **D** = white tape around end of tube
- 10 ft. (3m) aluminum reflector
(2) hanger brackets

GQC2

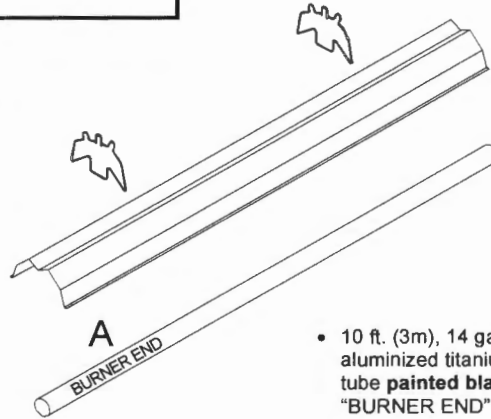
40 thru 60 MBTUH (20 ft. unit only)
[12-18 kW (6.1m only)]
65 thru 100 MBTUH [19-29 kW]



- 10 ft. (3m), 16 ga. (1.7mm) aluminized titanium alloy steel tube, **A** = "BURNER END" stenciled on tube
- 10 ft. (3m) aluminum reflector
- (2) hanger brackets

GQC4

105 thru 200 MBTUH [31-59 kW]



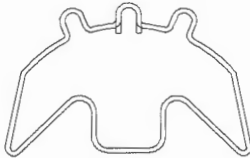
- 10 ft. (3m), 14 ga. (2.1mm) aluminized titanium alloy steel tube **painted black**, **A** = "BURNER END" stenciled on tube
- 10 ft. (3m) aluminum reflector
- (2) hanger brackets

TYPICAL PARTS

10 ft. (3m) aluminum reflector [length approx. 119" (302cm)]



Hanger Bracket





HEAT EXCHANGERS

ALUMINIZED PRESS-FIT TUBES SUSPENDED BY HANGERS

MIDDLE HEAT EXCHANGER COMPONENTS

GQH2 65 thru 200 MBTUH (30 thru 70 ft. units) [19-59 kW (9.1-21.3m)]

- 10 ft. (3m), 16 ga. (1.7mm) aluminized steel tube
- 10 ft. (3m) aluminum reflector
- (2) hanger brackets

GQH6 40 MBTUH (ONLY 15 ft. end tube) [12 kW (ONLY 4.6m end tube)]
65 thru 200 MBTUH (25 thru 70 ft. units) [19-59 kW (7.6-21.3m)]

- 5 ft. (1.5m), 16 ga. (1.7mm) aluminized steel tube
- 5 ft. (1.5m) aluminum reflector
- (2) hanger brackets

EXHAUST END HEAT EXCHANGER COMPONENTS

GQH1 40 thru 60 MBTUH (20 ft. unit) [12-18 kW (6.1m)], 65 thru 85 MBTUH (20 and 25 ft. propane MB units) [19-25 kW (6.1 and 7.6m propane MB units)]

- 10 ft. (3m), 16 ga. (1.7mm) aluminized steel tube, **A** = H1-turbulator factory installed, **B** = "EXHAUST END" stenciled on tube
- 10 ft. (3m) aluminum reflector
- (2) hanger brackets

GQH5 65 thru 200 MBTUH (excluding 20 and 25 ft. MB units) [19-59 kW (excluding 6.1 and 7.6m MB units)]

- 10 ft. (3m), 16 ga. (1.7mm) aluminized steel tube, **A** = H5-turbulator factory installed, **B** = "EXHAUST END" stenciled on tube
- 10 ft. (3m) aluminum reflector
- (2) hanger brackets

GQH9 65 thru 85 MBTUH (20 and 25 ft. natural gas MB units) [19-25 kW (6.1 and 7.6m natural gas MB units)]

- 10 ft. (3m), 16 ga. (1.7mm) aluminized steel tube, **A** = H9-turbulator factory installed, **B** = "EXHAUST END" stenciled on tube, **C** = white tape around end of tube
- 10 ft. (3m) aluminum reflector
- (2) hanger brackets

TYPICAL PARTS

10 ft. (3m) reflector [length approx. 119" (302cm)]

Hanger Bracket



INSTALLATION

ALUMINIZED PRESS-FIT TUBES SUSPENDED BY HANGERS (1 OF 2)

CAUTION

- **DO NOT** use gas piping or electrical conduit to provide any type of support for the heater's suspension.
- Means of suspension **MUST BE** able to support twice the weight of the heater, securely fastened to the building's structure, and allow for expansion during its operation.
- Chain for suspension **MUST BE** 12 in. (31cm) minimum in length and be 1/0 TENSO with a minimum working load rating of 200 lbs. (90.7 kg).
- The "S" hook **MUST BE** Chicago Hardware no. 5 or equal and carry a 70 pound (32kg) maximum load.

STEP

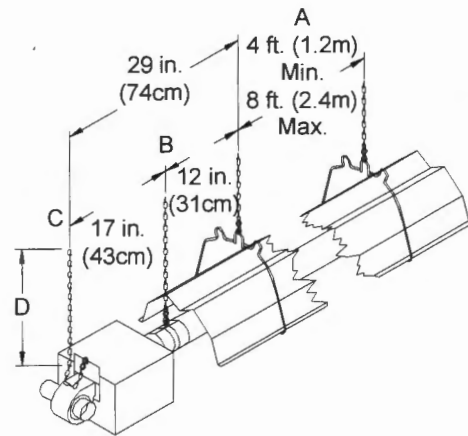
1

- To maintain straightness over the length of the system use a taut string in the planning of suspension points. Make true right angles if 90-degree elbows are used.
- Check the BASIC CONFIGURATIONS section for the general orientation of components matching the model number of your system.
- Identify all components in the COMBUSTION CHAMBERS – ALUMINIZED PRESS-FIT TUBES SUSPENDED BY HANGERS and HEAT EXCHANGERS – ALUMINIZED PRESS-FIT TUBES SUSPENDED BY HANGERS sections.
- U-type systems use a 180-degree U-bend. See U-TUBE INSTALLATION section.

STEP

2

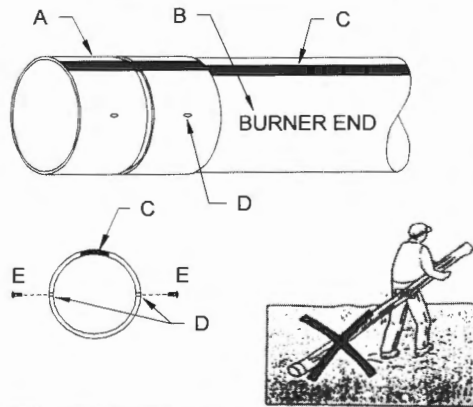
- Install chain for suspension of tubes and reflectors.
- Each section of tubing requires two (2) hangers.
- Use a minimum of 12 in. (31cm) of chain for each suspension point.
- **A** = The suspension points for each 10-foot (3m) tube should be a minimum of 4 feet (1.2m) and a maximum of 8 feet (2.4m) apart.
- **B** = Install a suspension chain to be positioned at the joint between the combustion chamber and the burner.
- **C** = Install an additional suspension point, for a required safety chain at the back of the burner box located 17 in. (43cm) from the joint between the combustion chamber and the burner.
- **D** = The burner safety chain should have an additional 6 in. (15cm) of length added to allow for slack.
- Install tube/reflector hangers. Slip one end of the S-hook through the last chain link and the other end through the tube/reflector hanger.
- **IMPORTANT: Crimp both ends of the S-hook closed!**



STEP

3

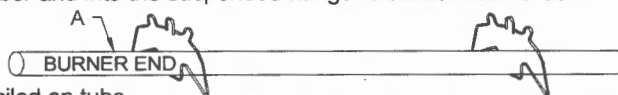
- Systems fifteen (15) feet (4.6m) or longer require joining together of combustion chamber and heat exchanger tube(s). See PRESS-FIT TUBE ASSEMBLY TIPS section.
- For U-type systems, a 180-degree u-bend is also used. See U-TUBE INSTALLATION section.
- Slip the burner coupling (A) over the end of the combustion chamber marked "BURNER END" (B). Ensure the weld seam of the combustion chamber is on top (C).
- Rotate the burner coupling (A) until the two holes (D) on one end of the coupling are each 90 degrees apart from the weld seam (C) on the combustion chamber and seat it against the center stop.
- Use (2) #12 MULTI-METAL Tek screws (E) (supplied with coupling) to fasten coupling to the combustion chamber (D).
- Tubes **MUST NOT** be dragged along the ground or other surfaces which may damage the ends.



STEP

4

- Take this assembly, with the weld seam still facing up, and place the end marked "BURNER END" (A) into the first two suspended hanger bracket assemblies at the point where the burner will eventually be located.
- Place a reflector (gloves are suggested; handle the reflectors with care as not to soil the shiny underside) over the combustion chamber and into the suspended hanger bracket assemblies.



A = "BURNER END" stenciled on tube.

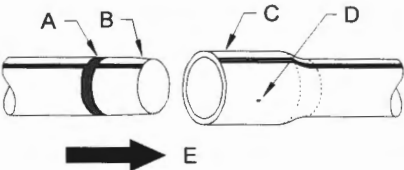
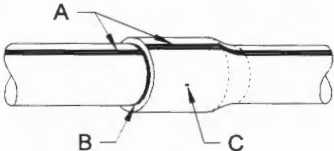
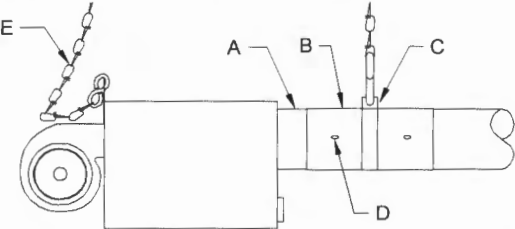

CAUTION: MB SERIES

- All burner covers are yellow, except for the MB Series, which are white. The MB burners **must be used** with the GQH1 or the GQH9 (end marked with white tape) exhaust end heat exchanger. **NO EXCEPTIONS.** Improper operation may result if this is not followed. See BASIC CONFIGURATIONS section.



INSTALLATION

ALUMINIZED PRESS-FIT TUBES SUSPENDED BY HANGERS (2 OF 2)

<p>STEP</p> <p>5</p>	<ul style="list-style-type: none"> The next heat exchanger tube, with it's weld seam up, [for 15 ft. and 20 ft. (4.6 and 6.1 m) systems only] can be put into the respective suspended hanger bracket assemblies. Manually push the flared end [with two (2) holes] of the heat exchanger tube over the swaged end of the combustion chamber as far as you can. [NOTE: The swaged end of the combustion chamber has a colored line (A) 3 in. (7.6 cm) from the end (B).]  <p>A = Colored insertion indicator, B = Swaged end, C = Flared end, D = Pilot hole, E = Air flow.</p>
<p>STEP</p> <p>6</p>	<ul style="list-style-type: none"> Go to the swaged end of the heat exchanger tube, and with a 2 pound (0.9kg) hammer and a two (2) in. by four (4) in. (5 cm x 10 cm) block of wood, hit the end of the tube until you have 3 in. (7.6cm) of insertion (the colored line will still be visible). Ensure all tubes are straight and level with the weld seam at the top before installing the screws. See the PRESS-FIT TUBE ASSEMBLY TIPS section for more information. Tek screw the tube joint connection through the two holes provided in the flared end with (2) two #12 MULTI-METAL Tek screws (supplied with the tube). Install the reflector inside the hangers. (Gloves are suggested so as not to soil the shiny underside.)  <p>A = Weld seam must be on top, B = Flared end comes up to, but does NOT cover the colored insertion indicator, C = #12 MULTI-METAL self drilling screws (2 each).</p>
<p>STEP</p> <p>7</p>	<ul style="list-style-type: none"> Slip the burner's tube (A) into the burner coupler (B) previously installed in Step 4. Once the burner is level, straight and inserted against the center stop, use (2) two #12 MULTI-METAL Tek screws (D) (supplied with the coupling) to fasten the burner to the coupling. Insert the S-hook of the burner safety chain (E) into the center hole of the burner safety chain bracket and then crimp the hook closed. Install suspension bracket (C) at the center of the burner coupler.  <p>A = Burner tube, B = Burner coupler, C = Suspension bracket, D = #12 MULTI-METAL self-drilling screws (4 ea.), E = Safety chain, 6" (15cm) of slack needed.</p>
<p>STEP</p> <p>8</p>	<ul style="list-style-type: none"> Reflectors must not be angle mounted more than 30° from horizontal for 65 to 125 MBTUH (19 – 37 kW) or 45° from horizontal for 40 to 60 or 130 to 200 MBTUH (12 – 18 or 38 – 59 kW). If located near a large doorway or in an area affected by wind see the WINDY CONDITION NOTES section. 
<p>WARNING</p>	
<ul style="list-style-type: none"> The # 12 MULTI-METAL Tek screws supplied with the coupling MUST NOT be substituted with any other type of Tek screw. If you lose them, contact the factory for new ones. 	<p style="text-align: center;">IMPORTANT</p> <ul style="list-style-type: none"> Connect the gas supply as instructed in the GAS SUPPLY AND GAS PRESSURE section. Connect the electrical supply as instructed in the ELECTRICAL SUPPLY AND THERMOSTATIC CONTROL section.
<p>CAUTION</p>	
<ul style="list-style-type: none"> Make sure all chains are plumb and vertical to prevent damage to tubes. 	



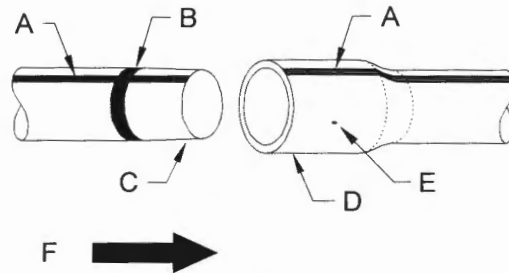
PRESS-FIT TUBE ASSEMBLY TIPS (1 OF 2)

RECOMMENDATION

- Experienced installers have made recommendations to do more connections at ground level before climbing a ladder.

IMPORTANT

- Do not drag the tubes and dent the connecting ends!**
- ALIGN THE WELD SEAMS OF ALL THE TUBES and make sure they are all on top when joining tubes!**



A = Weld seam, B = Color insertion indicator, C = Swaged end, D = Flared end, E = Pilot hole, F = Air flow.

TIP

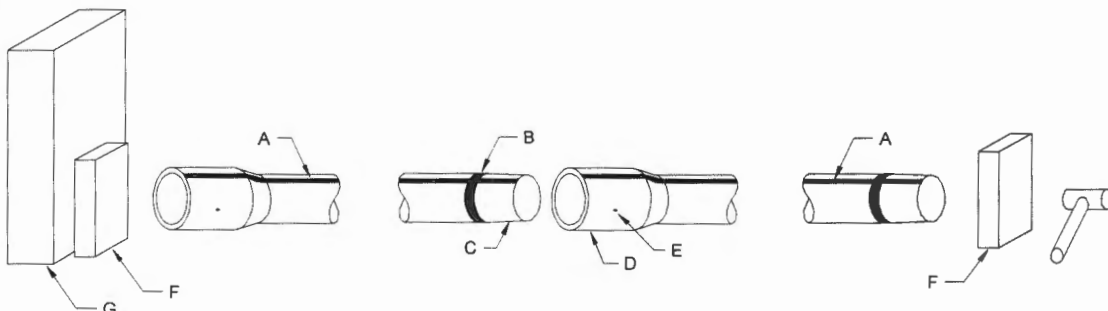
1

- Place two (2) ten (10) foot (3m) sections on the floor and align the weld seams in a line together. (Locate and properly orient the "BURNER END" and "EXHAUST END" markings on the combustion and exhaust end tubes).

TIP

2

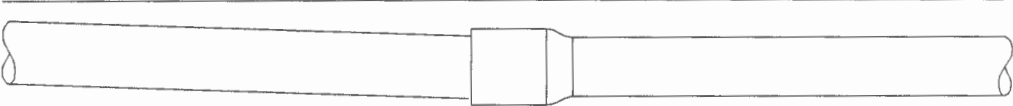
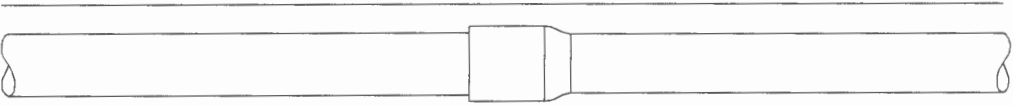
- Position a 2x4 in. (5x10 cm) block of wood on each of the far ends of both tubes.
- One block of wood prevents damage to the connecting end that will be used to tap that tube into the other.
- The other block of wood prevents damage to the other connecting end that is butted up to a nearby sturdy wall.



A = Weld seam, B = Color insertion indicator, C = Swaged end, D = Flared end, E = Pilot hole, F = Wood block [2 x 4 inches (5 x 10 cm)], G = Sturdy wall.

PRESS-FIT TUBE ASSEMBLY TIPS (2 OF 2)



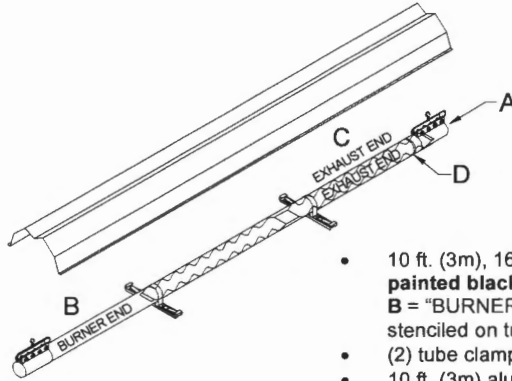
<p>TIP</p> <p>3</p>	<ul style="list-style-type: none"> Manually slide the swaged end of one tube into the flared end of the other tube. <u>ALIGN THE WELD SEAMS ON BOTH TUBES TOGETHER.</u> STRAIGHTEN the two (2) tubes and proceed to tap one tube into the other by hitting the wooden 2x4 in. (5x10 cm) block, <u>NOT</u> the tube! Continue to tap one tube into the other until the flared end comes up to, but does not cover the color insertion indicator.
<p>TIP</p> <p>4</p>	<ul style="list-style-type: none"> STRAIGHTEN the tubes again BEFORE driving the screws. Ensure all tubes are straight and level with the weld seam on top before installing the screws. Drive with a power tool the two (2) #12 MULTI-METAL Tek screws into the joint and position the four (4) hangers on the twenty (20) foot (6.1m) section. <div style="text-align: center;">  <p>WRONG – NOT STRAIGHT</p>  <p>RIGHT – STRAIGHT</p> </div>
<p>TIP</p> <p>5</p>	<ul style="list-style-type: none"> Attach a temporary rope or chain to the two (2) outer brackets and hoist the twenty (20) foot (6.1m) section into the air. <u>Align the weld seam on top,</u> level the section, and install the chain on the hangers.
<p>TIP</p> <p>6</p>	<ul style="list-style-type: none"> Repeat the steps for the next section(s) of tube and hoist it into the air. Use the temporary ropes/chains to maneuver the two (2) twenty (20) foot (6.1m) sections together as close as possible. <u>ALIGN THE WELD SEAMS OF BOTH SECTIONS TOGETHER ON TOP,</u> level the second section, and apply the chain to the four (4) hangers. With the first twenty (20) foot (6.1m) section secured, use a hammer tapping on a wooden 2x4 in. (5x10 cm) block to join both sections together, followed by the two (2) screws.
<ul style="list-style-type: none"> Complete the total installation according to this manual. Use these tips along with the instructions in the INSTALLATION – ALUMINIZED PRESS-FIT TUBES SUSPENDED BY HANGERS section. Use the WINDY CONDITION NOTES and the U-TUBE INSTALLATION sections as necessary. 	



COMBUSTION CHAMBERS BLACK IRON CLAMPED TUBES SUSPENDED BY CLAMPS

C90

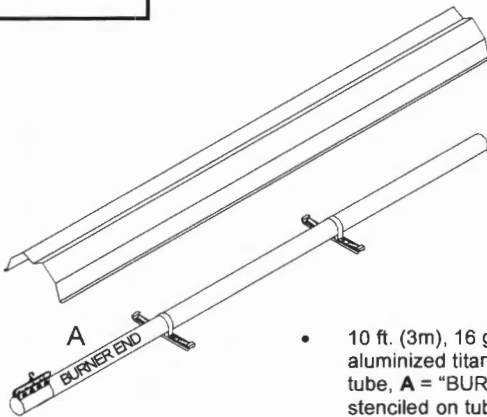
40 MBTUH (10 and 15 ft. units only)
[12 kW (3.0 and 4.6 m only)]



- 10 ft. (3m), 16 ga. (1.7mm) aluminized titanium alloy steel tube **painted black** with C9-turbulator (A) factory installed, B = "BURNER END" stenciled on tube, C = "EXHAUST END" stenciled on tube, D = white tape around end of tube.
- (2) tube clamps
- 10 ft. (3m) aluminum reflector
- (2) reflector brackets

C20

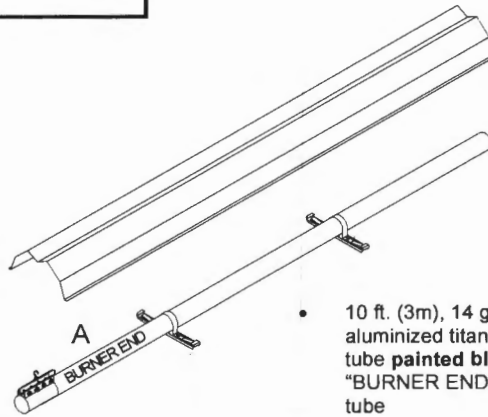
40 thru 60 MBTUH (20 ft. unit only)
[12-18 kW (6.1 m only)]
65 thru 100 MBTUH [19-29 kW]



- 10 ft. (3m), 16 ga. (1.7mm) aluminized titanium alloy steel tube, A = "BURNER END" stenciled on tube
- tube clamp
- 10 ft. (3m) aluminum reflector
- (2) reflector brackets

C40

105 thru 200 MBTUH [31-59 kW]



- 10 ft. (3m), 14 ga. (2.1mm) aluminized titanium alloy steel tube **painted black**, A = "BURNER END" stenciled on tube
- tube clamp
- 10 ft. (3m) aluminum reflector
- (2) reflector brackets

TYPICAL PARTS

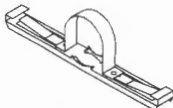
10 ft. (3m) reflector [length approx. 119" (302cm)]



Tube clamp



Reflector bracket



HEAT EXCHANGERS

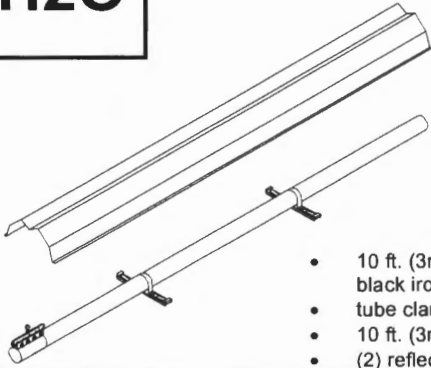
BLACK IRON CLAMPED TUBES SUSPENDED BY CLAMPS



MIDDLE HEAT EXCHANGER COMPONENTS

H20

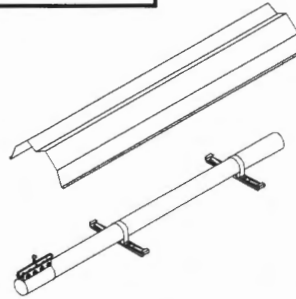
65 thru 200 MBTUH (30 thru 70 ft units)
[19-59 kW (9.1-21.3 m)]



- 10 ft. (3m), 12 ga. (2.8mm) black iron steel tube
- tube clamp
- 10 ft. (3m) aluminum reflector
- (2) reflector brackets

H60

40 MBTUH [ONLY 15 ft end tube]
[12 kW (ONLY 4.6 m end tube)]
65 thru 200 MBTUH (25 thru 70 ft units)
[19-59 kW (7.6-21.3 m)]

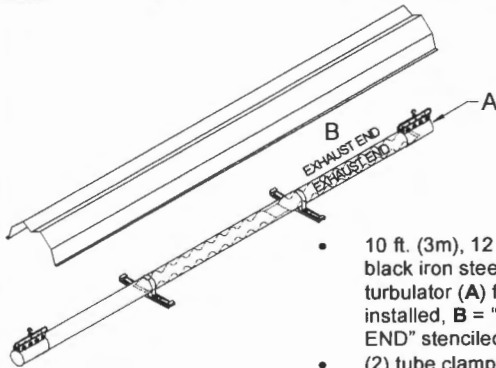


- 5 ft. (1.5m), 12 ga. (2.8mm) black iron steel tube
- tube clamp
- 5 ft. (1.5m) aluminum reflector
- (2) reflector brackets

EXHAUST END HEAT EXCHANGER COMPONENTS

H10

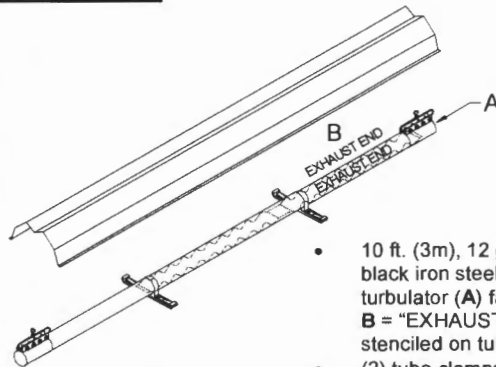
40 thru 60 MBTUH (20 ft unit) [12-18kW (6.1m)], 65 thru 85 MBTUH (20 and 25 ft propane gas MB units) [19-25kW (6.1 and 7.6m propane gas MB units)], 105 thru 130 MBTUH (30 and 35 ft natural gas MC units) [31-38kW (9.1-10.7m natural gas MC)]



- 10 ft. (3m), 12 ga. (2.8mm) black iron steel tube with H1-turbulator (A) factory installed, B = "EXHAUST END" stenciled on tube
- (2) tube clamps
- 10 ft. (3m) aluminum reflector
- (2) reflector brackets

H50

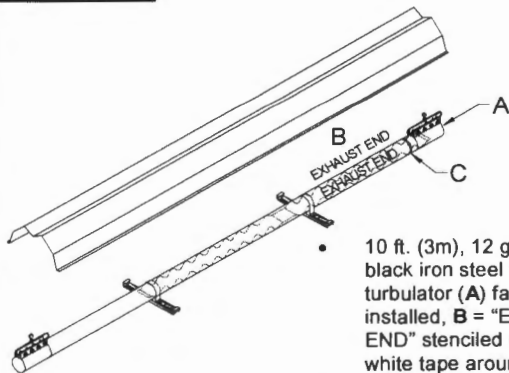
65 thru 200 MBTUH (excluding 20 and 25 ft MB units, and 30 and 35 ft MC units) [19-59 kW (excluding 6.1 and 7.6 m MB, and 9.1 and 10.7 m MC)]



- 10 ft. (3m), 12 ga. (2.8mm) black iron steel tube with H5-turbulator (A) factory installed, B = "EXHAUST END" stenciled on tube
- (2) tube clamps
- 10 ft. (3m) aluminum reflector
- (2) reflector brackets

H90

65 thru 85 MBTUH (20 and 25 ft natural gas MB units) [19-25 kW (6.1 and 7.6 m natural gas MB units)]



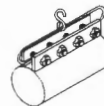
- 10 ft. (3m), 12 ga. (2.8mm) black iron steel tube with H9-turbulator (A) factory installed, B = "EXHAUST END" stenciled on tube, C = white tape around end of tube
- (2) tube clamps
- 10 ft. (3m) aluminum reflector
- (2) reflector brackets

TYPICAL PARTS

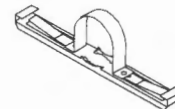
10 ft. (3m) reflector [length approx. 119" (302cm)]



Tube clamp



Reflector bracket





INSTALLATION

BLACK IRON CLAMPED TUBES SUSPENDED BY CLAMPS (1 OF 2)

CAUTION

- **DO NOT** use gas piping or electrical conduit to provide any type of support for the heater's suspension.
- Means of suspension **MUST BE** able to support twice the weight of the heater, securely fastened to the building's structure, and allow for expansion during its operation.
- Chain for suspension **MUST BE** 12 in. (31cm) minimum in length and be 1/0 TENSO with a minimum working load rating of 200 lbs. (90.7 kg).
- The "S" hook **MUST BE** Chicago Hardware no. 5 or equal and carry a 70 pound (32kg) maximum load.

STEP

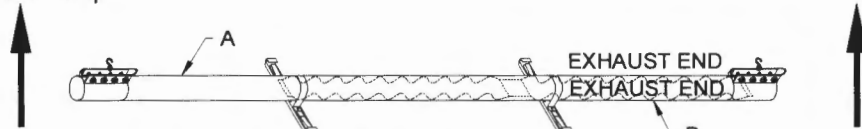
1

- To maintain straightness over the length of the system use a taut string in the planning of suspension points. Make true right angles if 90-degree elbows are used.
- Check the BASIC CONFIGURATIONS section for the general orientation of components matching the model number of your system. Component designations will have an "O" suffix, i.e. C9O.
- Identify all components in the COMBUSTION CHAMBERS – BLACK IRON CLAMPED TUBES SUSPENDED BY CLAMPS and HEAT EXCHANGERS – BLACK IRON CLAMPED TUBES SUSPENDED BY CLAMPS sections.
- U-type systems use a 180-degree U-bend. See U-TUBE INSTALLATION section.

STEP

2

- Lift into place the exhaust end of the final heat exchanger [or combustion chamber C9 on a 40 MBTUH 10-foot (12 kW 3.0 m) unit] and suspend it with weld seam on top (A) by inserting the S-hook into the loop in the sliding hanger at the top of the tube clamp, crimping it closed, and then inserting the other end of the S-hook into the last chain link, and crimping it closed. The final heat exchangers are marked "EXHAUST END" (B) according to the unit used. The last tube: for a 40 to 60 MBTUH 20-foot (12-18 kW 6.1 m) unit and 105 to 130 MBTUH 30 and 35-foot (31-38 kW 9.1 & 10.6 m) MC unit is a H1; for a 65 to 85 MBTUH 20 and 25-foot (19-25 kW 6.1 & 7.6 m) MB unit is a H9; and for a 65 to 200 MBTUH (19-59 kW) unit of all other lengths is a H5 as per the BASIC CONFIGURATIONS. **NOTE:** Make sure that tube is inserted tight against the center stop inside the tube clamp.

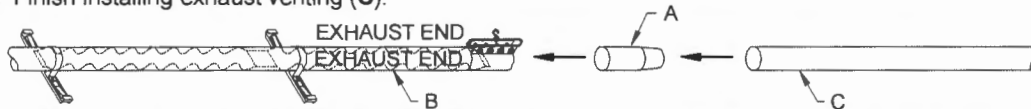


A = Weld seam of tube to be on top, B = "EXHAUST END" stenciled on tube.

STEP

3

- Insert factory accessory 4 in. (10.2 cm) Vent Pipe Adaptor (Connector) (A) into the end of the tube stenciled "EXHAUST END" (B). If factory accessory Vent Pipe Adaptor (Connector) is not used as specified in the EXHAUST VENTING section, the installer must reinforce the venting material as the tube clamp may damage it. Finish installing exhaust venting (C).

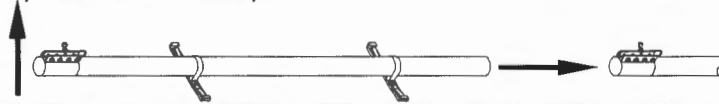


A = 4 in. (10cm) Vent Pipe Adaptor (Connector), B = "EXHAUST END" stenciled on tube, C = Exhaust venting.

STEP

4

- For heaters longer than 25 feet (7.6 m), lift the remaining heat exchanger(s) into place. Suspend the end with a tube clamp by inserting the S-hook into the last link of the previously hung chain and crimp it closed. Insert the end, without the clamp on it, into the tube clamp of the previous heat exchanger. Be certain that the tube is inserted to the stop inside the tube clamp.



STEP

5

- For heaters of 20 feet (6.1 m) or more, lift the Alumina-Therm [C2, (C4 painted black)] combustion chamber into place. Suspend the end of the tube stenciled "BURNER END" (A), with a tube clamp, by inserting the S-hook into the last link of the previously hung chain and crimp it closed. Insert the end, without a tube clamp, into the previous heat exchanger. Be certain that the tube is inserted to the center stop in the clamp. Tighten the clamp, sufficiently but not permanently, to make sure it does not come loose during installation.



A = "EXHAUST END" stenciled on tube

CAUTION: MB & MC SERIES

- All burner covers are yellow, except for the MB and MC Series, which are white. The MB and MC burners **must be used** with the H1 or the H9 (end marked with white tape) exhaust end heat exchanger. **NO EXCEPTIONS.** Improper operation may result if this is not followed. See BASIC CONFIGURATIONS section.

INSTALLATION



BLACK IRON CLAMPED TUBES SUSPENDED BY CLAMPS (2 OF 2)

<p>STEP 6</p>	<ul style="list-style-type: none"> Lift the burner into place and suspend it by inserting the S-hook of the safety chain (A) into the center hole of the safety chain bracket (B), and then crimp the hook closed. Insert the burner tube into the tube clamp at the burner end of the combustion chamber. Make sure that the burner tube is inserted against the center stop (C) inside of the tube clamp. Then, tighten the clamp as described in step 7. NOTE: The safety chain (A) for the burner has 6" (15 cm) of slack. It is NOT taut. 	
<p>A = Safety chain, B = Safety chain bracket, C = Center stop.</p>		
<p>STEP 7</p>	<ul style="list-style-type: none"> Tighten all tube clamp nuts on all tube clamps. Tighten nuts a half turn at a time, in a 2, 3, 4, 1 sequence, where 1 is always closest to the burner (A). Tighten nuts with a torque wrench until the flanges of the clamp touch and 65 ft.-lbs. (88 Nm) is achieved at each nut to assure proper seating of the clamps' inner sleeve. Do not pinch clamp hanger between flanges. S-hook of clamp must be closed after inserting chain. 	
<p>A = Always closest to burner.</p>		
<p>STEP 8</p>	<ul style="list-style-type: none"> Lift reflectors (A) into place and install on reflector brackets (B). Make sure not to soil the polished underside of the reflectors. Gloves are suggested. Insert the double turned edge of the reflector (A) under the reflector bracket tab (C). Be certain the spring steel clamp (D) is in place to hold the reflector (A) securely as shown. If the reflectors are to be at an angle, loosen the two (2) nuts holding the two (2) reflector brackets in place and rotate reflector and brackets into desired position. Reflectors must not be angle mounted more than 30° from horizontal for 65 to 125 MBTUH (19 – 37 kW) or 45° from horizontal for 40 to 60 or 130 to 200 MBTUH (12 – 18 or 38 – 59 kW). If located near a large doorway or in an area affected by wind see the WINDY CONDITION NOTES section. 	
<p>A = Reflector, B = Reflector bracket, C = reflector bracket tab, D = Spring steel clamp.</p>		
<p>STEP 9</p>	<ul style="list-style-type: none"> For U-tube construction, reference BASIC CONFIGURATIONS for placement of the 180° bend. Otherwise, installation procedure is the same as above. See also the U-TUBE INSTALLATION section. 	
<p>A = Tube clamp, B = Reflector bracket.</p>		
<p style="text-align: center;">CAUTION</p> <ul style="list-style-type: none"> Make sure all chains are plumb and vertical. A chain that is not plumb and vertical may cause damage to the radiant tube it suspends. 		<p style="text-align: center;">IMPORTANT</p> <ul style="list-style-type: none"> Connect the gas supply as instructed in the GAS SUPPLY AND GAS PRESSURE section. Connect the electrical supply as instructed in the ELECTRICAL SUPPLY AND THERMOSTATIC CONTROL section.

FOR SERVICE OR REPAIR, FOLLOW THESE STEPS IN ORDER:

FIRST: Record the following information

Model No.: _____

Unit Serial No.: _____

Date of Installation: _____

SECOND: Contact the Installer

Name _____

Address _____

Phone _____

THIRD: Contact the Nearest Distributor

Name _____

Address _____

Phone _____

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