

Service and Troubleshooting

GOODMAN® BRAND GM9C96/GC9C96 & AMANA® BRAND AM9C96/AC9C96 TWO STAGE FURNACE WITH NINE SPEED ECM MOTOR

Pride and workmanship go into every product to provide our customers with quality products. It is possible, however, that during its lifetime a product may require service. Products should be serviced only by a qualified service technician who is familiar with the safety procedures required in the repair and who is equipped with the proper tools, parts, testing instruments and the appropriate service manual. **REVIEW ALL SERVICE INFORMATION IN THE APPROPRIATE SERVICE MANUAL BEFORE BEGINNING REPAIRS.**



WARNING

ONLY PERSONNEL THAT HAVE BEEN TRAINED TO INSTALL, ADJUST, SERVICE OR REPAIR (HEREINAFTER, "SERVICE") THE EQUIPMENT SPECIFIED IN THIS MANUAL SHOULD SERVICE THE EQUIPMENT. THE MANUFACTURER WILL NOT BE RESPONSIBLE FOR ANY INJURY OR PROPERTY DAMAGE ARISING FROM IMPROPER SERVICE OR SERVICE PROCEDURES. IF YOU SERVICE THIS UNIT, YOU ASSUME RESPONSIBILITY FOR ANY INJURY OR PROPERTY DAMAGE WHICH MAY RESULT. IN ADDITION, IN JURISDICTIONS THAT REQUIRE ONE OR MORE LICENSES TO SERVICE THE EQUIPMENT SPECIFIED IN THIS MANUAL, ONLY LICENSED PERSONNEL SHOULD SERVICE THE EQUIPMENT. IMPROPER INSTALLATION, ADJUSTMENT, SERVICING OR REPAIR OF THE EQUIPMENT SPECIFIED IN THIS MANUAL, OR ATTEMPTING TO INSTALL, ADJUST, SERVICE OR REPAIR THE EQUIPMENT SPECIFIED IN THIS MANUAL WITHOUT PROPER TRAINING MAY RESULT IN PRODUCT DAMAGE, PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

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RS6612020
June 2021

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IMPORTANT INFORMATION

IMPORTANT NOTICES FOR CONSUMERS AND SERVICERS RECOGNIZE SAFETY SYMBOLS, WORDS AND LABELS

Pride and workmanship go into every product to provide our customers with quality products. It is possible, however, that during its lifetime a product may require service. Products should be serviced only by a qualified service technician who is familiar with the safety procedures required in the repair and who is equipped with the proper tools, parts, testing instruments and the appropriate service manual. **REVIEW ALL SERVICE INFORMATION IN THE APPROPRIATE SERVICE MANUAL BEFORE BEGINNING REPAIRS.**

WARNING

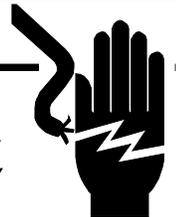
THIS UNIT SHOULD NOT BE CONNECTED TO, OR USED IN CONJUNCTION WITH, ANY DEVICES THAT ARE NOT DESIGN CERTIFIED FOR USE WITH THIS UNIT OR HAVE NOT BEEN TESTED AND APPROVED BY THE MANUFACTURER. SERIOUS PROPERTY DAMAGE OR PERSONAL INJURY, REDUCED UNIT PERFORMANCE AND/OR HAZARDOUS CONDITIONS MAY RESULT FROM THE USE OF DEVICES THAT HAVE NOT BEEN APPROVED OR CERTIFIED BY THE MANUFACTURER.

WARNING

TO PREVENT THE RISK OF PROPERTY DAMAGE, PERSONAL INJURY, OR DEATH, DO NOT STORE COMBUSTIBLE MATERIALS OR USE GASOLINE OR OTHER FLAMMABLE LIQUIDS OR VAPORS IN THE VICINITY OF THIS APPLIANCE.

WARNING

HIGH VOLTAGE
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING THIS UNIT. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.



OUTSIDE THE U.S., call 1-713-861-2500.
(Not a technical assistance line for dealers.) Your telephone company will bill you for the call.

IMPORTANT INFORMATION



WARNING

IF THE INFORMATION IN THESE INSTRUCTIONS IS NOT FOLLOWED EXACTLY, A FIRE OR EXPLOSION MAY RESULT CAUSING PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.

- DO NOT STORE OR USE GASOLINE OR OTHER FLAMMABLE VAPORS AND LIQUIDS IN THE VICINITY OF THIS OR ANY OTHER APPLIANCE.

- **WHAT TO DO IF YOU SMELL GAS:**
 - DO NOT TRY TO LIGHT ANY APPLIANCE.
 - DO NOT TOUCH ANY ELECTRICAL SWITCH; DO NOT USE ANY PHONE IN YOUR BUILDING.
 - IMMEDIATELY CALL YOUR GAS SUPPLIER FROM A NEIGHBOR'S PHONE. FOLLOW THE GAS SUPPLIER'S INSTRUCTIONS.
 - IF YOU CANNOT REACH YOUR GAS SUPPLIER, CALL THE FIRE DEPARTMENT.

- INSTALLATION AND SERVICE MUST BE PERFORMED BY A QUALIFIED INSTALLER, SERVICE AGENCY OR THE GAS SUPPLIER.



WARNING

SHOULD OVERHEATING OCCUR OR THE GAS SUPPLY FAIL TO SHUT OFF, TURN OFF THE MANUAL GAS SHUTOFF VALVE EXTERNAL TO THE FURNACE BEFORE TURNING OFF THE ELECTRICAL SUPPLY.



DANGER PELIGRO



CARBON MONOXIDE POISONING HAZARD

Special Warning for Installation of Furnace or Air Handling Units in Enclosed Areas such as Garages, Utility Rooms or Parking Areas

Carbon monoxide producing devices (such as an automobile, space heater, gas water heater, etc.) should not be operated in enclosed areas such as unventilated garages, utility rooms or parking areas because of the danger of carbon monoxide (CO) poisoning resulting from the exhaust emissions. If a furnace or air handler is installed in an enclosed area such as a garage, utility room or parking area and a carbon monoxide producing device is operated therein, there must be adequate, direct outside ventilation.

This ventilation is necessary to avoid the danger of CO poisoning which can occur if a carbon monoxide producing device continues to operate in the enclosed area. Carbon monoxide emissions can be (re)circulated throughout the structure if the furnace or air handler is operating in any mode.

CO can cause serious illness including permanent brain damage or death.

B10259-216

RIESGO DE INTOXICACIÓN POR MONÓXIDO DE CARBONO

Advertencia especial para la instalación de calentadores ó manejadoras de aire en áreas cerradas como estacionamientos ó cuartos de servicio.

Los equipos ó aparatos que producen monóxido de carbono (tal como automóvil, calentador de gas, calentador de agua por medio de gas, etc) no deben ser operados en áreas cerradas debido al riesgo de envenenamiento por monóxido de carbono (CO) que resulta de las emisiones de gases de combustión. Si el equipo ó aparato se opera en dichas áreas, debe existir una adecuada ventilación directa al exterior. Esta ventilación es necesaria para evitar el peligro de envenenamiento por CO, que puede ocurrir si un dispositivo que produce monóxido de carbono sigue operando en el lugar cerrado.

Las emisiones de monóxido de carbono pueden circular a través del aparato cuando se opera en cualquier modo.

El monóxido de carbono puede causar enfermedades severas como daño cerebral permanente ó muerte.

B10259-216

RISQUE D'EMPOISONNEMENT AU MONOXYDE DE CARBONE

Avertissement special au sujet de l'installation d'appareils de chauffage ou de traitement d'air dans des endroits clos, tels les garages, les locaux d'entretien et les stationnements.

Evitez de mettre en marche les appareils produisant du monoxyde de carbone (tels que les automobile, les appareils de chauffage autonome, etc.) dans des endroits non ventilés tels que les d'empoisonnement au monoxyde de carbone. Si vous devez faire fonctionner ces appareils dans un endroit clos, assurez-vous qu'il y ait une ventilation directe provenant de l'exterieur.

Cette ventilation est nécessaire pour éviter le danger d'intoxication au CO pouvant survenir si un appareil produisant du monoxyde de carbone continue de fonctionner au sein de la zone confinée.

Les émissions de monoxyde de carbone peuvent être recirculés dans les endroits clos, si l'appareil de chauffage ou de traitement d'air sont en marche.

Le monoxyde de carbone peut causer des maladies graves telles que des dommages permanents au cerveau et même la mort.

B10259-216

PRODUCT IDENTIFICATION

NOMENCLATURE

The model and manufacturing number are used for positive identification of component parts used in manufacturing. Please use these numbers when requesting service or parts information.

| | A | M | 9 | C | 8 | 0 | 0 | 6 | 0 | 3 | B | N | A | A |
|--|---|---|---|---|---|---|---|---|---|----|---|----|----|----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| Brand G - Goodman V - GMC | | | | | | | | | | | Minor Revision A - Initial Release B - 1st Revision | | | |
| Configuration M - Upflow/Horizontal C - Downflow/Horizontal | | | | | | | | | | | Major Revision A - Initial Release B - 1st Revision | | | |
| Motor 9 - Nine Speed ECM | | | | | | | | | | | Nox N => 40 NG/J NOx X =< 40 NG/J NOx U =< 14NG/J NOx | | | |
| Gas Valve C - 2 Stage S - 1 STAGE | | | | | | | | | | | Cabinet Width A - 14" B - 17.5" C - 21" D - 24.5" | | | |
| AFUE 80 - 80% AFUE 92 - 92% AFUE 96 - 96% AFUE 97 - 97% AFUE | | | | | | | | | | | Maximum CFM 3 - 1200 CFM 4 - 1600 CFM 5 - 2000 CFM | | | |
| MBTU/h 030 - 30,000 BTU/h 080 - 80,000 BTU/h 040 - 40,000 BTU/h 100 - 100,000 BTU/h 060 - 60,000 BTU/h 120 - 120,000 BTU/h | | | | | | | | | | | | | | |

SYSTEM OPERATION

Introduction

This is a Category IV furnace. This furnace uses a pressurized venting system and must be installed per National and local codes requirements and the installation manual that was shipped with the furnace.

Safety

Please adhere to the following warnings and cautions when installing, adjusting, altering, servicing, or operating the furnace.

| |
|---|
|  WARNING |
| TO PREVENT PERSONAL INJURY OR DEATH DUE TO IMPROPER INSTALLATION, ADJUSTMENT, ALTERATION, SERVICE OR MAINTENANCE, REFER TO THIS MANUAL. FOR ADDITIONAL ASSISTANCE OR INFORMATION, CONSULT A QUALIFIED INSTALLER, SERVICE AGENCY OR THE GAS SUPPLIER. |

| |
|---|
|  WARNING |
| THIS PRODUCT CONTAINS OR PRODUCES A CHEMICAL OR CHEMICALS WHICH MAY CAUSE SERIOUS ILLNESS OR DEATH AND WHICH ARE KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER, BIRTH DEFECTS OR OTHER REPRODUCTIVE HARM. |

| |
|--|
|  WARNING |
| TO PREVENT POSSIBLE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH DUE TO ELECTRICAL SHOCK, THE FURNACE MUST BE LOCATED TO PROTECT THE ELECTRICAL COMPONENTS FROM WATER. |

Charge (ESD) Precautions

NOTE: Discharge body's static electricity before touching unit. An electrostatic discharge can adversely affect electrical components.

Use the following precautions during furnace installation and servicing to protect the integrated control module from damage. By putting the furnace, the control, and the person at the same electrostatic potential, these steps will help avoid exposing the integrated control module to electrostatic discharge. This procedure is applicable to both installed and uninstalled (ungrounded) furnaces.

1. Disconnect all power to the furnace. Do not touch the integrated control module or any wire connected to the control prior to discharging your body's electrostatic charge to ground.
2. Firmly touch a clean, unpainted, metal surface of the furnace near the control. Any tools held in a person's hand during grounding will be discharged.
3. Service integrated control module or connecting wiring following the discharge process in Step 2. Use caution not to recharge your body with static electricity; (i.e., do not move or shuffle your feet, do not touch ungrounded objects, etc.). If you come in contact with an ungrounded object, repeat Step 2 before touching control or wires.
4. Discharge any static electricity from your body to ground before removing a new control from its container. Follow Steps 1 through 3 if installing the control on a furnace.

Return any old or new controls to their containers before touching any ungrounded object.

Product Application

This product is designed for use as a residential home gas furnace. It is **not** designed or certified for use in mobile home, trailer, or recreational vehicle applications.

This furnace can be used in the following non-industrial commercial applications: **Schools, Office buildings, Churches, Retail stores, Nursing homes, Hotels/motels, Common or office areas.** In such applications, the furnace must be installed with the installation instructions.

The *C9C96 and *M9C96 furnaces are ETL certified appliances and are appropriate for use with natural or propane gas. (**NOTE:** If using propane gas, a propane conversion kit is required).

*C9C96 and *M9C96 furnaces are dual certified.

Dual certification means that the combustion air inlet pipe is optional and the furnace can be vented as a:

- Non-direct vent (single pipe) central forced air furnace in which combustion air is taken from the installation area or from air ducted from the outside or,
- Direct vent (dual pipe) central forced air furnace in which all combustion air supplied directly to the furnace burners through a special air intake system outlined in this manual and the installation instructions.

To ensure proper installation, operation and servicing, thoroughly read the installation and service manuals for specifics pertaining to the installation, servicing and application of this product.

| |
|---|
|  WARNING |
| POSSIBLE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH DUE TO FIRE, EXPLOSION, SMOKE, SOOT, CONDENSTAIION, ELECTRICAL SHOCK OR CARBON MONOXIDE MAY RESULT FROM IMPROPER INSTALLATION, REPAIR, OPERATION, OR MAINTENANCE OF THIS PRODUCT. |

| |
|--|
|  WARNING |
| TO PREVENT PROPERTY DAMAGE, PERSONAL INJURY OR DEATH DUE TO FIRE, DO NOT INSTALL THIS FURNACE IN A MOBILE HOME, TRAILER, OR RECREATIONAL VEHICLE. |

To ensure proper furnace operation, install, operate, maintain and service the furnace in accordance with the installation, operation and service instructions, all local building codes and ordinances. In their absence, follow the latest edition of the National Fuel Gas Code (NFPA 54/ANSI Z223.1), and/or CAN/CGA B149 Installation Codes, local plumbing or waste water codes, and other applicable codes.

The rated heating capacity of the furnace should be greater than or equal to the total heat loss of the area to be heated. The total heat loss should be calculated by an approved method or in accordance with "ASHRAE Guide" or "Manual J-Load Calculations" published by the Air Conditioning Contractors of America.

SYSTEM OPERATION

| *M9C96 MINIMUM CLEARANCES TO COMBUSTIBLE MATERIALS | | | | | | |
|--|------|------|--------------------|--------------------|------|----|
| POSITION* ^S | IDES | REAR | FRONT ^B | OTTOM ^F | LUET | OP |
| Upflow | 0" | 0" | 1" | C0 | "1 | " |
| Horizontal | 6" | 0" | 1" | C0 | "6 | " |

| *C9C96 MINIMUM CLEARANCES TO COMBUSTIBLE MATERIALS | | | | | | |
|--|------|------|--------------------|--------------------|------|----|
| POSITION* ^S | IDES | REAR | FRONT ^B | OTTOM ^F | LUET | OP |
| Counterflow ⁰ | "0 | "1 | "N | C0 | " | " |
| Horizontal | 6" | 0" | 1" | C0 | "6 | " |

- C = If placed on combustible floor, floor MUST be wood only.
- NC = For installation on non-combustible floors only. A combustible subbase must be used for installations on combustible flooring.
- For servicing or cleaning, a 24" front clearance is recommended.
- Unit connections (electrical, flue, and drain) may necessitate greater clearances than the minimum clearances listed above.
- In all cases, accessibility clearance must take precedence over from the enclosure where accessibility clearances are greater.
- Approved for line contact in the horizontal position.

Thermostat Requirements

A two stage heat/cool thermostat is recommended. A single stage heating thermostat may be used. It is recommended that a high quality thermostat with a "C" terminal is used to operate the furnace.

Thermostat Location

In an area having good air circulation, locate the thermostat about five feet high on a vibration-free inside wall. Do not install the thermostat where it may be influenced by any of the following:

- Drafts, or dead spots behind doors, in corners, or under cabinets.
- Hot or cold air from registers.
- Radiant heat from the sun.
- Light fixtures or other appliances.
- Radiant heat from a fireplace.
- Concealed hot or cold water pipes, or chimneys.
- Unconditioned areas behind the thermostat and dehumidistat, such as an outside wall.

COMBUSTION AND VENTILATION AIR REQUIREMENTS

WARNING

POSSIBLE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH MAY OCCUR IF THE FURNACE IS NOT PROVIDED WITH ENOUGH FRESH AIR FOR PROPER COMBUSTION AND VENTILATION OF FLUE GASES. MOST HOMES REQUIRE OUTSIDE AIR BE SUPPLIED TO THE FURNACE AREA.

Improved construction and additional insulation in buildings have reduced heat loss by reducing air infiltration and escape around doors and windows. These changes have helped in reducing heating/cooling costs but have created a problem supplying combustion and ventilation air for gas fired and other fuel burning appliances. Appliances that pull air out

of the house (clothes dryers, exhaust fans, fireplaces, etc.) increase the problem by starving appliances for air.

When the furnace is installed as a direct ven (2-pipe) furnace, no special provisions for air for combustion are required. However, if this furnace is to be installed in the same space with other gas appliances, such as a water heater, ensure there is an adequate supply of combustion and ventilation air for the other appliances. Refer to the latest edition of the National Fuel Gas Code NFPA 54/ANSI Z223.1 or CAN/CGA B149 Installation Codes, or applicable provisions of the local building codes for determining the combustion air requirements for the appliances.

Installation Positions

*M9C96 models may be installed up flow or horizontally with left or right side down. *C9C96 models may be installed down flow or horizontally with left or right side down. Do not install any furnace on its back.

Horizontal Applications and Considerations

Horizontal applications, in particular, may dictate many of the installation's specifics such as airflow direction, ductwork connections, flue and/or combustion air pipe connections, etc. The basic application of this furnace as a horizontal furnace differs only slightly from an upright installation.

Horizontal Installations

1. Horizontal installations require 5.5" under the furnace to accommodate the drain trap.
2. Horizontal furnaces must be installed with 3/4" slope from back to front to permit condensate flow towards the front of the furnace.

When installing horizontally with the left side down, there are two options for connecting the vent pipe to the furnace.

1. Venting may be connected to the furnace vent pipe fitting on the original top (now the end) of the furnace
2. The internal vent pipe and elbow may be removed from the furnace to permit the vent to exit the top (original side) of the furnace. If this option is used, an RF000142 Vent-Drain coupling must be used to keep condensate from collecting in the inducer assembly

Refer to the following instructions and illustration.

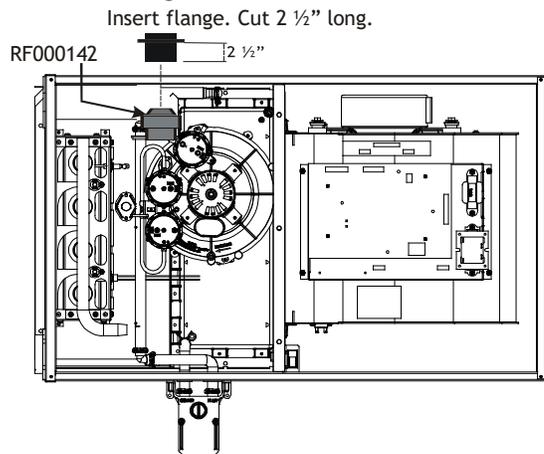


Figure 9

SYSTEM OPERATION

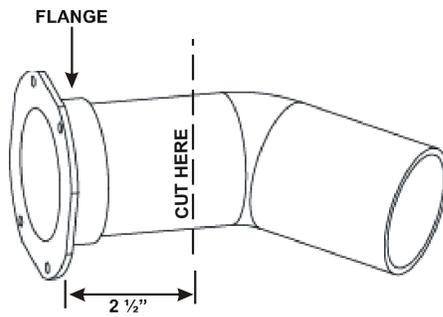


Figure 10

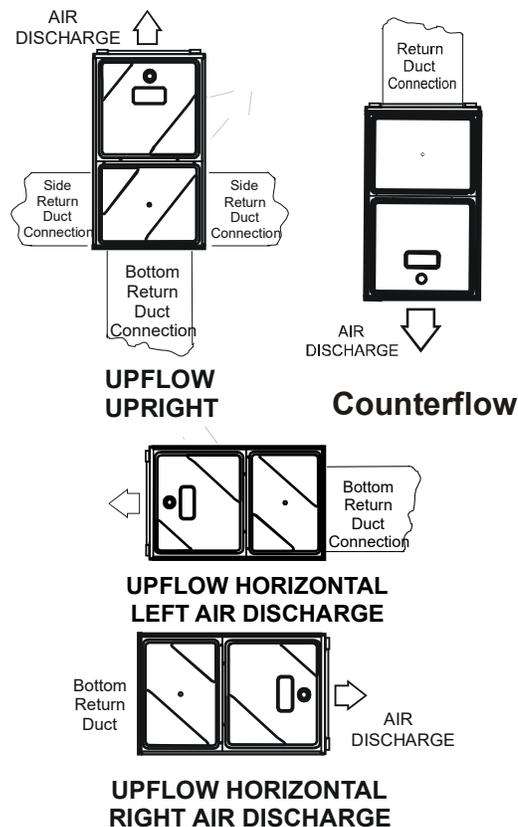
1. Remove screws from the vent flange.
2. Remove the internal elbow and vent pipe
3. Cut 2 1/2" from the flange .
4. Remove cabinet plug adjacent to inducer outlet and install an original cabinet vent hole.
5. Install RF000142 coupling on inducer outlet.
6. Install flanged vent section removed in step 2 and secure with clamps.
7. Secure flange to cabinet using screws removed in step 1.

Drain Trap and Lines

In horizontal applications the condensate drain trap is secured to the furnace side panel, suspending it below the furnace. A minimum clearance of 5.5" below the furnace must be provided for the drain trap. Additionally, the appropriate downward piping slope must be maintained from the drain trap to the drain location. Refer to *Condensate Drain Trap and Lines* section in this manual or the installation instructions for further details. If the drain trap and drain line will be exposed to temperatures near or below freezing, adequate measures must be taken to prevent condensate from freezing. **NOTE:** The use of insulation and/or heat tape is recommended. Failure to provide proper condensate drainage can result in property damage.

Leveling

Leveling ensures proper condensate drainage from the heat exchanger and induced draft blower. For proper flue pipe drainage, the furnace must be level lengthwise from end to end. The furnace should also be level from back to front or have a slight tilt with the access doors downhill (approximately 3/4") from the back panel. The slight tilt allows the heat exchanger condensate, generated in the recuperator coil, to flow forward to the recuperator coil front cover.



90% Furnace Recommended Installation Positions

Alternate Electrical and Gas Line Connections

The furnaces have provisions allowing for electrical and gas line connections through either side panel. In horizontal applications the connections can be made either through the "top" or "bottom" of the furnace.

Drain Pan

A drain pan must be provided if the furnace is installed above a conditioned area. The drain pan must cover the entire area under the furnace (and air conditioning coil if applicable).

Freeze Protection

If the drain trap and drain line will be exposed to temperatures near or below freezing, adequate measures must be taken to prevent condensate from freezing. **NOTE:** The use of insulation and/or heat tape is recommended. Failure to provide proper condensate drainage can result in property damage.

SYSTEM OPERATION

Propane Gas and/or High Altitude Installations

 **WARNING**

POSSIBLE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH MAY OCCUR IF THE CORRECT CONVERSION KITS ARE NOT INSTALLED. THE APPROPRIATE KITS MUST BE APPLIED TO INSURE SAFE AND PROPER FURNACE OPERATION. ALL CONVERSIONS MUST BE PERFORMED BY A QUALIFIED INSTALLER OR SERVICE AGENCY.

This furnace is shipped from the factory configured for natural gas at standard altitude. Propane gas installations require an orifice change to compensate for the energy content difference between natural and propane gas.

High altitude installations may require both a pressure switch and an orifice change. These changes are necessary to compensate for the natural reduction in the density of both the gas fuel and the combustion air at higher altitude.

Refer to the product Specification Sheet for a listing of appropriate manufacturer's kits for propane gas and/or high altitude installations. The indicated kits must be used to insure safe and proper furnace operation. All conversions must be performed by a qualified installer, or service agency.

 **WARNING**

FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN BODILY INJURY OR DEATH. CAREFULLY READ AND FOLLOW ALL INSTRUCTIONS GIVEN IN THIS SECTION.

 **WARNING**

UPON COMPLETION OF THE FURNACE INSTALLATION, CAREFULLY INSPECT THE ENTIRE FLUE SYSTEM BOTH INSIDE AND OUTSIDE THE FURNACE TO ASSURE IT IS PROPERLY SEALED. LEAKS IN THE FLUE SYSTEM CAN RESULT IN SERIOUS PERSONAL INJURY OR DEATH DUE TO EXPOSURE TO FLUE PRODUCTS, INCLUDING CARBON MONOXIDE.

 **WARNING**

TO AVOID BODILY INJURY, FIRE OR EXPLOSION, SOLVENT CEMENTS MUST BE KEPT AWAY FROM ALL IGNITION SOURCES (I.E., SPARKS, OPEN FLAMES, AND EXCESSIVE HEAT) AS THEY ARE COMBUSTIBLE LIQUIDS. AVOID BREATHING CEMENT VAPORS OR CONTACT WITH SKIN AND/OR EYES.

Condensate Drain Lines and Drain Trap

A condensing gas furnace achieves its high level of efficiency by extracting almost all of the heat from the products of combustion and cooling them to the point where condensation takes place. The condensate which is generated must be piped to an appropriate drain location.

 **WARNING**

IN UPRIGHT UPFLOW INSTALLATIONS, THE DRAIN TRAP MUST BE MOUNTED ON THE OPPOSITE SIDE OF THE UNIT FROM THE JUNCTION BOX. THIS WILL REDUCE THE RISK OF WATER REACHING THE JUNCTION BOX IN THE EVENT OF A BLOCKED DRAIN CONDITION. FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN POSSIBLE PROPERTY DAMAGE, PERSONAL INJURY, OR DEATH DUE TO ELECTRICAL SHOCK.

- If the drain line is routed through an area which may see temperatures near or below freezing, precautions must be taken to prevent condensate from freezing within the drain line.
- If an air conditioning coil is installed with the furnace, a common drain may be used. An open tee must be installed in the drain line, near the cooling coil, to relieve positive air pressure from the coil's plenum. This is necessary to prohibit any interference with the function of the furnace's drain trap.

GAS SUPPLY AND PIPING

The furnace rating plate includes the approved furnace gas input rating and gas types. The furnace must be equipped to operate on the type of gas applied. This includes any conversion kits required for alternate fuels and/or high altitude.

 **CAUTION**

TO PREVENT UNRELIABLE OPERATION OR EQUIPMENT DAMAGE, THE INLET GAS SUPPLY PRESSURE MUST BE AS SPECIFIED ON THE UNIT RATING PLATE WITH ALL OTHER HOUSEHOLD GAS FIRED APPLIANCES OPERATING.

Inlet gas supply pressures must be maintained within the ranges specified below. The supply pressure must be constant and available with all other household gas fired appliances operating. The minimum gas supply pressure must be maintained to prevent unreliable ignition. The maximum must not be exceeded to prevent unit overfiring.

| INLET GAS SUPPLY PRESSURE | | |
|---------------------------|---------------------|---------------------|
| Natural Gas | Minimum: 4.5" w.c. | Maximum: 10.0" w.c. |
| Propane Gas | Minimum: 11.0" w.c. | Maximum: 13.0" w.c. |

HIGH ALTITUDE DERATE

When this furnace is installed at high altitude, the appropriate High Altitude orifice kit must be applied. This is required due to the natural reduction in the density of both the gas fuel and combustion air as altitude increases. The kit will provide the proper design certified input rate within the specified altitude range.

High altitude kits are purchased according to the installation altitude and usage of either natural or propane gas. Refer to the product Specification Sheet for a tabular listing of appropriate altitude ranges and corresponding manufacturer's high altitude (Natural, Propane gas, and/or Pressure Switch) kits.

Do **not** derate the furnace by adjusting the manifold pressure to a lower pressure than specified on the furnace rating plate. The combination of the lower air density and a lower manifold pressure will prohibit the burner orifice from drawing the proper

SYSTEM OPERATION

amount of air into the burner. This may cause incomplete combustion, flashback, and possible yellow tipping.

In some areas the gas supplier may artificially derate the gas in an effort to compensate for the effects of altitude. If the gas is artificially derated, the appropriate orifice size must be determined based upon the BTU/ft³ content of the derated gas and the altitude. Refer to the National Fuel Gas Code, NFPA 54/ANSI Z223.1, and information provided by the gas supplier to determine the proper orifice size.

A different pressure switch may be required at high altitude regardless of the BTU/ft³ content of the fuel used. Refer to the product Specification Sheet for a tabular listing of appropriate altitude ranges and corresponding manufacturer's pressure switch kits.

PROPANE GAS CONVERSION

| |
|--|
|  WARNING |
| <p>POSSIBLE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH MAY OCCUR IF THE CORRECT CONVERSION KITS ARE NOT INSTALLED. THE APPROPRIATE KITS MUST BE APPLIED TO INSURE SAFE AND PROPER FURNACE OPERATION. ALL CONVERSIONS MUST BE PERFORMED BY A QUALIFIED INSTALLER OR SERVICE AGENCY.</p> |

This unit is configured for natural gas. The appropriate manufacturer's propane gas conversion kit, must be applied for propane gas installations.

Refer to the specification sheet for the model you are servicing. Refer to the "propane gas and/or High Altitude Installations" section for details.

GAS VALVE

This unit is equipped with a 24 volt gas valve controlled during furnace operation by the integrated control module. As shipped, the valve is configured for natural gas. The valve is field convertible for use with propane gas by using the appropriate propane gas conversion kit. Taps for measuring the gas supply pressure and manifold pressure are provided on the valve.

NOTE: The gas supply pressure on White-Rodgers "G/J" model gas valve, can be checked with a gas pressure test kit (Part #0151K00000S) available through our authorized distributors.

The gas valve has a manual ON/OFF control located on the valve itself. This control may be set only to the "ON" or "OFF" position. Refer to the *Lighting Instructions Label* or the "Putting the Furnace Into Operation" section of this manual or the installation instructions for use of this control during start up and shut down periods.

GAS PIPING CONNECTIONS

| |
|--|
|  CAUTION |
| <p>TO AVOID POSSIBLE UNSATISFACTORY OPERATION OR EQUIPMENT DAMAGE DUE TO UNDERFIRING OF EQUIPMENT, USE THE PROPER SIZE OF NATURAL/PROPANE GAS PIPING NEEDED WHEN RUNNING PIPE FROM THE METER/TANK TO THE FURNACE.</p> |

The gas piping supplying the furnace must be properly sized based on the gas flow required, specific gravity of the gas, and length of the run. The gas line installation must comply with local codes, or in their absence, with the latest edition of the National Fuel Gas Code, NFPA 54/ANSI Z223.1.

| Natural Gas Capacity of Pipe In Cubic Feet of Gas Per Hour (CFH) | | | | | |
|---|-------------------------|------|-----|--------|--------|
| Length of Pipe in Feet | Nominal Black Pipe Size | | | | |
| | 1/2" | 3/4" | 1" | 1 1/4" | 1 1/2" |
| 10 | 132 | 278 | 520 | 1050 | 1600 |
| 20 | 92 | 190 | 350 | 730 | 1100 |
| 30 | 73 | 152 | 285 | 590 | 980 |
| 40 | 63 | 130 | 245 | 500 | 760 |
| 50 | 56 | 115 | 215 | 440 | 670 |
| 60 | 50 | 105 | 195 | 400 | 610 |
| 70 | 46 | 96 | 180 | 370 | 560 |
| 80 | 43 | 90 | 170 | 350 | 530 |
| 90 | 40 | 84 | 160 | 320 | 490 |
| 100 | 38 | 79 | 150 | 305 | 460 |

(Pressure 0.5 psig or less and pressure drop of 0.3" W.C.; Based on 0.60 Specific Gravity Gas)

$$CFH = \frac{BTUH \text{ Furnace Input}}{\text{Heating Value of Gas (BTU/Cubic Foot)}}$$

To connect the furnace to the building's gas piping, the installer must supply a ground joint union, drip leg, manual shutoff valve, and line and fittings to connect to gas valve. In some cases, the installer may also need to supply a transition piece from 1/2" pipe to a larger pipe size.

The following stipulations apply when connecting gas piping. Refer to the following figures for typical gas line connections to the furnace.

1. Use black iron or steel pipe and fittings for the building piping.
2. Use pipe joint compound on male threads only. Pipe joint compound must be resistant to the action of the fuel used.
3. Use ground joint unions.
4. Install a drip leg to trap dirt and moisture before it can enter the gas valve. The drip leg must be a minimum of three inches long.
5. Install a 1/8" NPT pipe plug fitting, accessible for test gage connection, immediately upstream of the gas supply connection to the furnace.
6. Use two pipe wrenches when making connection to the gas valve to keep it from turning. The orientation of the gas valve on the manifold must be maintained as shipped from the factory.
7. Install a manual shutoff valve between the gas meter and unit within six feet of the unit. If a union is installed, the union must be downstream of the manual shutoff valve, between the shutoff valve and the furnace.
8. Tighten all joints securely.

SYSTEM OPERATION

GAS PIPING CHECKS

Before placing unit in operation, leak test the unit and gas connections.

| |
|---|
|  WARNING |
| TO AVOID THE POSSIBILITY OF EXPLOSION OR FIRE, NEVER USE A MATCH OR OPEN FLAME TO TEST FOR LEAKS. |

Check for leaks using an approved chloride-free soap and water solution, an electronic combustible gas detector, or other approved testing methods.

NOTE: Never exceed specified pressures for testing. Higher pressure may damage the gas valve and cause subsequent overfiring, resulting in heat exchanger failure. Disconnect this unit and shutoff valve from the gas supply piping system before pressure testing the supply piping system with pressures in excess of 1/2 psig (3.48 kPa). Isolate this unit from the gas supply piping system by closing its external manual gas shutoff valve before pressure testing supply piping system with test pressures equal to or less than 1/2 psig (3.48 kPa).

PROPANE GAS TANKS AND PIPING

| |
|--|
|  WARNING |
| PROPANE GAS IS HEAVIER THAN AIR AND ANY LEAKING GAS CAN SETTLE IN ANY LOW AREAS OR CONFINED SPACES. TO PREVENT PROPERTY DAMAGE, PERSONAL INJURY, OR DEATH DUE TO FIRE OR EXPLOSION CAUSED BY A PROPANE GAS LEAK, INSTALL A GAS DETECTION WARNING DEVICE. |

A gas detecting warning system is the only reliable way to detect a propane gas leak. Iron oxide (rust) can reduce the level of odorant in propane gas. Do not rely on your sense of smell. Contact a local propane gas supplier about installing a gas detecting warning system. If the presence of gas is suspected, please refer to the warning on this page.

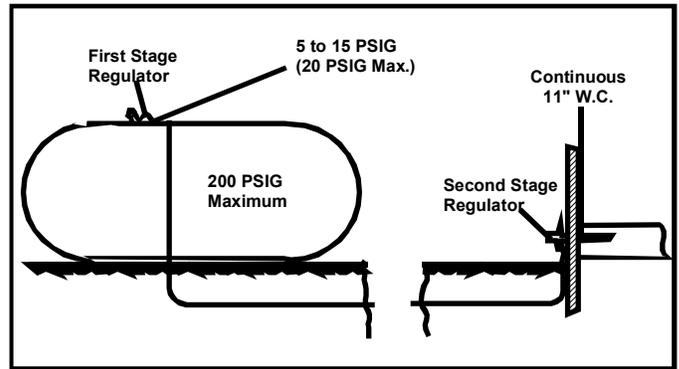
All propane gas equipment must conform to the safety standards of the National Board of Fire Underwriters, NBFU Manual 58.

For satisfactory operation, propane gas pressure must be 10 inch WC at the furnace manifold with all gas appliances in operation. Maintaining proper gas pressure depends on three main factors:

1. Vaporization rate, depending on temperature of the liquid, and "wetted surface" area of the container or containers.
2. Proper pressure regulation. (Two-stage regulation is recommended for both cost and efficiency).
3. Pressure drop in lines between regulators, and between second stage regulator and the appliance. Pipe size will depend on length of pipe run and total load of all appliances.

Complete information regarding tank sizing for vaporization, recommended regulator settings, and pipe sizing is available from most regulator manufacturers and propane gas suppliers.

Refer to the following illustration for typical propane gas installations and piping.



Typical Propane Gas Installation

| |
|--|
|  WARNING |
| IF THE GAS FURNACE IS INSTALLED IN A BASEMENT, AN EXCAVATED AREA OR A CONFINED SPACE, IT IS STRONGLY RECOMMENDED TO CONTACT A PROPANE SUPPLIER TO INSTALL A GAS DETECTING WARNING DEVICE IN CASE OF A GAS LEAK. |
| <ul style="list-style-type: none">• SINCE PROPANE GAS IS HEAVIER THAN AIR, ANY LEAKING GAS CAN SETTLE IN ANY LOW AREAS OR CONFINED SPACES.• PROPANE GAS ODORANT MAY FADE, MAKING THE GAS UNDETECTABLE EXCEPT WITH A WARNING DEVICE. |

| |
|---|
|  WARNING |
| AN UNDETECTED GAS LEAK WILL CREATE A DANGER OF EXPLOSION OR FIRE. IF THE PRESENCE OF GAS IS SUSPECTED, FOLLOW THE INSTRUCTIONS ON THE COVER OF THIS MANUAL. FAILURE TO DO SO COULD RESULT IN SERIOUS PERSONAL INJURY OR DEATH. |

Use a separate fused branch electrical circuit containing properly sized wire, and fuse or circuit breaker. The fuse or circuit breaker must be sized in accordance with the maximum overcurrent protection specified on the unit rating plate. An electrical disconnect must be provided at the furnace. Use a separate fused branch electrical circuit containing properly sized wire, and fuse or circuit breaker. The fuse or circuit breaker must be sized in accordance with the maximum overcurrent protection specified on the unit rating plate. An electrical disconnect must be provided at the furnace location.

NOTE: Line polarity must be observed when making field connections.

SYSTEM OPERATION



WARNING

IF THE INFORMATION IN THESE INSTRUCTIONS IS NOT FOLLOWED EXACTLY, A FIRE OR EXPLOSION MAY RESULT CAUSING PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.

- DO NOT STORE OR USE GASOLINE OR OTHER FLAMMABLE VAPORS AND LIQUIDS IN THE VICINITY OF THIS OR ANY OTHER APPLIANCE.

- WHAT TO DO IF YOU SMELL GAS:

- DO NOT TRY TO LIGHT ANY APPLIANCE.
- DO NOT TOUCH ANY ELECTRICAL SWITCH; DO NOT USE ANY PHONE IN YOUR BUILDING.
- IMMEDIATELY CALL YOUR GAS SUPPLIER FROM A NEIGHBOR'S PHONE. FOLLOW THE GAS SUPPLIER'S INSTRUCTIONS.
- IF YOU CANNOT REACH YOUR GAS SUPPLIER, CALL THE FIRE DEPARTMENT.

- INSTALLATION AND SERVICE MUST BE PERFORMED BY A QUALIFIED INSTALLER, SERVICE AGENCY OR THE GAS SUPPLIER.

Sizing Between First and Second Stage Regulator*

Maximum Propane Capacities listed are based on 2 psig pressure drop at 10 psig setting. Capacities in 1,000 BTU/hour.

| Pipe or Tubing Length Feet | Tubing Size, O.D. Type L | | | | | Nominal Pipe Size Schedule 40 | |
|-------------------------------|--------------------------|-------|-------|-------|-------|----------------------------------|-------|
| | 3/8" | 1/2" | 5/8" | 3/4" | 7/8" | 1/2" | 3/4" |
| 10 | 730 | 1,700 | 3,200 | 5,300 | 8,300 | 3,200 | 7,500 |
| 20 | 500 | 1,100 | 220 | 3,700 | 5,800 | 2,200 | 4,200 |
| 30 | 400 | 920 | 2,000 | 2,900 | 4,700 | 1,800 | 4,000 |
| 40 | 370 | 850 | 1,700 | 2,700 | 4,100 | 1,600 | 3,700 |
| 50 | 330 | 770 | 1,500 | 2,400 | 3,700 | 1,500 | 3,400 |
| 60 | 300 | 700 | 1,300 | 2,200 | 3,300 | 1,300 | 3,100 |
| 80 | 260 | 610 | 1,200 | 1,900 | 2,900 | 1,200 | 2,600 |
| 100 | 220 | 540 | 1,000 | 1,700 | 2,600 | 1,000 | 2,300 |
| 125 | 200 | 490 | 900 | 1,400 | 2,300 | 900 | 2,100 |
| 150 | 190 | 430 | 830 | 1,300 | 2,100 | 830 | 1,900 |
| 175 | 170 | 400 | 780 | 1,200 | 1,900 | 770 | 1,700 |
| 200 | 160 | 380 | 730 | 1,100 | 1,800 | 720 | 1,500 |

To convert to capacities at 15 psig settings - multiply by 1.130

To convert to capacities at 5 psig settings - multiply by 0.879

Sizing Between Second or Second Stage Regulator & Appliance*

Maximum Propane Capacities listed are based on 1/2" W.C. pressure drop at 11" W.C. setting. Capacities in 1,000 BTU/hour.

| Pipe or Tubing Length Feet | Tubing Size, O.D. Type L | | | | | Nominal Pipe Size Schedule 40 | | | | |
|-------------------------------|--------------------------|------|------|-------|------|----------------------------------|------|-------|--------|--------|
| | 3/8" | 1/2" | 5/8" | 3/4" | 7/8" | 1/2" | 3/4" | 1" | 1-1/4" | 1-1/2" |
| 10 | 39 | 92 | 199 | 329 | 501 | 275 | 567 | 1,071 | 2,205 | 3,307 |
| 20 | 26 | 62 | 131 | 216 | 346 | 189 | 393 | 732 | 1,496 | 2,299 |
| 30 | 21 | 50 | 107 | 181 | 277 | 152 | 315 | 590 | 1,212 | 1,858 |
| 40 | 19 | 41 | 90 | 145 | 233 | 129 | 267 | 504 | 1,039 | 1,559 |
| 50 | 18 | 37 | 79 | 131 | 198 | 114 | 237 | 448 | 913 | 1,417 |
| 60 | 16 | 35 | 72 | 1,211 | 187 | 103 | 217 | 409 | 834 | 1,275 |
| 80 | 13 | 29 | 62 | 104 | 155 | 89 | 185 | 346 | 724 | 1,066 |
| 100 | 11 | 26 | 55 | 90 | 138 | 78 | 162 | 307 | 630 | 976 |
| 125 | 10 | 24 | 48 | 81 | 122 | 69 | 146 | 275 | 567 | 866 |
| 150 | 9 | 21 | 43 | 72 | 109 | 63 | 132 | 252 | 511 | 787 |
| 200 | 8 | 19 | 39 | 66 | 100 | 54 | 112 | 209 | 439 | 665 |
| 250 | 8 | 17 | 36 | 60 | 93 | 48 | 100 | 185 | 390 | 590 |

*Data in accordance with NFPA pamphlet No. 54

Propane Gas Piping Charts

When installing a propane storage tank, the contractor must consider proper tank sizing, safety, efficiency, ground characteristics and aesthetics. For a residential customer, the size may range from 100-1,000 gallons, depending on household use. Typically, a 500 gallon tank is ample for an average four-bedroom home. However, it is best to consult your local propane supplier to ensure the proper sizing for propane storage requirements. Determining the correct tank size for each household is a function of demand, economy, efficiency and convenience. It is a process that requires cooperation between the propane supplier and customer.

ELECTRICAL CONNECTIONS



WARNING

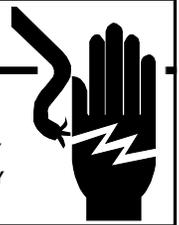
TO AVOID THE RISK OF ELECTRICAL SHOCK, WIRING TO THE UNIT MUST BE PROPERLY POLARIZED AND GROUNDED.



WARNING

HIGH VOLTAGE

DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING THIS UNIT. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.



CAUTION

LABEL ALL WIRES PRIOR TO DISCONNECTION WHEN SERVICING CONTROLS. WIRING ERRORS CAN COUSE IMPROPER AND DANGEROUS OPERATION. VERIFY PROPER OPERATION AFTER SERVICING.

WIRING HARNESS

The wiring harness is an integral part of this furnace. Field alteration to comply with electrical codes should not be required. Wires are color coded for identification purposes. Refer to the wiring diagram for wire routings. 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 105° C. Any replacement wiring must be copper conductor.

115 VOLT LINE CONNECTIONS

Before proceeding with electrical connections, ensure that the supply voltage, frequency, and phase correspond to that specified on the unit rating plate. Power supply to the furnace must be N.E.C. Class 1, and must comply with all applicable codes. The furnace must be electrically grounded in accordance with local codes or, in their absence, with the latest edition of The National Electric Code, ANSI NFPA 70 and/or The Canadian Electric Code CSA C22.1.

SYSTEM OPERATION

WARNING

IN 90% FURNACE UPRIGHT UPFLOW INSTALLATIONS, THE DRAIN TRAP MUST BE MOUNTED ON THE OPPOSITE SIDE OF THE UNIT FROM THE JUNCTION BOX. THIS WILL REDUCE THE RISK OF WATER REACHING THE JUNCTION BOX IN THE EVENT OF A BLOCKED DRAIN CONDITION.

Connect hot, neutral, and ground wires as shown in the wiring diagram located on the unit's blower door. Metal conduit is not considered a substitute for an actual ground wire to the unit. Line polarity must be observed when making field connections. Line voltage connections can be made through either the right or left side panel.

The furnace is shipped configured for a right side (left side for counterflow) electrical connection with the junction box located inside the burner compartment. To make electrical connections through the opposite side of the furnace, the junction box must be relocated to the other side of the burner compartment prior to making electrical connections.

CAUTION

EDGES OF SHEET METAL HOLES MAY BE SHARP. USE GLOVES AS PRECAUTION WHEN REMOVING HOLE PLUGS.

NOTE: Wire routing must not interfere with circulator blower operation, filter removal, or routine maintenance.

WARNING

TO AVOID THE RISK OF ELECTRICAL SHOCK, INJURY, OR DEATH, THE FURNACE MUST BE ELECTRICALLY GROUNDED IN ACCORDANCE WITH LOCAL CODES OR, IN THEIR ABSENCE, WITH THE LATEST EDITION OF THE NATIONAL ELECTRIC CODE.

WARNING

HIGH VOLTAGE
DISCONNECT ALL POWER BEFORE SERVICING OR CHANGING ANY ELECTRICAL WIRING. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.



| ACCESSORY LOAD SPECIFICATIONS | |
|-------------------------------|----------------------------|
| Electronic Air Cleaner | 1.0 Amp maximum at 120 VAC |
| Humidifier | 1.0 Amp maximum at 120 VAC |

The integrated control module electronic air cleaner terminals (EAC) are energized with 115 volts whenever the circulator blower is energized.

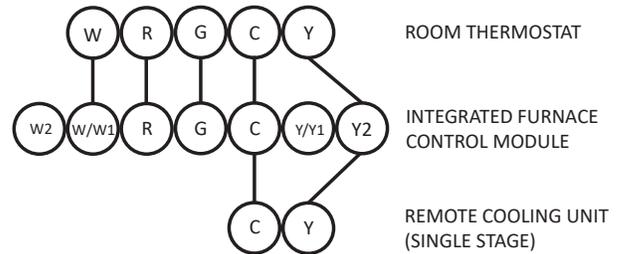
24 VOLT THERMOSTAT WIRING

NOTE: Low voltage connections can be made through either the right or left side panel. Wire routing must not interfere with circulator blower operation, filter removal, or routine maintenance.

A 40 V.A. transformer and an integrated electronic control

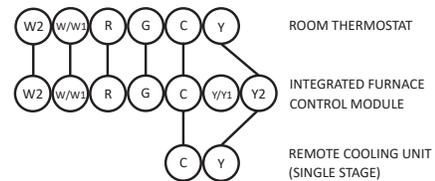
are built into the furnace to allow use with most cooling equipment. Consult the wiring diagram located in this manual, the installation manual, or on the blower door for further details of 115 Volt and 24 Volt wiring.

Thermostat Wiring Diagrams

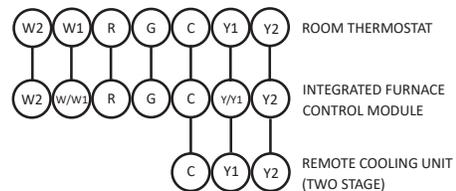


Thermostat - Single-Stage Heating with Single-Stage Cooling
NOTE: To apply a single-stage Heating Thermostat, the staging option must be set on single-stage.

Figure 11



Thermostat - Two-Stage Heating with Single-Stage Cooling
Figure 12



Thermostat - Two-Stage Heating with Two-Stage Cooling
Figure 13

USING A SINGLE-STAGE HEATING THERMOSTAT

A single-stage heating thermostat may be used to control this furnace; however, the furnace is setup by default to use a two-stage heating thermostat. To use a single stage heating thermostat the installer must make the desired selections in the user menus using the push button switches on the control board. When a single stage heating thermostat is used there are two options for controlling the timed transition from low to high fire: 1) Auto 2) Fixed Time.

- Press the Left or Right menu switches to get to the R H 5 menu.
- The menu will display these options: no 10 20 30 60 Aut

SYSTEM OPERATION

- Fixed time options are expressed in minutes on the display as: 10 20 30 60.
- If *AUT* (Automatic) is selected, the actual timing for the transition to 2nd stage heat will be calculated by the control board based on length of run time of previous heating cycles (duty cycle).
- Press the center switch to save the selection.

In Auto mode, the transition to 2nd stage heat will vary between 1 to 12 minutes.

| Duty Cycle % | Heating Stage Timing | Demand |
|--------------|--|------------------|
| 0-38 | 1 st Stage, 12 minute 2 nd Stage | Light |
| 39-50 | 1 st Stage, 10 minute 2 nd Stage | Light to Average |
| 51-62 | 1 st Stage, 7 minute 2 nd Stage | Average |
| 63-75 | 1 st Stage, 5 minute 2 nd Stage | Average to Heavy |
| 76-88 | 1 st Stage, 3 minute 2 nd Stage | Heavy |
| 89-100 | 1 st Stage, 1 minute 2 nd Stage | Heavy |

USING A TWO STAGE HEATING THERMOSTAT

- The furnace is setup by default to use a two-stage heating thermostat.
- The menu may be accessed by pressing the Left or Right menu switches to get to the *A H 5* menu.
- The menu will display these options: *no 10 20 30 60 AUT*.
- Select *no*.
- Press the center switch to save the selection.
- In this mode only a W2 signal on the control board will bring on 2nd stage heat.

FOSSIL FUEL APPLICATIONS

This furnace can be used in conjunction with a heat pump in a fossil fuel application. A fossil fuel application refers to a combined gas furnace and heat pump installation which uses an outdoor temperature sensor to determine the most cost efficient means of heating (heat pump or gas furnace).

A heat pump thermostat with *three stages of heat* is required to properly use a two-stage furnace in conjunction with a heat pump. Refer to the fossil fuel kit installation instructions for additional thermostat requirements.

Strictly follow the wiring guidelines in the fossil fuel kit installation instructions. All furnace connections must be made to the furnace two-stage integrated control module and the "FURNACE" terminal strip on the fossil fuel control board.

TWINNING

Two furnaces of the same model may be twinned. The integrated control board has a 3/16" terminal labeled "TWIN" located beside the low voltage thermostat connection strip.

Twinning allows simultaneous operation of two furnaces and forces the indoor blower motors of each furnace to operate synchronously into a common duct system. Using the twinning function will require only field installed wiring with no external kits or parts. The staging and speed tap options must be set the same on both furnaces.

NOTE: Each furnace must be connected to its own 115 VAC power supply. The L1 connection to each furnace must be in phase (connected to circuit breakers on the same 115 VAC service panel phase leg). To verify that the furnaces are in phase, check from L1 to L1 on each furnace with a voltmeter. If the furnaces are in phase, the voltage between both furnaces will be ZERO.

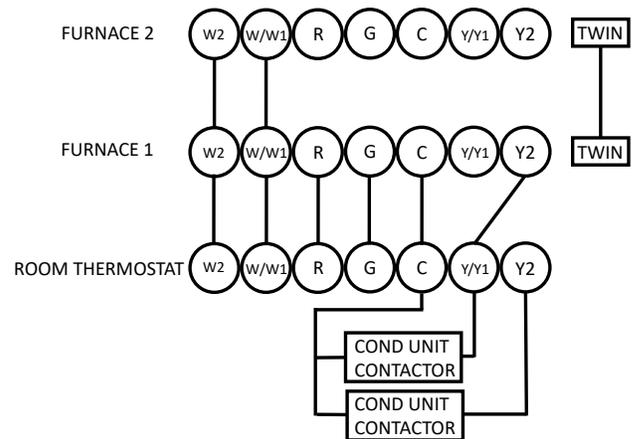


Figure 14

115 VOLT LINE CONNECTION OF ACCESSORIES (HUMIDIFIER AND ELECTRONIC AIR CLEANER)

The furnace integrated control module is equipped with line voltage accessory terminals for controlling power to an optional field-supplied humidifier and/or electronic air cleaner.

The accessory load specifications are noted in the chart below:

| | |
|------------------------|----------------------------|
| Humidifier | 1.0 Amp maximum at 120 VAC |
| Electronic Air Cleaner | 1.0 Amp maximum at 120 VAC |

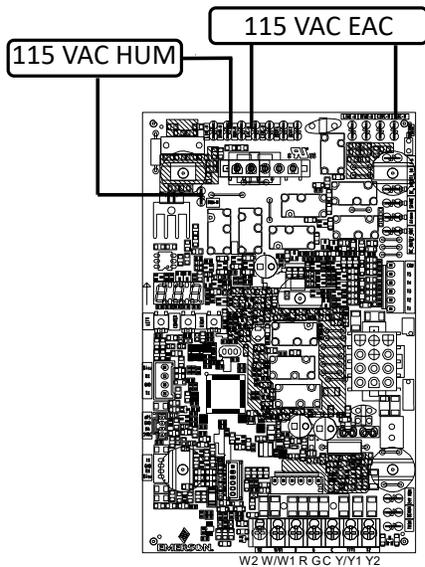
Turn OFF power to the furnace before installing any accessories. Follow the humidifier or air cleaner manufacturers' instructions for locating, mounting, grounding, and controlling these accessories. Accessory wiring connections are to be made through the 1/4" quick connect terminals provided on the furnace integrated control module. The humidifier and electronic air cleaner hot terminals are identified as HUM H and EAC H. The humidifier and electronic air cleaner neutral terminals are identified as NEUTRAL. All field wiring must conform to applicable codes. Connections should be made as shown.

If it is necessary for the installer to supply additional line voltage wiring to the inside of the furnace, the wiring must conform to all local codes, and have a minimum temperature rating of 105°C. All line voltage wire splices must be made

SYSTEM OPERATION

inside the furnace junction box.

The integrated control module humidifier terminal (HUM H) is energized with 115 volts whenever the induced draft blower is energized. The integrated control module electronic air cleaner terminal (EAC H) is energized with 115 volts whenever the circulator blower is energized. This terminal can also be used to provide 115 volt power to a humidifier transformer. The remaining primary transformer wire would be connected to the Line N on the control board.

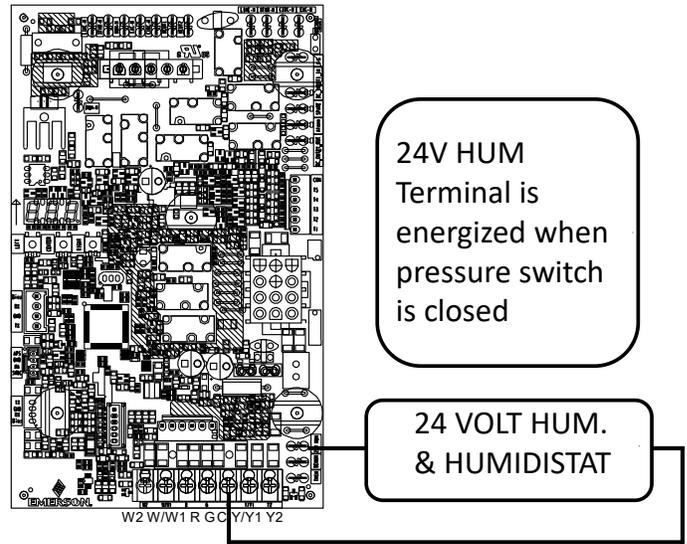


Accessories - Accessories Wiring
Figure 15

LOW VOLTAGE HUMIDIFIER

The furnace integrated control module is equipped with a low voltage terminal for providing power to an optional field-supplied 24 volt humidifier. The 24V HUM terminal is energized any time the draft inducer is powered. See connection diagram below.

NOTE: This is a 24 volt circuit only, the common connection must be on C terminal of the low voltage terminal strip (where thermostat wires are connected). Wiring for this circuit must **NOT** be connected to the line N location where line voltage neutral wires are connected.



24 Volt Humidifier Connection
Figure 16

GAS HEAT SEQUENCE OF OPERATION

Call for 1st Stage Heat

- On a call for heat, the thermostat contacts close & the control board receives 24 VAC on the W1 terminal.
- The control board microcomputer runs its self-check routine.
- The control verifies the limit switch is closed (24 VAC on Pin 8 of the 12 Pin connector).
- The control verifies that pressure switch circuit is open (0 VAC on Pin 5).
- The control module performs a gas valve circuitry check to verify gas valve relay state and presence of voltage at the valve.
- The system will energize the Induced draft blower.
- The pre-purge period begins once the low fire pressure switch is detected closed (24 VAC on Pin 5).
- After the completion of pre-purge, the control will energize the igniter.
- After completion of the igniter warm-up period:
- The gas valve is energized.
- The igniter is de-energized as soon as flame is sensed.
- After 30 seconds the indoor blower is energized on heating speed.
- When using a single-stage heating thermostat, the furnace will transition to 2nd stage gas heat by either a fixed time or auto mode depending on menu selections made by the installer.
- The inducer motor is enabled at high speed.
- Closure of the 2nd stage pressure switch will energize the high fire stage of the gas valve.

SYSTEM OPERATION

- The 2nd stage gas heat speed of the indoor blower is energized
- When the thermostat is satisfied:
- The gas valve is de-energized.
- The inducer remains energized for the post purge period (15 seconds).
- The indoor blower runs for the selected off delay period (90 seconds by default, adjustable from 30 – 180 seconds).

Call for 2nd Stage Heat During 1st Stage Heat Operation

- The control board receives a 24 VAC signal on the W2 terminal.
- The inducer motor is enabled at high speed.
- Closure of the 2nd stage pressure switch will energize the high fire stage of the gas valve.
- The 2nd stage gas heat speed of the indoor blower is energized.

HEATING MODE SPEED SELECTION

To change the main blower speed in HEATING mode, follow the following steps:

1. Press the left or right switch until LED displays “gA1” (for single-stage HEATING) or “gA2” (for two-stage HEATING). Press the center switch and LED will display the selected speed number as Fxx (xx: Blower speed number).
2. The control will rotate available speed number every time left / right switches are pressed. The table below shows the available speeds for low & high heat mode.
3. Press the center switch to save the selection.

NOTE: Always refer to the Heating Chart to choose from available heating speeds

| THERMOSTAT CALL | AVAILABLE SPEEDS |
|-----------------|------------------|
| W/W1 | F01 (DEFAULT) |
| | F03 |
| | F04 |
| W2 | F02 (DEFAULT) |
| | F04 |
| | F05 |

One and Two-Stage Heating Speed Table for 2 Stage IFC

CONTINUOUS FAN MODE SPEED SELECTION

To change the main blower speed in circulation mode, follow the following steps:

1. Press the left or right switch until LED displays “FSd”. Press the center switch and LED will display the selected speed number as Fxx (xx: Blower speed number from 1 to 9). F03 is the default speed for circulation.

2. The control will rotate available speed number every time left/right switches are pressed. All 9 speeds are available for circulation.
3. When the center switch is pressed, the current displayed speed will be selected, and control will immediately apply that speed setting.

| THERMOSTAT CALL | AVAILABLE SPEEDS |
|-----------------|------------------|
| G | F01 |
| | F02 |
| | F03 (DEFAULT) |
| | F04 |
| | F05 |
| | F06 |
| | F07 |
| | F08 |
| | F09 |

Circulation Speed Table for 2 Stage IFC

COOLING MODE SEQUENCE OF OPERATION

Low Stage Cooling Mode Sequence:

On a call for low stage cooling, the Y/Y1 or Y/Y1 and G thermostat contacts close signaling the furnace control board with 24 VAC on Y/Y1 or Y/Y1 and G terminals.

- The 7-Segment will display the cool mode: 1 R [
- The compressor and condenser fan are energized.
- The circulator fan is energized at low cool speed after a cool on delay. The electronic air cleaner will also be energized.
- After the thermostat is satisfied, the compressor is de-energized and the Cool Mode Fan Off Delay period begins.
- Following the Cool Mode Fan Off Delay period, the cool circulator and air cleaner relay are de-energized.

2nd Stage Cooling Mode Sequence:

On a call for 2nd stage cooling, the Y2 or Y2 and G thermostat contacts close signaling the furnace control board with 24 VAC on Y2 or Y2 and G terminals.

- The 7-Segment will display the cool mode: 2 R [
- The compressor and condenser fan are energized.
- The circulator fan is energized at cool speed after a cool on delay. The electronic air cleaner will also be energized.
- After the thermostat is satisfied, the compressor is de-energized and the Cool Mode Fan Off Delay period begins.
- Following the Cool Mode Fan Off Delay period, the cool circulator and air cleaner relay are de-energized

SYSTEM OPERATION

COOLING MODE SPEED SELECTION

To change the main blower speed in COOLING mode, follow the following steps:

1. Press the left or right switch until LED displays “AC1 “(for single stage COOLING) or “AC2 “(for two-stage COOLING). Press the center switch and LED will display the selected speed number as Fxx (xx: Blower speed number from 1 to 9).
2. The control will rotate available speed number every time left/right switches are pressed. All 9 speeds are available for both Single and Two Stage cooling.
3. When the center switch is pressed, the current displayed speed will be selected, and control will apply the newly selected speed in next cooling call.

| THERMOSTAT CALL | AVAILABLE SPEEDS |
|-----------------|------------------|
| Y/Y1 | F01 |
| | F02 |
| | F03 |
| | F04 (DEFAULT) |
| | F05 |
| | F06 |
| | F07 |
| | F08 |
| | F09 |

Single-Stage Cooling Speed Table for 2 Stage IFC

| THERMOSTAT CALL | AVAILABLE SPEEDS |
|-----------------|------------------|
| Y2 | F01 |
| | F02 |
| | F03 |
| | F04 |
| | F05 (DEFAULT) |
| | F06 |
| | F07 |
| | F08 |
| | F09 |

Two-Stage Cooling Speed Table for 2 Stage IFC

CIRCULATING AIR AND FILTERS DUCTWORK - AIR FLOW

Duct systems and register sizes must be properly designed for the C.F.M. and external static pressure rating of the furnace. Ductwork should be designed in accordance with the recommended methods of “Air Conditioning Contractors of America” manual D.

A duct system should be installed in accordance with Standards of the National Board of Fire Underwriters for the Installation of Air Conditioning, Warm Air Heating and Ventilating Systems, Pamphlets No. 90A and 90B.

A return air filter is not supplied with the furnace. The installer

must supply a means of filtering all of the return air. Filter(s) shall comply with UL900 or CAN/ULC-S111 Standards. If the furnace is installed without filters, and is not covered by the warranty.

Upflow furnaces with air delivery of less than 1800 CFM:

Use one side return or one bottom return ductwork connection.

Upflow furnaces with air delivery of 1800 CFM or higher:

Use two side returns or one side return and one bottom return connection.

Guide dimples locate the side and bottom return cutout locations. Use a straight edge to scribe lines connecting the dimples. Cut out the opening on these lines. An undersized opening will cause reduced airflow. For bottom return connection, remove the bottom of the cabinet before setting the furnace on the raised platform or return air duct.

A closed return duct system must be used, with the return duct connected to the furnace. ***NOTE: Ductwork must never be attached to the back of the furnace.*** Supply and return connections to the furnace may be made with flexible joints to reduce noise transmission, if desired. If a central return is used, a connecting duct must be installed between the unit and the utility room wall so the blower will not interfere with combustion air or draft. The room, closet, or alcove must not be used as a return air chamber.

When the furnace is used in connection with a cooling unit, the furnace should be installed in parallel with or on the upstream side of the cooling unit to avoid condensation in the heating element. With a parallel flow arrangement, the dampers or other means used to control the flow of air must be adequate to prevent chilled air from entering the furnace and, if manually operated, must be equipped with means to prevent operation of either unit unless the damper is in the full heat or cool position.

When the furnace is heating, the temperature of the return air entering the furnace must be between **55°F** and **100°F**.

UPRIGHT FILTER INSTALLATIONS

Depending on the installation and/or customer preference, differing filter arrangements can be applied. Filters can be installed in the central return register and a side panel external filter rack kit (upflow filter kit # EFR02 As an alternative a media air filter or electronic air cleaner can be used as the requested filter. Refer to the following minimum filter requirement charts for determination of the minimum filter area to ensure proper unit performance. The following figures show possible filter locations.

SYSTEM OPERATION

| Upflow Models | Minimum Recommended Filter Size |
|-----------------|--|
| *0403A* | 1 - 16 X 25 Side or 1 - 14 X 24 Bottom Return |
| *0603A* | 1 - 16 X 25 Side or 14 X 24 Bottom Return |
| *0603B* | 1 - 16 X 25 Side or Bottom Return |
| *0803B* | 1 - 16 X 25 Side or Bottom Return |
| *0804B* | 1 - 16 X 25 Side or Bottom Return |
| *0804C* | 1 - 16 X 25 Side or Bottom Return |
| *0805C* | 1 - 16 X 25 Side or Bottom Return ¹ |
| *0805D* | 2 - 16 X 25 Side or 1 - 20 X 25 Bottom Return ¹ |
| *1004C* | 2 - 16 X 25 Side or 1 - 20 X 25 Bottom Return |
| *1005C* | 2 - 16 X 25 Side or 1 - 20 X 25 Bottom Return |
| *1205D* | 2 - 16 X 25 Side or 1 - 24 X 24 Bottom Return |
| Downflow Models | |
| *0403A* | 2 - 10 X 20 or 1 - 14 X 25 Top Return |
| *0603A* | 2 - 10 X 20 or 1 - 14 X 25 Top Return |
| *0804B* | 2 - 14 X 20 or 1 - 16 X 25 Top Return |
| *1005C* | 2 - 14 X 20 or 1 - 20 X 25 Top Return |

Larger filters may be used, filters may also be centrally located

¹ = Use 2 - 16 X 25 filters and two side returns or 20 X 25 filter on bottom return if furnace is connected to a cooling unit over 4 tons nominal capacity
A combination of one side & bottom may be used instead of both sides

Horizontal Installations

Filter(s) must be installed external to the furnace casing for horizontal installations. For most installations it is preferable to use a central return with filters installed in the duct behind the return air grill. In this way filter replacement is relatively simple by merely removing the grille, rather than going into the attic or crawl space.

ADDITIONAL FILTERING ACCESSORIES

External Filter Rack Kit (EFR02)

The external filter rack kit is intended to provide a location external to the furnace casing, for installation of a permanent filter on upflow model furnaces. The rack is designed to mount over the indoor blower compartment area of either side panel, and provide filter retention as well as a location for attaching return air ductwork.

Combustion Quality

Combustion quality can be affected by several factors. Major factors are venting and draining.

Venting

The venting system should be planned and installed with the following in mind;

- Should not be longer than necessary
- Use 45° elbows rather than 90° elbows when possible
- Must not sag or otherwise trap condensate
- Use longest radius fittings possible
- If using 3" venting, make the transition from 2" to 3" as close as practically possible
- Make sure there is no flue gas recirculation into the combustion air pipe

Condensate Drainage

Furnace combustion can be affected if a furnace is holding condensate. Check for proper connections of drain hoses,

make sure furnace condensate trap is clean. Make sure furnace is not improperly sloped. Make sure air conditioning coil drain is not interfering with furnace drain.

Other Causes

1. Manifold Gas Pressure must be set for the gas being used, Natural or L.P., high and low firing rates. If converted to L.P. gas, check size of all orifices
2. Remove Draft Inducer, Check the integrity of the gasket between the inducer and the collector box cover, any air leak here will have a negative effect on combustion. Check the orifice hole in the collector box, it must be free of burrs on both sides
3. Make sure burners are clean, not out of position and line up correctly with exchanger tubes, including the heat exchanger orifice plate between the burners and the heat exchanger tubes, make sure it is not loose, missing a screw or hanging down between the burners and heat exchangers causing flame impingement.
4. Make sure the field installed gas line is not binding and causing distortion of burner assembly
5. If the furnace is installed as a one pipe system; make sure the surrounding area and structure are adequate to provide combustion air
6. Make sure there are no cabinet air leaks allowing supply air to affect combustion
7. If heat exchanger integrity is uncertain, follow procedures in Service Bulletin SF-041

SCHEDULED MAINTENANCE

| | |
|--|---|
|  WARNING |  |
| HIGH VOLTAGE DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING THIS UNIT. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH. | |

| |
|--|
|  CAUTION |
| IF YOU MUST HANDLE THE IGNITOR, HANDLE WITH CARE. TOUCHING THE IGNITOR BODY WITH BARE FINGERS, ROUGH HANDLING, OR VIBRATION COULD RESULT IN EARLY IGNITOR FAILURE. ONLY A QUALIFIED SERVICER SHOULD EVER HANDLE THE IGNITOR. |

ANNUAL INSPECTION

The furnace should be inspected by a qualified installer, or service agency at least once per year. This check should be performed at the beginning of the heating season. This will ensure that all furnace components are in proper working order and that the heating system functions appropriately. Pay particular attention to the following items. Repair or service as necessary.

- Flue pipe system. Check for blockage and/or leakage. Check the outside termination and the connections at and internal to the furnace.
- Combustion air intake pipe system (where applicable). Check for blockage and/or leakage. Check the outside termination and the connection at the furnace.
- Heat exchanger. Check for corrosion and/or buildup within the heat exchanger passageways.
- Burners. Check for proper ignition, burner flame, and flame sense.
- Drainage system. Check for blockage and/or leakage. Check hose connections at and internal to furnace.
- Wiring. Check electrical connections for tightness and/or corrosion. Check wires for damage.
- Filters.

AIR FILTER

| |
|---|
|  WARNING |
| NEVER OPERATE FURNACE WITHOUT A FILTER INSTALLED AS DUST AND LINT WILL BUILD UP ON INTERNAL PARTS RESULTING IN LOSS OF EFFICIENCY, EQUIPMENT DAMAGE, AND POSSIBLE FIRE. |

Filters must be used with this furnace. Filters do not ship with these furnaces but must be provided by the installer for proper furnace operation.

Remember that dirty filters are the most common cause of inadequate heating or cooling performance.

| | |
|---|---|
|  WARNING |  |
| HIGH VOLTAGE DISCONNECT ALL POWER BEFORE SERVICING, REMOVING THE FILTER OR PERFORMING ANY OTHER MAINTENANCE. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH. | |

Maintenance

Improper filter maintenance is the most common cause of inadequate heating or cooling performance. Filters should be cleaned (permanent) or replaced (disposable) every two months or as required. It is the owner's responsibility to keep air filters clean. When replacing a filter, it must be replaced with a filter of the same type and size.

Filter Removal

Depending on the installation, differing filter arrangements can be applied. Filters can be installed in the central return register, the bottom of the blower compartment (upflow only). A media air filter or electronic air cleaner can be used as an alternate filter. The filter sizes given in the *Product Design* section of this manual or the product *Specification Sheet* must be followed to ensure proper unit performance. Refer to the following information for removal and installation of filters.

FILTER REMOVAL PROCEDURE

Media Air Filter or Electronic Air Cleaner Removal

Follow the manufacturer's directions for service.

Horizontal Unit Filter Removal

Filters in horizontal installations are located in the central return register.

INDUCED DRAFT AND CIRCULATION BLOWERS

The bearings in the induced draft blower and circulator blower motors are permanently lubricated by the manufacturer. No further lubrication is required. Check motor windings for accumulation of dust which may cause overheating. Clean as necessary.

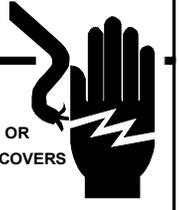
CONDENSATE DRAINAGE SYSTEM (QUALIFIED SERVICER ONLY)

The drain tubes, standpipe, and field supplied drain line must be checked annually and cleaned as often as necessary to ensure proper condensate drainage.

FLAME SENSOR (QUALIFIED SERVICER ONLY)

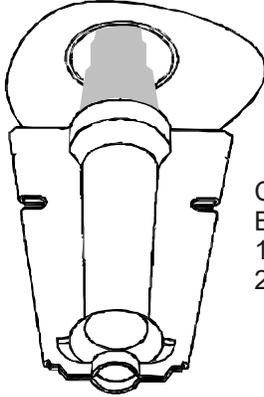
Under some conditions, the fuel or air supply can create a nearly invisible coating on the flame sensor. This coating acts as an insulator, causing a drop in the flame sensing signal. If this occurs, a qualified servicer must carefully clean the flame sensor with steel wool.

BURNERS

| | |
|---|---|
|  WARNING |  |
| HIGH VOLTAGE ELECTRICAL COMPONENTS ARE CONTAINED IN BOTH COMPARTMENTS. TO AVOID ELECTRICAL SHOCK, INJURY OR DEATH, DO NOT REMOVE ANY INTERNAL COMPARTMENT COVERS OR ATTEMPT ANY ADJUSTMENT. CONTACT A QUALIFIED SERVICE AGENT AT ONCE IF AN ABNORMAL FLAME APPEARANCE SHOULD DEVELOP. | |

SCHEDULED MAINTENANCE

Periodically during the heating season make a visual check of the burner flames. Turn the furnace on at the thermostat. Wait a few minutes since any dislodged dust will alter the normal flame appearance. Flames should be stable, quiet, soft and blue with slightly orange tips. They should not be yellow. They should extend directly outward from the burner ports without curling downward, floating or lifting off the ports.



Check the
Burner Flames for:
1. Stable, soft and blue.
2. Not curling, floating
or lifting off.

Burner Flame

HEATING PERFORMANCE TEST

Before attempting to diagnose an operating fault code, run a Heating Performance Test to determine if the heating system is performing within 5% of the BTU input found on the rating plate of the unit being tested. To conduct a heating performance test, the BTU input to the unit must be calculated (see Clocking a Gas Meter). Before clocking a gas meter, contact your local utility to provide the caloric value (BTU content) of the natural gas in the area.

It is also important to confirm the airflow (CFM) is within the temperature rise range (see Airflow Data in spec sheet) and external static pressure range (approximately 0.5" water column). How-to instructions can be found in the service manual under Checking External Static Pressure and Checking Temperature Rise.

CLOCKING A GAS METER

1. Turn off all gas appliances in the home.
2. Turn on the furnace. Ensure the furnace is operating at a 100% firing rate on 2 stage and modulating furnace product.
3. Once heating cycle is at a steady state (typically 15 minutes of operation), use a stopwatch to time how long it takes the smallest unit of measure dial on the gas meter to make a full revolution. In Table 1, one cubic foot is selected. The smallest unit of measure will vary depending on the gas meter.

SCHEDULED MAINTENANCE

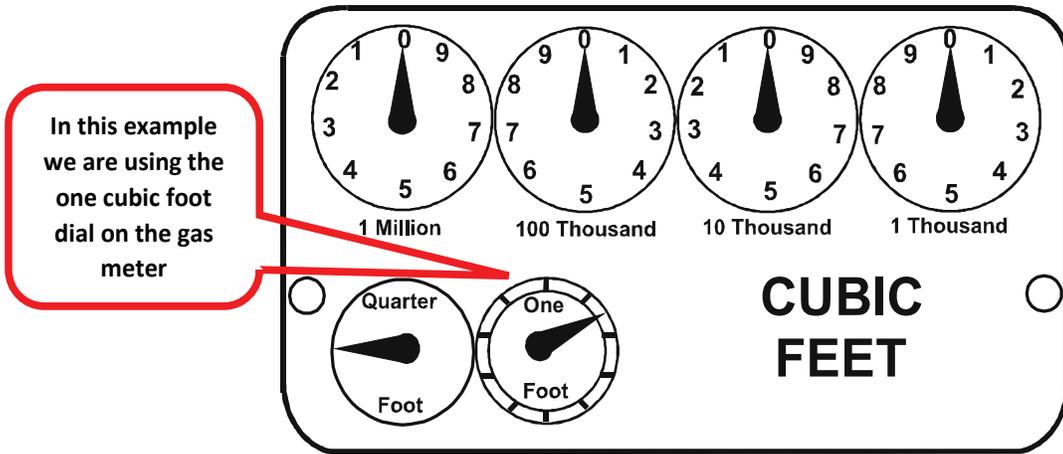


TABLE 1

4. Using Table 2 below, find the number of seconds it took for the dial to make a full revolution. To the right of that number of seconds and below the Size of Test Dial (selected in step 3 and shown in Table 1) will be the Cubic Feet per Hour (CFH).

Locate 40 seconds for one revolution in the chart below

Then locate the 1 cu ft dial column and select the corresponding CFH from the 40 seconds for one revolution row

| GAS RATE -- CUBIC FEET PER HOUR | | | | | | | | | | | |
|---------------------------------|-------------------|-----------|---------|---------|---------|----------------------------|-------------------|-----------|---------|---------|---------|
| Seconds for One Revolution | Size of Test Dial | | | | | Seconds for One Revolution | Size of Test Dial | | | | |
| | 1/4 cu/ft | 1/2 cu/ft | 1 cu/ft | 2 cu/ft | 5 cu/ft | | 1/4 cu/ft | 1/2 cu/ft | 1 cu/ft | 2 cu/ft | 5 cu/ft |
| 10 | 90 | 180 | 360 | 720 | 1800 | 36 | 25 | 50 | 100 | 200 | 500 |
| 11 | 82 | 164 | 327 | 655 | 1636 | 37 | -- | -- | 97 | 195 | 486 |
| 12 | 75 | 150 | 300 | 600 | 1500 | 38 | 23 | 47 | 95 | 189 | 474 |
| 13 | 69 | 138 | 277 | 555 | 1385 | 39 | -- | -- | 92 | 185 | 462 |
| 14 | 64 | 129 | 257 | 514 | 1286 | 40 | 22 | 45 | 90 | 180 | 450 |
| 15 | 60 | 120 | 240 | 480 | 1200 | 41 | -- | -- | -- | 176 | 439 |
| 16 | 56 | 113 | 225 | 450 | 1125 | 42 | 21 | 43 | 86 | 172 | 429 |
| 17 | 53 | 106 | 212 | 424 | 1059 | 43 | -- | -- | -- | 167 | 419 |
| 18 | 50 | 100 | 200 | 400 | 1000 | 44 | -- | 41 | 82 | 164 | 409 |
| 19 | 47 | 95 | 189 | 379 | 947 | 45 | 20 | 40 | 80 | 160 | 400 |
| 20 | 45 | 90 | 180 | 360 | 900 | 46 | -- | -- | 78 | 157 | 391 |
| 21 | 43 | 86 | 171 | 343 | 857 | 47 | 19 | 38 | 76 | 153 | 383 |
| 22 | 41 | 82 | 164 | 327 | 818 | 48 | -- | -- | 75 | 150 | 375 |
| 23 | 39 | 78 | 157 | 313 | 783 | 49 | -- | -- | -- | 147 | 367 |
| 24 | 37 | 75 | 150 | 300 | 750 | 50 | 18 | 36 | 72 | 144 | 360 |
| 25 | 36 | 72 | 144 | 288 | 720 | 51 | -- | -- | -- | 141 | 355 |
| 26 | 34 | 69 | 138 | 277 | 692 | 52 | -- | -- | 69 | 138 | 346 |
| 27 | 33 | 67 | 133 | 265 | 667 | 53 | 17 | 34 | -- | 136 | 340 |
| 28 | 32 | 64 | 129 | 257 | 643 | 54 | -- | -- | 67 | 133 | 333 |
| 29 | 31 | 62 | 124 | 248 | 621 | 55 | -- | -- | -- | 131 | 327 |
| 30 | 30 | 60 | 120 | 240 | 600 | 56 | 16 | 32 | 64 | 129 | 321 |
| 31 | -- | -- | 116 | 232 | 581 | 57 | -- | -- | -- | 126 | 316 |
| 32 | 28 | 56 | 113 | 225 | 563 | 58 | -- | 31 | 62 | 124 | 310 |
| 33 | -- | -- | 109 | 218 | 545 | 59 | -- | -- | -- | 122 | 305 |
| 34 | 26 | 53 | 106 | 212 | 529 | 60 | 15 | 30 | 60 | 120 | 300 |
| 35 | -- | -- | 103 | 206 | 514 | -- | -- | -- | -- | -- | -- |

TABLE 2

5. Use this formula to verify the Cubic Feet per Hour (CFH) input determined in step 4 is correct:

$$(3600 \times \text{Gas Meter Dial Size}) / \text{Time (seconds)} = \text{Cubic Feet per Hour (CFH)}$$

3600 is used as there are 60 seconds in a minute and 60 minutes in an hour.
60x60=3600

SCHEDULED MAINTENANCE

6. Check with your local utility for actual BTU content (caloric value) of natural gas in the area (the average is 1025 BTU's).
7. Use this formula to calculate the BTU/HR input (See BTU/HR Calculation Example):

$$\text{Cubic Feet per Hour (CFH) x BTU content of your natural gas} = \text{BTU/HR input}$$

8. Should the figure you calculated not fall within five (5) percent of the nameplate rating of the unit, adjust the gas valve pressure regulator or resize orifices. To adjust the pressure regulator on the gas valve, turn downward (clockwise) to increase pressure and input, and upward (counterclockwise) to decrease pressure and input. A properly operating unit must have the BTU per hour input and CFM of air, within the limits shown to prevent short cycling of the equipment. As the external static pressure goes up, the temperature rise will also increase. Consult the proper tables for temperature rise limitation.

BTU/HR Calculation Example:

The unit being tested takes 40 seconds for the 1 cubic foot dial to make one complete revolution. Using the chart, this translates to 90 cubic feet per hour. Based upon the assumption that one cubic foot of natural gas has 1,025 BTU's (Check with your local utility for actual BTU content), the **calculated input is 92,250 BTU's per hour.**

Furnace Nameplate Input in this example: 90,000 BTU/HR

Calculated Gas Input in this example: 92,250 BTU/HR

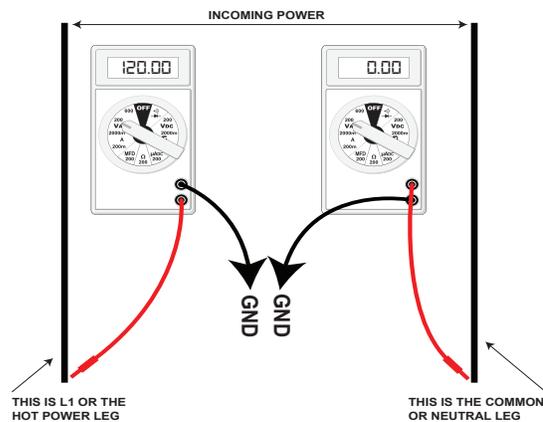
This example is within the 5% tolerance input and does not need adjustment.

SERVICING

As more and more electronic's are introduced to the Heating Trade, Polarization of incoming power and phasing of primary to secondary voltage on transformers becomes more important.

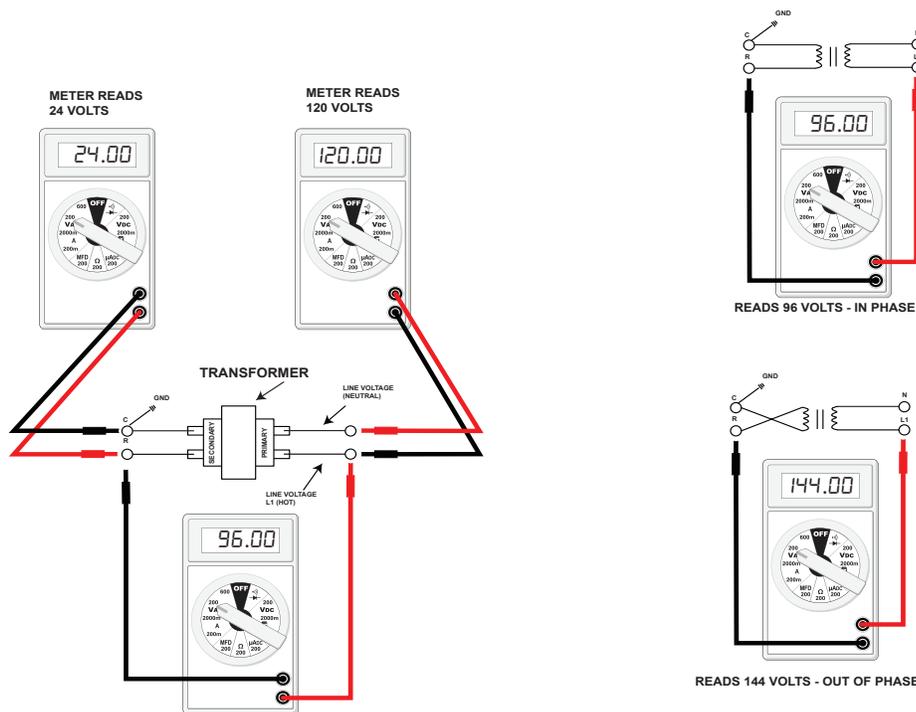
Polarization has been apparent in the Appliance industry since the introduction of the three prong plug, however, the Heating Industry does not use a plug for incoming power, but is hard wired.

Some of the electronic boards being used today, with flame rectification, will not function properly and/or at all without polarization of incoming power. Some also require phasing between the primary and secondary sides of step-down transformers.



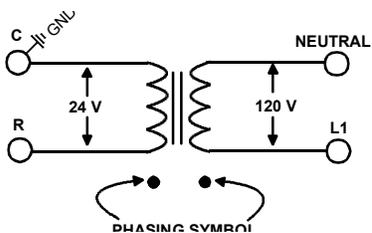
These then should be wired to the furnace accordingly.

CHECKING FOR PHASING - PRIMARY TO SECONDARY OF UNMARKED TRANSFORMERS*



If meter reads approximately 96 volts - the primary to secondary are in phase - if reads approximately 144 volts out of phase - reverse low voltage wires.

***NOTE:** For flame rectification the common side of the secondary voltage (24 V) is cabinet grounded. If you were to bench test a transformer the primary neutral and secondary common must be connected together for testing purposes.



Some transformers will display phasing symbols as shown in the illustration to the left to assist in determining proper transformer phasing.

Checking for polarization and phasing should become a habit in servicing. Let's start now.

NOTE: Newer integrated ignition controls have a diagnostic flash code for reversed polarity (Refer to *Troubleshooting-Diagnostic Chart* for LED Codes).

SERVICING

CHECKING VOLTAGE

| | |
|--|---|
|  WARNING |  |
| HIGH VOLTAGE DISCONNECT ALL POWER BEFORE SERVICING OR CHANGING ANY ELECTRICAL WIRING. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH. | |

1. Remove cover from the Junction Box and gain access to incoming power lines.

With Power ON:

| |
|--|
|  WARNING |
| LINE VOLTAGE NOW PRESENT |

2. Using a voltmeter, measure the voltage across the hot and neutral connections.

NOTE: To energize the furnace, the Door Interlock Switch must be engaged at this point.

3. No reading - indicates open wiring, open fuse, no power, or faulty Door Interlock Switch from unit to fused disconnect service. Repair as needed.
4. With ample voltage at line voltage connectors, energize the furnace blower motor by jumpering terminals R to G on the integrated ignition control.
5. With the blower motor in operation, the voltage should be 115 volts \pm 10 percent.
6. If the reading falls below the minimum voltage, check the line wire size. Long runs of undersized wire can cause low voltage. If wire size is adequate, notify the local power company of the condition.
7. After completing check and/or repair, replace Junction Box cover and reinstall the service panel doors.
8. Turn on electrical power and verify proper unit operation.

CHECKING WIRING

| |
|--|
|  WARNING |
| DISCONNECT ALL POWER BEFORE SERVICING. |

1. Check wiring visually for signs of overheating, damaged insulation and loose connections.
2. Use an ohmmeter to check continuity of any suspected open wires.
3. If any wires must be replaced, replace with AWM, 105°C. 2/64 thick insulation of the same gauge or its equivalent.

CHECKING THERMOSTAT, WIRING

| |
|--|
|  WARNING |
| DISCONNECT ALL POWER BEFORE SERVICING. |

1. Remove the blower compartment door to gain access to the thermostat low voltage wires located at the furnace integrated control module terminals.
2. Remove the thermostat low voltage wires at the furnace control panel terminal board.
3. Jumper terminals R to W (or W1 and W2 for two-stage models) on the integrated ignition control.

With Power On (and Door Interlock Switch closed):

| |
|--|
|  WARNING |
| LINE VOLTAGE NOW PRESENT |

4. Induced Draft Motor must run and pull in pressure switch.
5. If the hot surface ignitor heats and at the end of the ignitor warm-up period the gas valve opens and the burners ignite, the trouble is in the thermostat or wiring.
6. With power off, check the continuity of the thermostat and wiring. Repair or replace as necessary.

If checking the furnace in the air conditioning mode, proceed as follows.

7. With power off, Jumper terminals R to Y
8. Turn on the power.
9. If the furnace blower motor starts and the condensing unit runs, then the trouble is in the thermostat or wiring. Repair or replace as necessary.
10. After completing check and/or repair of wiring and check and/or replacement of thermostat, reinstall blower compartment door.
11. Turn on electrical power and verify proper unit operation.

CHECKING TRANSFORMER AND CONTROL CIRCUIT

A step-down transformer 120 volt primary to 24 volt secondary, 40 VA (Heating and Cooling Models) supplies ample capacity of power for either operation.

| | |
|--|---|
|  WARNING |  |
| HIGH VOLTAGE DISCONNECT ALL POWER BEFORE SERVICING OR CHANGING ANY ELECTRICAL WIRING. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH. | |

1. Remove blower compartment door to gain access to the thermostat low voltage wires located at the furnace integrated control module.

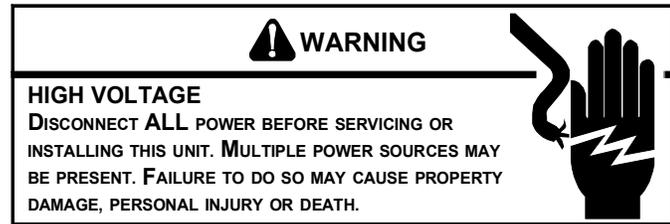
SERVICING

- Remove the thermostat low voltage wires at the furnace integrated control module terminals.

With Power On (and Door Interlock Switch closed):



- Use a voltmeter, check voltage across terminals R and C. Must read 24 VAC.
- No voltage indicates faulty transformer, open fuse, bad wiring, bad splice, or open door interlock switch.
- Check transformer primary voltage at incoming line voltage connections, fuse, splices, and blower door interlock switch.
- If line voltage is available to the primary side of transformer and not at secondary side, the transformer is inoperative. Replace.
- After completing check and/or replacement of transformer and check and/or repair of control circuit, reinstall blower compartment door.
- Turn on electrical power and verify proper unit operation.



CHECKING AIR CIRCULATOR BLOWER MOTOR (NINE-SPEED ECM MOTOR)



- Remove blower compartment door to gain access to the circulator blower motor and integrated ignition control.
- Check for any obstruction that would keep the fan wheel / fan motor from turning.

The nine-speed ECM motor requires a line voltage power supply (black connected to CIRC H and white connected to CIRC-N on the control board) as well as a signal on one of the speed taps (T1-T5).

The speed tap voltage is D.C. and can vary depending on SPEED SELECTION. The voltage reading from any

one of the speed taps is referenced between the COM terminal in the speed tap harness and the speed taps on the control board. These voltages will range from 3-15 vDC depending upon speed selection.

CHECKING DUCT STATIC

The maximum and minimum allowable external static pressures are found in the specification section. These tables also show the amount of air being delivered at a given static by a given motor speed or pulley adjustment.

The furnace motor cannot deliver proper air quantities (CFM) against statics other than those listed.

Too great of an external static pressure will result in insufficient air that can cause excessive temperature rise, resulting in limit tripping, etc. Whereas not enough static may result in motor overloading.

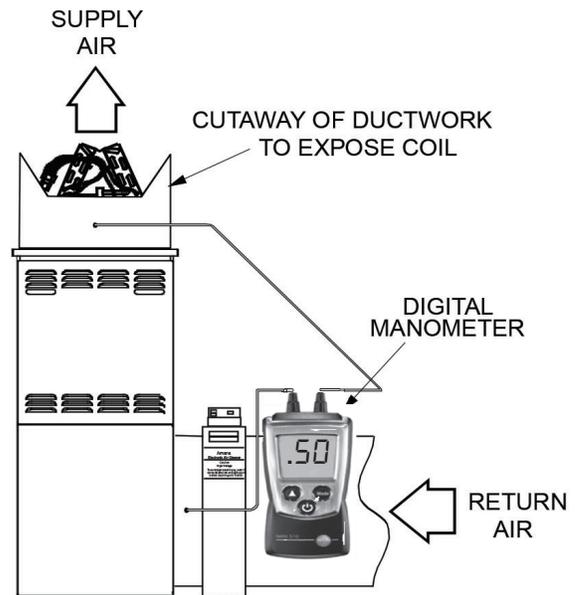
To determine proper air movement, proceed as follows:

- With clean filters in the furnace, use a manometer to measure the static pressure of the return duct at the inlet of the furnace. (Negative Pressure)
- Measure the static pressure of the supply duct. (Positive Pressure)
- Add the two (2) readings together for total external static pressure.

NOTE: Both readings may be taken simultaneously and read directly on the manometer if so desired. If an air conditioner coil or Electronic Air Cleaner is used in conjunction with the furnace, the readings must also include these components, as shown in the following drawing.

- Consult proper tables for the quantity of air.

If the total external static pressure exceeds the minimum or maximum allowable statics, check for closed dampers, registers, undersized and/or oversized poorly laid out duct work.



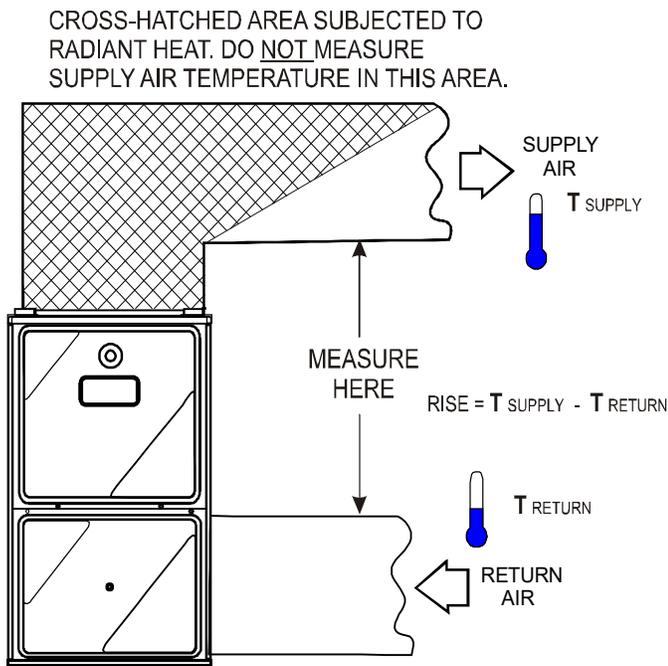
Checking Static Pressure

SERVICING

CHECKING TEMPERATURE RISE

The more air (CFM) being delivered through a given furnace, the less the rise will be; so the less air (CFM) being delivered, the greater the rise. The temperature rise should be adjusted in accordance to a given furnace specifications and its external static pressure. An incorrect temperature rise may result in condensing in or overheating of the heat exchanger. An airflow and temperature rise table is provided in the blower performance specification section. Determine and adjust temperature rise as follows:

1. Operate furnace with burners firing for approximately ten minutes. Check BTU input to furnace - do not exceed input rating stamped on rating plate. Ensure all registers are open and all duct dampers are in their final (fully or partially open) position.
2. Place thermometers in the return and supply ducts as close to the furnace as possible. Thermometers must not be influenced by radiant heat by being able to "see" the heat exchanger.



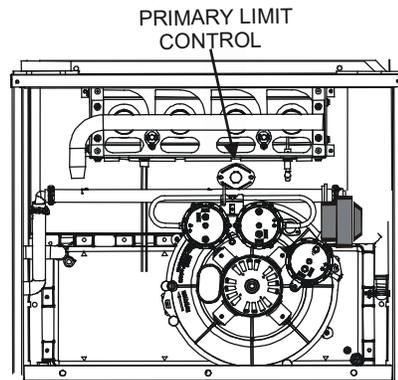
Checking Temperature Rise

3. Subtract the return air temperature from the supply air temperature to determine the air temperature rise. Allow adequate time for thermometer readings to stabilize.
4. Adjust temperature rise by adjusting the circulator blower

speed. Increase blower speed to reduce temperature rise. Decrease blower speed to increase temperature rise. Refer to *Circulator Blower Speed* section in the Product Design section of this manual for speed changing details. Temperature rise is related to the BTUH output of the furnace and the amount of air (CFM) circulated over the heat exchanger. Measure motor current draw to determine that the motor is not overloaded during adjustments.

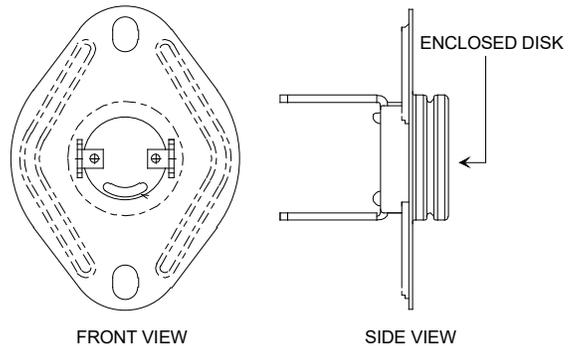
CHECKING PRIMARY LIMIT CONTROL

All primary limit controls are nonadjustable, automatic reset, bi-metal type limit control. Refer to the following drawing for the location of the primary limit.



Primary Limit Control Location (90% Upflow Furnace Shown)

The following drawing illustrates the style of limit switches used on the 90% furnaces.



Primary Limit Control Style (90% Furnaces)



WARNING

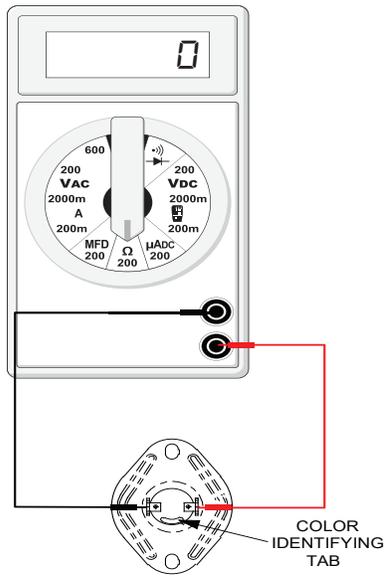


HIGH VOLTAGE
 DISCONNECT **ALL** POWER BEFORE SERVICING OR CHANGING ANY ELECTRICAL WIRING. **MULTIPLE** POWER SOURCES MAY BE PRESENT. **FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.**

1. Remove burner compartment door to gain access to the primary limit.
2. Remove low voltage wires at limit control terminals.

SERVICING

- With an ohmmeter, test between these two terminals as shown in the following drawing. The ohmmeter should read continuous unless heat exchanger temperature is above limit control setting. If not as above, replace the control.



Testing Primary Limit Control

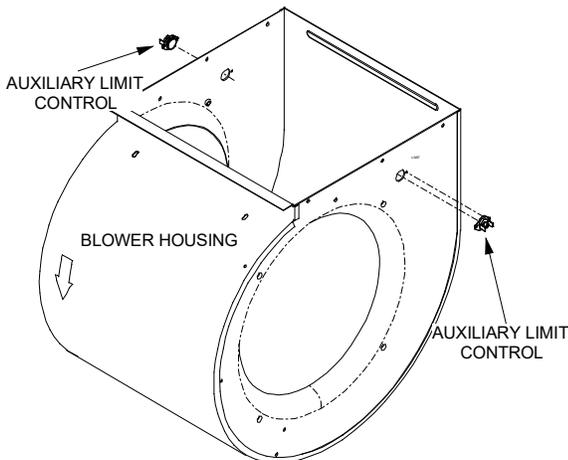
- After completing check and/or replacement of primary limit control, reinstall burner compartment door.
- Turn on electrical power and verify proper unit operation.

WARNING: DO NOT bypass Primary Limit safety circuit.

CHECKING AUXILIARY LIMIT CONTROL

The auxiliary limit control is designed to prevent furnace operation in case of main blower failure in horizontal installations. It may also open if the power supply is interrupted while the furnace is firing.

The auxiliary limit control is suitable for both horizontal right and horizontal left installations. Regardless of airflow direction, it does not need to be relocated. The (2) two auxiliary limits are located on the blower housing (one on each side), as shown in the following illustration.

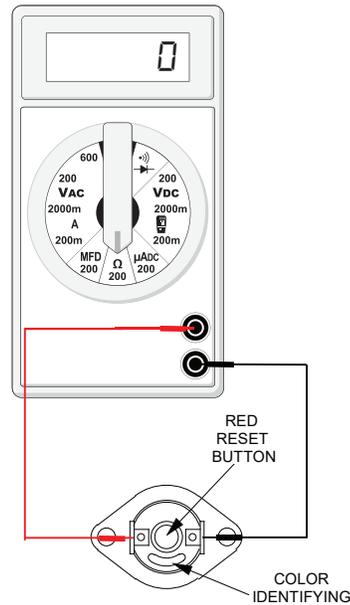


Auxiliary Limit Control Location

⚠ WARNING

HIGH VOLTAGE
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING THIS UNIT. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

- Remove blower compartment door to gain access to the auxiliary.
- Remove the wires from the auxiliary limit control terminals.
- Using an ohmmeter, test for continuity across the two terminals.



Testing Auxiliary Limit Control

⚠ WARNING

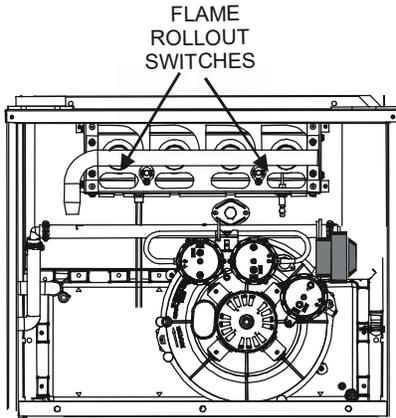
TO AVOID POSSIBLE FIRE, ONLY RESET THE AUXILIARY LIMIT CONTROL ONCE. IF IT SHOULD OPEN A SECOND TIME, A QUALIFIED SERVICER MUST DETERMINE WHY THE AUXILIARY LIMIT OPENED BEFORE RESETTING AGAIN.

WARNING: DO NOT bypass Auxillary Limit safety circuit.

SERVICING

CHECKING FLAME ROLLOUT CONTROL

A temperature activated manual reset control is mounted to the manifold assembly as shown in the following illustration.



**Flame Rollout Switch Location
(90% Upflow Furnace Shown, Counterflow Similar)**

The control is designed to open should a flame roll out occur. An over firing condition or flame impingement on the heat shield may also cause the control to open. If the rollout control opens, the air circulation blower will run continuously.

| |
|--|
|  WARNING |
| LINE VOLTAGE NOW PRESENT |

1. Remove the burner compartment door to gain access to the rollout switch(es) mounted to burner bracket.
2. Reset the manual roll out switch
3. Remove wires from roll out switch
4. Using an ohmmeter, check for continuity across the switch.
5. If the switch will not close after manually resetting, it must be replaced.
6. Measure the voltage between each side of the rollout control and ground during the ignition attempt. If a roll out switch has tripped, it is important to find out why. Possible causes could be flame impingement, orifice plate out of position, burners with excessive cross-over slot dimension, over-firing, improper orifices, improper gas pressure, air leaking from around the heat exchanger into the burner compartment, air leaking through the heat exchanger itself.
7. After check and/or replacement of rollout switch, reinstall burner compartment door and verify proper unit operation.

INDUCED DRAFT BLOWER MOTOR

| | |
|--|---|
|  WARNING |  |
| HIGH VOLTAGE DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING THIS UNIT. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH. | |

1. Remove burner compartment door to gain access to the induced draft blower motor.
2. Disconnect the motor wire leads from its connection point at the induced draft motor.
3. Using a ohmmeter, test for continuity between each of the motor leads.
4. Touch one probe of the ohmmeter to the motor frame (ground) and the other probe in turn to each lead.
If the windings do not test continuous or a reading is obtained to ground, replace the motor.
5. If the windings have a continuity reading, reconnect wires. Turn power on to the furnace and turn the thermostat on in the heating mode. Check voltage for 115V at the induced draft motor terminals during the trial for ignition. If you have 115V and the motor does not run, replace the induced draft motor.
6. After completing check and/or replacement of induced draft motor, reinstall burner compartment door.
7. Turn on electrical power and verify proper unit operation.

CHECKING GAS VALVE (Redundant)

A combination redundant operator type gas valve which provides all manual and automatic control functions required for gas fired heating equipment is used.

The valve provides control of main burner gas flow, pressure regulation, and 100 percent safety shut-off.

| |
|--|
|  WARNING |
| DISCONNECT ALL POWER BEFORE SERVICING |

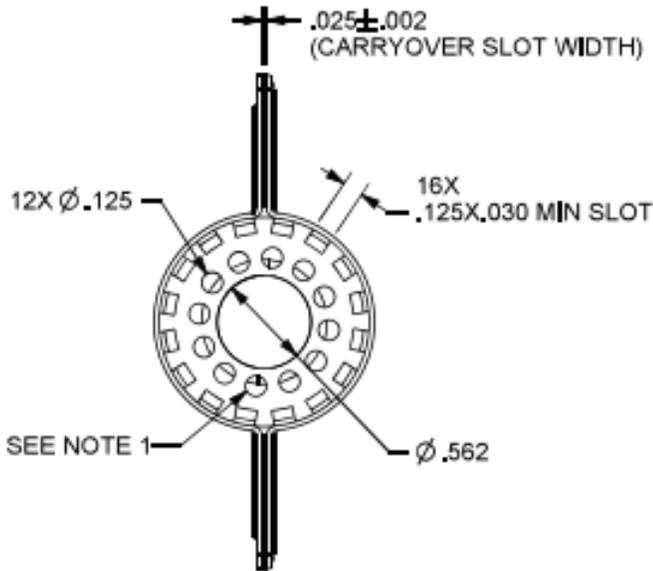
Two stage gas valves always require 24 volts between common and low fire (main coil) to open. Also, the furnace front cover pressure switch is wired in series with the low (main) solenoid of the gas valve. In the event of a non functioning gas valve, always check the front cover pressure switch. Also see CHECKING GAS PRESSURE and CHECKING PRESSURE SWITCHES.

SERVICING

CHECKING MAIN BURNERS

The main burners are used to provide complete combustion of various fuels in a limited space, and transfer this heat of the burning process to the heat exchanger.

Proper ignition, combustion, and extinction are primarily due to burner design, orifice sizing, gas pressure, primary and secondary air, vent and proper seating of burners.



34.5" Burner

WARNING
DISCONNECT ALL GAS AND ELECTRICAL POWER SUPPLY.

In checking main burners, look for signs of rust, oversized and undersized carry over ports restricted with foreign material, etc, burner cross-over slots should not be altered in size.

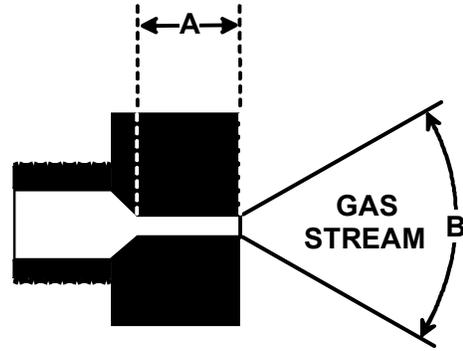
CHECKING ORIFICES

*M9C96/*C9C96 model furnaces have factory installed #45 natural gas orifices (except *M9C960303AN which has #50). The only time resizing is required is when a reduction in firing rate is required for an increase in altitude or a furnace is being converted for use with LP gas.

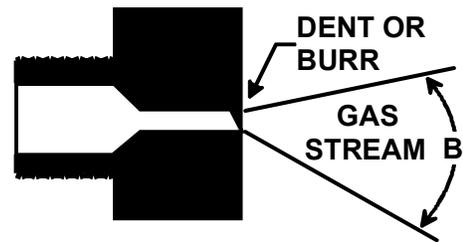
Orifices should be treated with care in order to prevent damage. They should be removed and installed with a box-end wrench in order to prevent distortion. In no instance should an orifice be peened over and redrilled. This will change the angle or deflection of the vacuum effect or entraining of primary air, which will make it difficult to adjust the flame properly. This same problem can occur if an orifice spud of a different length is substituted.

WARNING
DISCONNECT ALL GAS AND ELECTRICAL POWER SUPPLY.

1. Check orifice visually for distortion and/or burrs.
2. Check orifice size with orifice sizing drills.



The length of Dimension "A" determines the angle of Gas Stream "B".



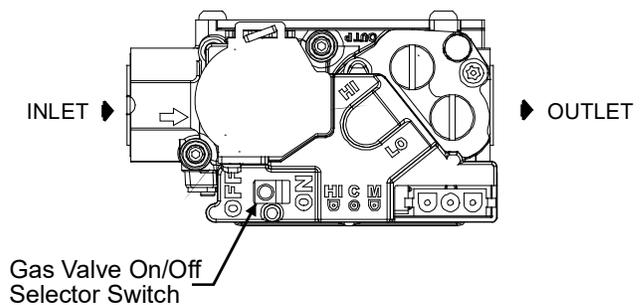
A dent or burr will cause a severe deflection of the gas stream.

CHECKING GAS PRESSURE

Gas Supply Pressure Measurement

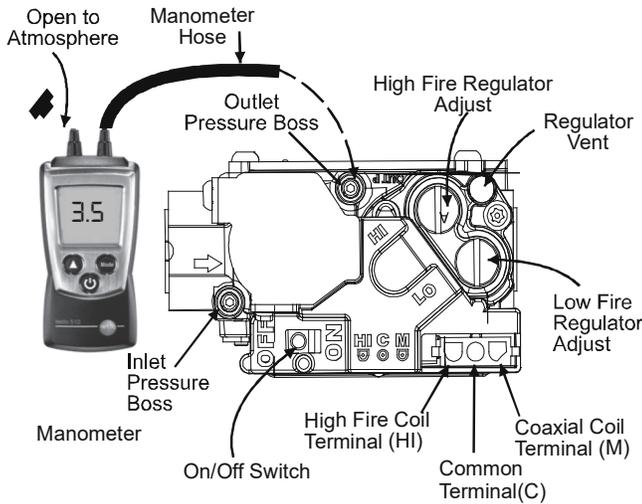
GAS PRESSURE TEST

The line pressure supplied to the gas valve must be within the range specified below. The supply pressure can be measured at the gas valve inlet pressure tap or at a hose fitting installed in the gas piping drip leg. The supply pressure must be measured with the burners operating. To measure the gas supply pressure, use the following procedure.



White-Rodgers Model 36J54 (Two-Stage)

SERVICING



White-Rodgers Model 36J54 Connected to Manometer

1. Turn OFF gas to furnace at the manual gas shutoff valve external to the furnace.
2. Connect a calibrated manometer (or appropriate gas pressure gauge) at either the gas valve inlet pressure tap or the gas piping drip leg. See White-Rodgers 36J54 gas valve figure for location of inlet pressure tap.

| INLET GAS SUPPLY PRESSURE | | |
|---------------------------|---------------------|---------------------|
| Natural Gas | Minimum: 4.5" w.c. | Maximum: 10.0" w.c. |
| Propane Gas | Minimum: 11.0" w.c. | Maximum: 13.0" w.c. |

NOTE: If measuring gas pressure at the drip leg, a field-supplied hose barb fitting must be installed prior to making the hose connection. If using the inlet pressure tap on the White-Rodgers 36J54 gas valve, then use the 36G/J Valve Pressure Check Kit, Part No. 0151K00000S.

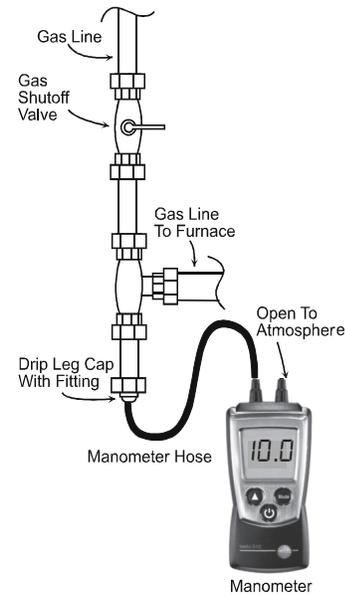
3. Turn ON the gas supply and operate the furnace and all other gas consuming appliances on the same gas supply line.
4. Measure furnace gas supply pressure with burners firing. Supply pressure must be within the range specified in the *Inlet Gas Supply Pressure* table.

If supply pressure differs from table, make the necessary adjustments to pressure regulator, gas piping size, etc., and/or consult with local gas utility.

5. Turn OFF gas to furnace at the manual shutoff valve and disconnect manometer. Reinstall plug before turning on gas to furnace.
6. Turn OFF any unnecessary gas appliances stated in step 3.

GAS MANIFOLD PRESSURE MEASUREMENT AND ADJUSTMENT

Only small variations in gas pressure should be made by adjusting the gas valve pressure regulator. The manifold pressure must be measured with the burners operating. To measure and adjust the manifold pressure, use the following procedure.



Measuring Inlet Gas Pressure (Alt. Method)

CAUTION

TO PREVENT UNRELIABLE OPERATION OR EQUIPMENT DAMAGE, THE GAS MANIFOLD PRESSURE MUST BE AS SPECIFIED ON THE UNIT RATING PLATE. ONLY MINOR ADJUSTMENTS SHOULD BE MADE BY ADJUSTING THE GAS VALVE PRESSURE REGULATOR.

1. Turn OFF gas to furnace at the manual gas shutoff valve external to the furnace.
2. Turn off all electrical power to the system.
3. Outlet pressure tap connections:
White-Rodgers 36J54 valve: Back outlet pressure test screw (inlet/outlet pressure tap) out one turn (counterclockwise, not more than one turn).
4. Attach a hose and manometer to the outlet pressure tap (White-Rodgers valve).
5. Turn ON the gas supply.
6. Turn on power and close thermostat "R" and "W1" contacts to provide a call for low stage heat.
7. Measure the gas manifold pressure with burners firing. Adjust manifold pressure using the *Manifold Gas Pressure* table shown below.
8. Remove regulator cover screw from the low (LO) outlet pressure regulator adjust tower and turn screw clockwise to increase pressure or counterclockwise to decrease pressure. Replace regulator cover screw.
9. Close thermostat "R", "W1" and "W2" contacts to provide a call for high stage heat.
10. Remove regulator cover screw from the high (HI) outlet pressure regulator adjust tower and turn screw clockwise to increase pressure or counterclockwise to decrease pressure. Replace regulator cover screw.
11. Turn off all electrical power and gas supply to the system.

SERVICING

12. Remove the manometer hose from the hose barb fitting or outlet pressure tap.
13. Replace outlet pressure tap:
White-Rodgers 36J54 valve: Turn outlet pressure test screw in to seal pressure port (clockwise, 7 in-lb minimum).
14. Turn on electrical power and gas supply to the system.
15. Close thermostat contacts "R" and "W1/W2" to energize the valve.

| Manifold Gas Pressure | | | |
|-----------------------|------------|------------------|------------|
| Gas | | Range | Nominal |
| Natural | Low Stage | 1.6 - 2.2" w.c. | 1.9" w.c. |
| | High Stage | 3.2 - 3.8" w.c. | 3.5" w.c. |
| Propane | Low Stage | 5.7 - 6.3" w.c. | 6.0" w.c. |
| | High Stage | 9.7 - 10.3" w.c. | 10.0" w.c. |

Using a leak detection solution or soap suds, check for leaks at screw (White-Rodgers valve). Bubbles forming indicate a leak. **SHUT OFF GAS AND REPAIR ALL LEAKS IMMEDIATELY!**

NOTE: For gas to gas conversion, consult your dealer for appropriate conversion.

 **CAUTION**

TO PREVENT UNRELIABLE OPERATION OR EQUIPMENT DAMAGE, THE INLET GAS SUPPLY PRESSURE MUST BE AS SPECIFIED ON THE UNIT RATING PLATE WITH ALL OTHER HOUSEHOLD GAS FIRED APPLIANCES OPERATING.

| Manifold Gas Pressure | | | |
|-----------------------|------------|------------------|-----------|
| Gas | Rate | Range | Nominal |
| Natural Gas | High Stage | 3.2 to 3.8" w.c. | 3.5" w.c. |
| | Low Stage | 1.6 to 2.2" w.c. | 1.9" w.c. |

 **WARNING**

HIGH VOLTAGE
DISCONNECT ALL ELECTRICAL POWER AND SHUT OFF GAS SUPPLY BEFORE SERVICING OR INSTALLING THIS UNIT. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.



 **WARNING**

HIGH VOLTAGE
DISCONNECT ALL ELECTRICAL POWER AND SHUT OFF GAS SUPPLY BEFORE SERVICING OR INSTALLING.

| Manifold Gas Pressure | | | |
|-----------------------|------------|-------------------|------------|
| Gas | Rate | Range | Nominal |
| Propane Gas | High Stage | 9.7 to 10.3" w.c. | 10.0" w.c. |
| | Low Stage | 5.7 to 6.3" w.c. | 6.0" w.c. |

CHECKING HOT SURFACE IGNITOR

120V Silicon Nitride Ignitor - *M/C9C96 use a 120V silicon nitride igniter for ignition. The normal operating temperature is approximately 2156°F - 2678°F. At room temperature the ignitor ohm reading should be from 37-68 ohms.

7. Place unit in heating cycle, measure current draw of ignitor during preheat cycle.
The steady state current at 120V is 0.37 to 0.68 amps.
8. After checking and/or replacing of hot surface ignitor, reinstall burner compartment door and verify proper unit operation.

CHECKING FOR FLASHBACK

Flashback will also cause burning in the burner venturi, but is caused by the burning speed being greater than the gas-air flow velocity coming from a burner port.

Flashback may occur at the moment of ignition, after a burner heats up or when the burner turns off. The latter is known as extinction pop.

Since the end results of flashback and delayed ignition can be the same (burning in the burner venturi) a definite attempt should be made to determine which has occurred.

If flashback should occur, check for the following:

1. Improper gas pressure - adjust to proper pressure (See *CHECKING GAS PRESSURE*).
2. Check burner for proper alignment and/or replace burner.
3. Improper orifice size - check orifice for obstruction.

CHECKING PRESSURE SWITCH

The pressure control is a safety device to prevent the combustion cycle from occurring with inadequate venting caused by a restricted or blocked vent pipe. In addition to the inducer pressure switch, this furnace has a "front cover pressure switch" wired in series with the gas valve. This pressure switch keeps the gas valve from opening in the event of condensate backing up in the secondary heat exchanger. This could occur from improperly connected drains or a plugged drain tube.

 **WARNING**

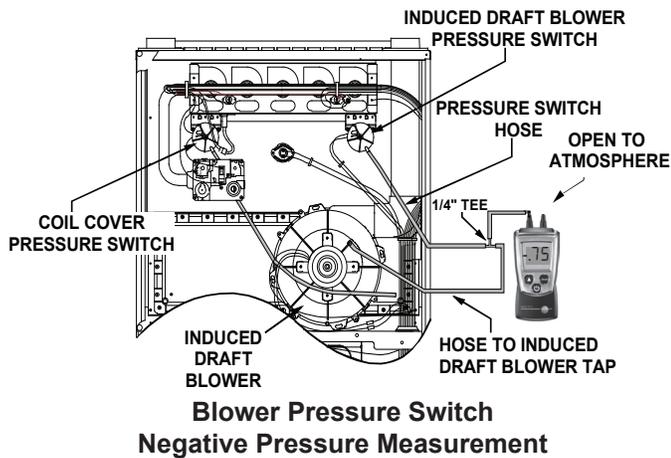
HIGH VOLTAGE
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING THIS UNIT. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.



1. Remove burner compartment door to gain access to pressure switch(es).
2. Remove wires from the pressure switch(es) electrical terminals.
3. Remove the pressure control hose from the control and interconnect with an manometer as shown in the following figures.
4. With an ohm meter connected across the pressure switch terminals; with the inducer running the switch should close

SERVICING

and the ohm meter should show a complete circuit across the pressure switch. If the switch is not closed, compare the negative pressure to the closing point specified for the particular switch. Either the switch is defective or the inducer / venting system is inadequate.



HIGH ALTITUDE APPLICATION (USA)

The furnace as shipped requires no change to run between 0 - 7500 feet. Do not attempt to increase the firing rate by changing orifices or increasing the manifold pressure below 7500 feet. This can cause poor combustion and equipment failure. High altitude installations above 7500 feet may require both a pressure switch and an orifice change. These changes are necessary to compensate for the natural reduction in the density of both the gasfuel and the combustion air at higher altitude.

For installations above 7500 feet, please refer to your distributor for required kit(s). Contact the distributor for a tabular listing of appropriate manufacturer's kits for propane gas and/or high altitude installations. The indicated kits must be used to insure safe and proper furnace operation. All conversions must be performed by a qualified installer, or service agency.

In some areas the gas supplier may artificially derate the gas in an effort to compensate for the effects of altitude. If the gas is artificially derated the appropriate orifice size must be determined based on the BTU/ft³ content of the derated gas and the altitude. Refer to the National Fuel Gas Code, NFPA 54/ANSI Z223.1, and information provided by the gas supplier to determine the proper orifice size.

CHECKING FOR DELAYED IGNITION

Delayed ignition is a delay in lighting a combustible mixture of gas and air which has accumulated in the combustion chamber.

Furnace design makes this extremely unlikely unless safety controls have been by-passed or tampered with. Never by-pass or alter furnace controls.

If delayed ignition should occur, the following should be checked:

1. Improper gas pressure - adjust to proper pressure (See *CHECKING GAS PRESSURE*).

2. Improper burner positioning - burners should be in locating slots, level front to rear and left to right.
3. Carry over (lighter tube or cross lighter) obstructed - clean.
4. Main burner orifice(s) deformed, or out of alignment to burner - replace.

CHECKING INTEGRATED IGNITION CONTROL BOARDS

NOTE: Failure to earth ground the furnace, reversing the neutral and hot wire connection to the line (polarity), or a high resistance connection in the neutral line may cause the control to lockout due to failure to sense flame.

| |
|--|
|  WARNING |
| TO AVOID THE RISK OF ELECTRICAL SHOCK, WIRING TO THE UNIT MUST BE PROPERLY POLARIZED AND GROUNDED. DISCONNECT POWER BEFORE PERFORMING SERVICE LISTED BELOW. |

The ground wire must run from the furnace all the way back to the electrical panel. Proper grounding can be confirmed by disconnecting the electrical power and measuring resistance between the neutral (white) connection and the burner closest to the flame sensor. Resistance should be less than 2 ohms.

The ignition control is a combination electronic and electromechanical device and is not field repairable.

| |
|--|
|  WARNING |
| LINE VOLTAGE NOW PRESENT |

These tests must be completed within a given time frame due to the operation of the ignition control.

The ignition control is capable of diagnosing many furnace failures to help in troubleshooting. The trial for ignition period is 4 seconds.

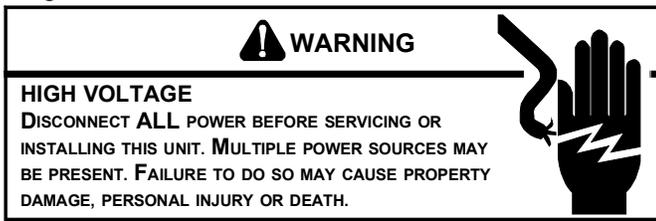
Goodman® Brand and Amana® Brand Two-Stage

1. Check for 120 volts from Line 1 (Hot) to Line 2 (Neutral) at the ignition control. No voltage, check the door switch connections and wire harness for continuity.
2. Check for 24 volts from W to C terminal on the ignition control. No voltage. Check transformer, room thermostat, and wiring.
If you have 24 volts coming off the transformer but receive approximately 13 volts on the terminal board between (C) and (R), check for blown fuse.
3. After the ignitor warmup time, begin checking for 24 volts to the gas valve. Voltage will be present for four seconds during trial for ignition.
4. If proof of flame was established voltage will be provided to the air circulation blower following the heat on delay period.

SERVICING

CHECKING FLAME SENSOR

A flame sensing device is used in conjunction with the ignition control module to prove combustion. If proof of flame is not present the control will de-energize the gas valve and “retry” for ignition or lockout.



Flame current can be measured by:

1. Putting a D.C. microamp meter in series with the flame rod



2. As soon as flame is established a micro-amp reading should be evident once proof of flame (micro-amp reading) is established, the hot surface ignitor will be de-energized.
3. The Integrated Ignition controls will have 1 to 4 micro-amps. If the micro-amp reading is less than the minimum specified, check for high resistance wiring connections, sensor to burner gap, dirty flame sensor, or poor grounding.
4. If absolutely no reading, check for continuity on all components and if good - replace ignition control module.

NOTE: Contaminated fuel or combustion air can create a nearly invisible coating on the flame sensor. This coating works as an insulator causing a loss in the flame sense signal. If this situation occurs the flame sensor must be cleaned with steel wool.

IMPORTANT INFORMATION

2 Stage Status Codes

| Menu Description | LED Display | | Notes |
|--|-------------|-------------------------|---|
| | Main Menu | Option Menu | |
| Active Alarm menu | <i>Err</i> | Exx | (xx: code numbers) |
| Last 6 Faults | <i>L6F</i> | Exx | (xx: code numbers) |
| Code Release Number | <i>Cr</i> | CR Number | |
| Reset to Factory Default | <i>rFd</i> | yes, no | |
| Blower Speed for Continuous Fan Mode | <i>F5d</i> | Fxx | (xx: Blower Speed Number F01, F02..) |
| Blower Speed for 1st Stage Compressor Mode | <i>AC 1</i> | Fxx | (xx: Blower Speed Number F01, F02..) |
| Blower Speed for 2nd Stage Compressor Mode | <i>AC 2</i> | Fxx | (xx: Blower Speed Number F01, F02..) |
| Cool On Delay | <i>Cnd</i> | Delay, Seconds | Default set at 7 Secs, Adjustments can be made in 7 Secs increments from 0 to 35 Secs |
| Cool Off Delay | <i>CFd</i> | Delay, Seconds | Default set at 65 Secs, Adjustments can be made in 5 Secs increments from 0 to 120 Secs |
| Blower Speed for 1st Stage Gas Heat Mode | <i>9A 1</i> | Fxx | (xx: Blower Speed Number F01, F02..) |
| Blower Speed for 2nd Stage Gas Heat Mode | <i>9A 2</i> | Fxx | (xx: Blower Speed Number F01, F02..) |
| Gas Heat On Delay | <i>9nd</i> | Delay, Seconds | Default set at 30 Secs, Adjustments can be made in 5 Secs increments from 5 to 30 Secs |
| Gas heat Off Delay | <i>9Fd</i> | Delay, Seconds | Default set at 90 Secs, Adjustments can be made in 30 Secs increments from 30 to 180 Secs |
| Automatic Heat Staging - For Two Stage Control | <i>AHS</i> | no, 10, 20, 30, 60, AUt | Refer to Section "CHANGING HEATING MODE SETTING" |

IMPORTANT INFORMATION

2 Stage Status Codes

| Mode | Main Menu |
|--------------------------------|-------------|
| Idle | <i>1 dL</i> |
| Continuous Fan | <i>FRn</i> |
| Compressor Cooling, Low Stage | <i>1RC</i> |
| Compressor Cooling, High Stage | <i>2RC</i> |
| Gas heat, Low Stage | <i>9H 1</i> |
| Gas heat, High Stage | <i>9H 2</i> |
| OEM test Mode | <i>EOL</i> |

IMPORTANT INFORMATION

2 Stage Troubleshooting Codes

| TROUBLESHOOTING CHART | | | |
|--|-------------|--|--|
| Symptom | LED Status | Fault Description | Corrective Actions |
| Normal operation | <i>1 dL</i> | Normal operation | None |
| Furnace fails to operate | <i>EE0</i> | Furnace lockout due to an excessive number of ignition "retries" (3 total) Failure to establish flame Loss of flame after establishment | Locate and correct gas interruption Replace or realign igniter Check flame sense signal, clean sensor if coated or oxidized Check flue piping for blockage, proper length, elbows, and termination Verify proper induced draft blower performance |
| Furnace fails to operate | <i>EE1</i> | Low stage pressure switch circuit is closed at start of heating cycle Low stage pressure switch contacts sticking Short in pressure switch circuit wiring | Replace low stage pressure switch Repair short in wiring |
| Induced draft blower runs continuously with no furnace operation | <i>EE2</i> | Low stage pressure switch circuit is not closed Pressure switch hose blocked/pinched, or connected improperly Blocked flue and/or inlet air pipe, blocked drain system or weak induced draft blower Incorrect pressure switch set point or malfunctioning switch contacts Loose or improperly connected wiring | Inspect pressure switch hose, repair/replace if necessary Inspect flue for blockage, proper length, elbows, and termination Check induced draft blower performance, correct as necessary Check pressure switch operation, replace as needed Tighten or correct wiring connection |
| Circulator blower runs continuously No furnace operation | <i>EE3</i> | Primary limit circuit is open Insufficient conditioned air over the heat exchanger Blocked filters, restrictive ductwork, improper circulator blower speed, or failed circulator blower motor Loose or improperly connected wiring in high limit circuit | Check filters and ductwork for blockage Clean filters or remove obstruction Check circulator blower speed and performance Correct speed or replace blower motor if necessary Tighten or correct wiring connection |
| Induced draft blower and circulator blower runs continuously No furnace operation | <i>EE4</i> | Flame sensed with no call for heat Short to ground in flame sense circuit Lingering burner flame Slow closing gas valve | Correct short at flame sensor or in flame sensor wiring Check for lingering or lazy flame Verify proper operation of gas valve |
| No furnace operation | <i>EE5</i> | Open fuse Short in low voltage wiring | Replace fuse Locate and correct short in low voltage wiring |

TO VIEW & CLEAR FAULT CODES

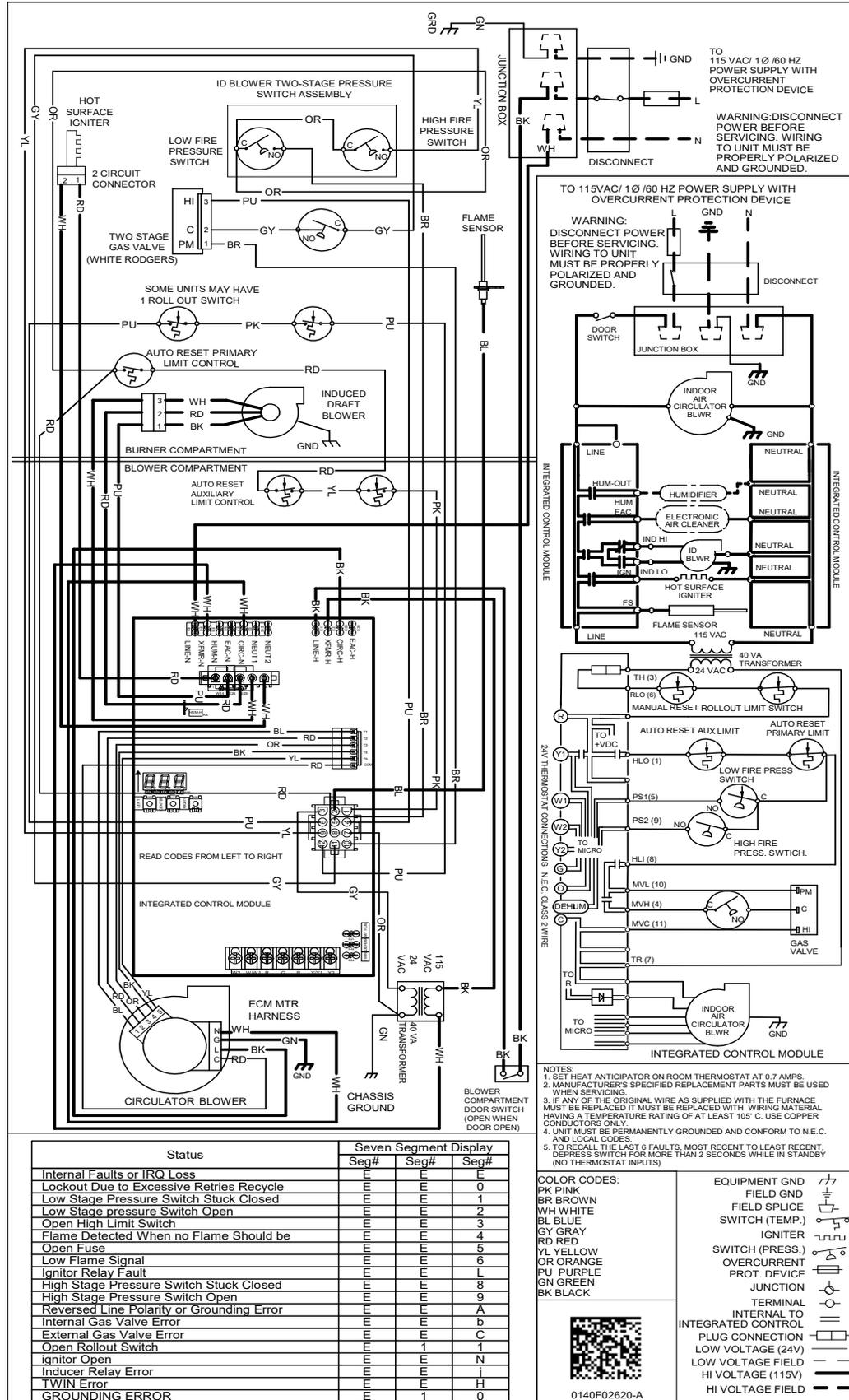
- Press either the Left or Right switch until *L 5 F* is displayed.
- Press the center switch to view stored faults.
- Press and hold the center switch for 5 to 30 seconds.
- All stored faults will be erased, and the display will flash - - - three times and return to *L 5 F*.

IMPORTANT INFORMATION

2 Stage Troubleshooting Codes

| TROUBLESHOOTING CHART | | | |
|--|-----------------|--|--|
| Symptom | LED Status | Fault Description | Corrective Actions |
| Normal furnace operation | EE6 | Flame sense micro amp signal is minimal Flame sensor is coated/oxidized Flame sensor incorrectly positioned in burner fame Lazy burner flame due to improper gas pressure or combustion air | Clean flame sensor if coated or oxidized Inspect for proper flame sensor alignment Compare current gas pressure to rating plate and adjust as needed |
| Furnace fails to operate | EEL | Problem with igniter circuit Improperly connected or shorted igniter Poor unit ground Igniter relay fault on integrated control module | Check and correct wiring from integrated control module to igniter Diagnose and replace shorted igniter as needed Verify and correct unit ground wiring if needed Check igniter output from control, replace if necessary |
| Furnace fails to operate on high stage; furnace operates normally on low stage Induced draft blower operating | EEB | High stage pressure switch circuit is closed at start of heating cycle. High stage pressure switch contacts sticking Shorts in pressure switch circuit wiring | Diagnose and replace high stage pressure switch if needed Repair short in wiring |
| Furnace fails to operate on high stage; furnace operates normally on low stage Induced draft blower operating | EE9 | High stage pressure switch circuit is not closed | Inspect pressure switch hose, repair/replace if necessary Inspect flue and/or inlet air piping for blockage, proper length, elbows, and termination Check induced draft blower performance, correct as necessary Tighten or correct wiring connection |
| Furnace fails to operate | EEA | Polarity of 115 volt AC is reversed Poor unit ground | Correct polarity, check and correct wiring if necessary Verify proper ground, correct if necessary |
| Furnace fails to operate | EEb | Gas valve is not energized when it should be External Gas Valve Error | Check wiring in gas valve circuit Replace integrated control board |
| Furnace fails to operate | EEc | Gas valve is energized when it should not be Internal gas valve error | Check wiring in gas valve circuit Replace integrated control board |
| Furnace fails to operate. Integrated control module LED display provides no signal | None | No 115 power to furnace or no 24 volt power to integrated control module. Blown fuse or tripped circuit breaker Integrated control module is non- functional | Restore high voltage power to furnace and integrated control module. Correct condition which caused fuse to open, replace fuse Replace non-functional integrated control module. |
| Furnace fails to operate | E 10 | Grounding fault Poor neutral connection | Verify neutral wire connection to furnace & continuity to ground source |
| Furnace fails to operate | E 11 | Open roll out switch | Check for correct gas pressure Check for correct burner alignment Check for and correct burner restriction |
| Furnace fails to operate | EE _n | Ignitor Open | Check for Ignitor wiring. Replace Damaged Ignitor |
| Furnace fails to operate | EEJ | Inducer relay Error | Replace integrated control board |
| Twinning feature not working | EEH | TWIN Error | Check for wiring connections. Replace integrated control board |
| Furnace fails to operate | EEE | Internal Faults or IRQ Loss in Control Board | Replace integrated control board |

WARNING
HIGH VOLTAGE!
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING THIS UNIT. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.



| Status | Seven Segment Display | | |
|---|-----------------------|------|------|
| | Seg# | Seg# | Seg# |
| Internal Faults or IRQ Loss | | | 0 |
| Lockout Due to Excessive Retries Recycle | | | 1 |
| Low Stage Pressure Switch Stuck Closed | | | 2 |
| Low Stage pressure Switch Open | | | 3 |
| Open High Limit Switch | | | 4 |
| Flame Detected When no Flame Should be | | | 5 |
| Open Fuse | | | 6 |
| Low Flame Signal | | | L |
| Ignitor Relay Fault | | | 8 |
| High Stage Pressure Switch Stuck Closed | | | 9 |
| High Stage Pressure Switch Open | | | A |
| Reversed Line Polarity or Grounding Error | | | b |
| Internal Gas Valve Error | | | C |
| External Gas Valve Error | | | 1 |
| Open Rollout Switch | | | N |
| Ignitor Open | | | I |
| Inducer Relay Error | | | H |
| TWIN Error | | | 0 |
| GROUNDING ERROR | | | 0 |

Wiring is subject to change. Always refer to the wiring diagram on the unit for the most up-to-date wiring.

CUSTOMER FEEDBACK

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