



# INSTALLATION, OPERATION & MAINTENANCE MANUAL

THESE INSTRUCTIONS  
APPLY TO THE  
**MODEL GTM**  
CATEGORY I NATURAL  
GAS AND LP GAS MID  
EFFICIENCY WARM AIR  
FURNACE.



### Warning

This Product Must Be Installed By A Licensed Plumber Or Gas Fitter when Installed Within The Commonwealth Of Massachusetts.

### ⚠ 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.

### ⚠ WARNING

#### FOR YOUR SAFETY

- ⇒ Do not store or use gasoline or other flammable vapors and liquids, or other combustible materials 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, or a cellular phone from a location well away from the building. Follow the gas supplier's instructions.
  - If you cannot reach your gas supplier, call the fire department.
  - Do not re-enter the building until authorized to do so by the gas supplier or the fire department.
- ⇒ **Improper installation, adjustment, alteration, service or maintenance can cause injury, property damage or loss of life. Refer to this manual.**
- ⇒ **Installation and service must be performed by a qualified installer, service agency or the gas supplier.**



### DO NOT DESTROY THIS MANUAL

Please read carefully and keep in a safe place for future reference by a service technician.

**WARNING**

THESE INSTRUCTIONS ARE INTENDED AS AN AID TO QUALIFIED SERVICE PERSONNEL FOR PROPER INSTALLATION, ADJUSTMENT AND OPERATION OF THIS FURNACE. READ THESE INSTRUCTIONS THOROUGHLY BEFORE ATTEMPTING INSTALLATION OR OPERATION. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN IMPROPER INSTALLATION, ADJUSTMENT, SERVICE OR MAINTENANCE, POSSIBLY RESULTING IN FIRE, ELECTRICAL SHOCK, CARBON MONOXIDE POISONING, EXPLOSION, PROPERTY DAMAGE, PERSONAL INJURY OR DEATH

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## INTRODUCTION

The Model GTM gas fired mid-efficiency (non-condensing) furnace is an upflow or horizontal warm air furnace suitable for residential and light commercial heating applications from 50,000 to 100,000 BTU/Hr.

Model GTM is CGA / AGA design certified as a Category I chimney vent central forced air furnace with all combustion air supplied from the ambient air around the furnace. (See section on Combustion Air).

All GTM models may be fired by natural gas or LP gas (propane). GTM models may be field converted from natural gas to LP gas using Kit No. 28851, or may be field converted from LP gas to natural gas using Kit No. 28852.

The furnace is shipped completely assembled except the filter rack. Please inspect for damage, as the furnace is unpacked.

## SAFETY

### Codes:

1. This furnace must be installed:
  - 1.1. in accordance with all local codes, by-laws and regulations by those authorities having jurisdiction.
  - 1.2. In Canada, this furnace must be installed in accordance with the current CAN/CGA - B149 Installation Code for Fuel Burning Appliances.
  - 1.3. In the United States, this furnace must be installed in accordance with the current ANSI Z223.1 (NFPA 54) National Fuel Gas Code.
2. Electrical connections must be made in accordance with:
  - 2.1. any applicable local codes, by-laws and regulations.
  - 2.2. Canada: current edition of CAN/CSA C22.1, Canadian Electrical Code (Part 1).
  - 2.3. United States: current edition of ANSI/NFPA 70, National

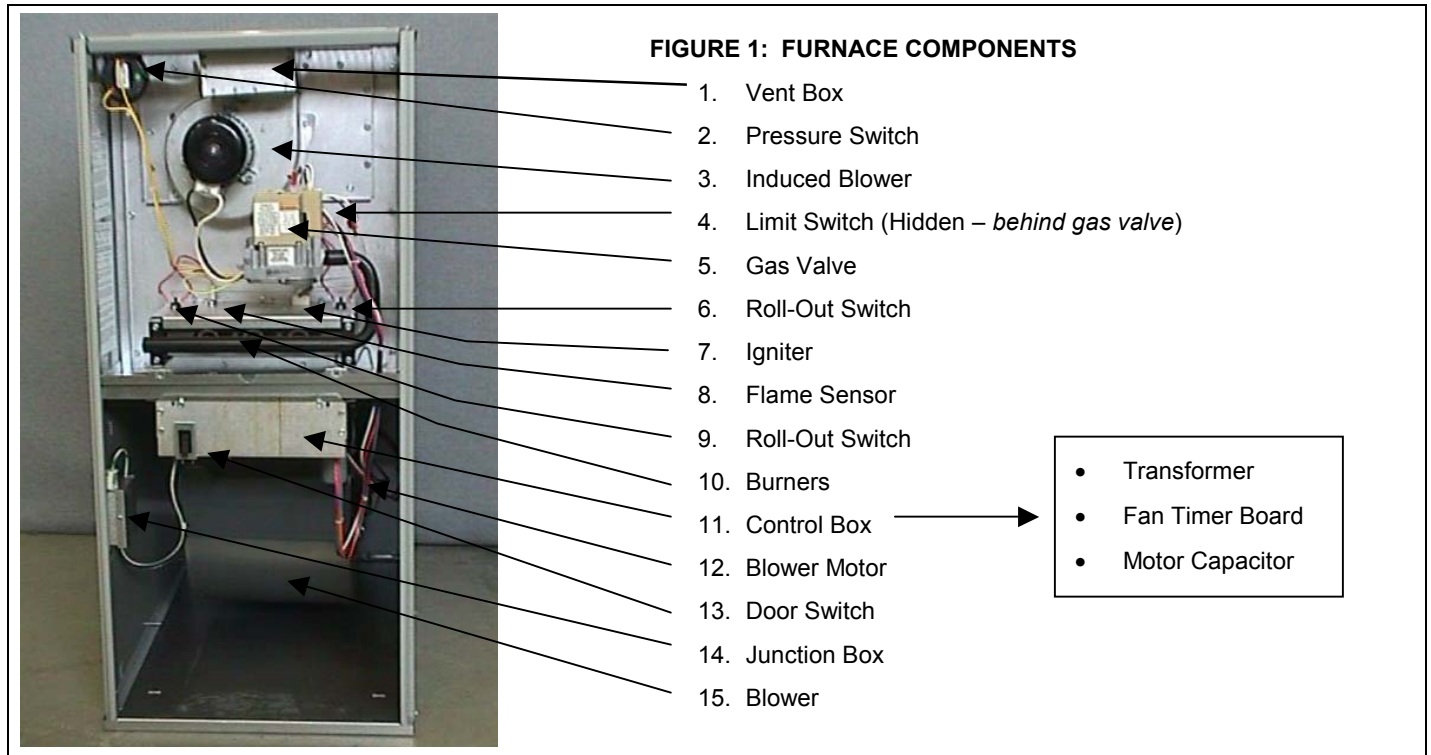
Electrical Code.

Codes and additional information may be obtained from:

Canadian Gas Association  
Suite 1, 243 Consumers Road  
North York, ON, M2J 5E3  
416-498-1994

American Gas Association  
1515 Wilson Boulevard  
Arlington, VA, 22209  
703-841-8400

National Fire Protection Association  
1 Batterymarch Park  
Quincy, MA, 02269-9101  
617-770-3000



**▲WARNING**

DO NOT INSTALL THIS FURNACE IN A MOBILE HOME! This furnace is not approved for installation in a mobile home. Doing so could cause **FIRE, PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.**

**▲WARNING**

THE FURNACE CONTAINS FOIL COVERED FIBERGLAS INSULATION. Inhalation of fiberglass particles is associated with respiratory disease including cancer.

**▲WARNING**

Natural gas and propane are normally odorized by the fuel supplier. In some cases, the odorant may not be perceivable. Installation of UL and CUL recognized fuel gas detectors installed in accordance with their manufacturer's instructions is recommended as an additional margin of safety.

**▲WARNING**

The exhaust gases from this furnace contain chemicals, which on some occasions may include carbon monoxide (CO). Carbon monoxide is an odorless, tasteless, clear colorless gas, which is highly toxic. Even low concentrations are suspected of causing birth defects and other reproductive harm.

UL and CUL recognized CO detectors are recommended for all buildings equipped with fossil fuel burning appliances. All CO detectors should be installed in accordance with their manufacturer's instructions and applicable local building codes.

**▲WARNING**

WHEN THIS FURNACE IS INSTALLED IN A RESIDENTIAL GARAGE, IT MUST BE INSTALLED SO THE BURNERS AND IGNITION SOURCE ARE LOCATED NO LESS THAN 18 INCHES ABOVE THE FLOOR TO PREVENT THE RISK OF IGNITING FLAMMABLE VAPORS WHICH MAY BE PRESENT IN THE GARAGE.

THE FURNACE MUST BE LOCATED OR PROTECTED TO AVOID PHYSICAL DAMAGE BY VEHICLES.

FAILURE TO HEED THESE WARNINGS CAN CAUSE A FIRE OR EXPLOSION, RESULTING IN PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.

**FURNACE SIZING**

The maximum hourly heat loss for each heated space shall be calculated in accordance with the procedures described in the manuals of the **Heating, Refrigeration and Air Conditioning Institute of Canada** (HRAI), or by any other method which is suitable for local conditions, provided the results obtained are in substantial agreement with, and not less than those obtained using the procedure described in their manuals.

In the United States, **Manual J**, titled, "**Load Calculation**" published by the **Air Conditioning Contractors of America**, describes a suitable procedure for calculating the maximum hourly heat loss.

If the installation is a retrofit application, do not rely on the capacity of the existing heating equipment as a

method to size the new furnace. Many of the heat transfer multiples listed in earlier versions of load calculation manuals were much higher than those listed in more recent editions. It is possible that energy saving measures have been completed since the installation of the existing furnace. This might include additional insulation in the attic or walls, the application of sprayed foam insulation, the addition of storm windows and doors, weatherstripping, caulking, etc.

Many of the older furnaces were equipped with large belt drive blower systems, operating at low RPM's. If replacing an existing furnace, be sure that the existing ductwork can handle the amount of airflow necessary for a reasonable temperature rise. Most older gas furnaces operated with a system temperature rise of 70 - 100°F. The GTM Series furnace has been

designed for operation with a system temperature rise ( $\Delta T$ ) of 35 - 65°F. If the furnace selected has an identical output capacity as the original furnace, a substantial increase in system airflow will be required. See Table 1 and the airflow characteristics in Appendix A.

**TABLE 1. TYPICAL AIR FLOW**

GTM	CFM Required for a $\Delta T$ of:			
	35	45	55	65
050	1225	952	779	659
070	1714	1333	1091	923
085	2080	1618	1324	1120
100	2449	1905	1558	1319

Existing ductwork should be assessed for its air handling capabilities. For residential applications, the recommended air velocity of a supply air

trunk duct is 700 feet per minute (fpm), and should not exceed 900 fpm. The recommended air velocity of a supply air branch run is 600 fpm, and should not exceed 900 fpm. These values are slightly lower for flexible ducting. The recommended air velocity of a return air trunk duct is 600 fpm, and should not exceed 700 fpm. The recommended and maximum air velocity of a return air branch 600 fpm.

The *equal friction chart*, as published by ASHRAE and HRAI, is the basis for the various air duct calculators available through heating supply companies. Following the air velocity guide lines, according to the *equal friction chart*, or a *slide rule air duct calculator*, a typical 6 inch round duct has a capacity of approximately 100 cfm.

EXAMPLE: By noting the airflow required in Table 1, and following the air velocity guidelines, a GTM070, in a retro-fit application would require at least the equivalent of 11 six inch supply branch runs to have the airflow capacity to permit the furnace to operate at a 55° temperature rise, ( $\Delta T$ ).

NOTE: The return air system is equally as important as the supply air system. An under-sized return air system will prevent sufficient quantities of air from reaching the supply air system; properly sized or otherwise, and will consequently reduce the service life of the furnace and its components.

## LOCATION of UNIT

### 1. GENERAL:

- 1.1. Select a location where the furnace venting can be routed between the furnace and the chimney or B-Vent with a minimum of lengths and fittings. Be sure to check that the proposed routing will meet code requirements with respect to minimum clearances.
- 1.2. Select a location as near as possible to the existing or proposed duct system.
- 1.3. The furnace location must permit access for servicing, and be within the *clearance to combustibles guidelines* as marked on the appliance rating plate.
- 1.4. The furnace should be installed on a firm base when installed in

the upflow position. This could typically be the concrete floor if installing the furnace in a basement.

- 1.5. If the furnace is being installed so that the return air will enter through the bottom, the perimeter of the furnace must be properly supported
- 1.6. When installed in the horizontal position, the furnace may be supported from the bottom, or suspended. (see diagrams.)

### 2. OTHER CONSIDERATIONS:

#### IMPORTANT:

If the furnace is to be located in an area where the combustion air is laden with chemical compounds such as bromine, chlorine or fluorine, as may be found in swimming pool chemicals, laundry detergents, etc., use outdoor air for combustion. These compounds when exposed to flame, form acids which attack the heat exchanger and other components.

A partial list of these contaminants would include:

- Aerosols, particularly CFC based aerosols,
- Air fresheners,
- "Airplane" glue and similar cements,
- Ammonia, as is commonly found in permanent wave solutions used in women's hair dressing salons,
- Anti-static fabric softeners used in clothes dryers,
- Carbon tetrachloride,
- Chlorinated cleaners and waxes,
- Chlorine and bromine based swimming pool chemicals and treatments,
- De-icing salts or chemicals, rock salt, etc.,
- Dry cleaning solutions such as perchloroethylene,
- Halogen based refrigerants including R-12 and R-22,
- Hydrochloric acid, muriatic acid, or other acid based masonry washing compounds,
- Polyurethane and similar derivatives fumes,

- Printer's inks, paint removers, furniture strippers, varnishes, varsol, toluene, etc.,
- Water softener salts and chemicals.

#### IMPORTANT

This furnace is not to be used for temporary heating of buildings or structures under construction.

#### IMPORTANT

If this furnace is to be used with air conditioning and is to be installed in an area over a finished ceiling or living area, install a field fabricated auxiliary drain pan under the furnace to protect that area from accidental condensate spills. The auxiliary pan should be large enough to collect accidentally spilled condensate from the air conditioning evaporator coil assembly if applicable.

NOTE: These furnaces are approved for installation in attics, alcoves, utility rooms, closets and crawlspaces. If this furnace is to be installed in a utility room, be sure that it is located in such a way as to allow access for servicing or the removal of the other appliance, (hot water heater, for example).

#### IMPORTANT

If the furnace is to be installed in a garage, the burners must be a minimum of 18 inches (460 mm) above the floor.

If the furnace is to be installed in a commercial (repair) garage, the burners must be a minimum of 4.5 feet (1375 mm) above the floor.

The furnace must be protected from physical damage by metal barriers or other acceptable means.

### 3. AIR CONDITIONING

This furnace may be used as part of an air conditioning system. The furnace wiring and control system is "air conditioning ready". There are the following factors to consider:

- The air conditioning evaporator coil must be downstream of the heat exchanger. The cooled air passing over the warm ambient

air inside the heat exchanger tubes can cause condensation inside the tubes, resulting in corrosion and premature failure.

- A parallel duct system can be installed to direct the air from the furnace through the evaporator coil only. Use dampers or other means to bypass the heat exchanger. If [summer/winter] dampers are used, they should be interlocked to prevent system operation unless the dampers are in the full open or full closed position.

### CLEARANCES

Table 2 in Figure 2 provides the certified clearances to combustibles and dimensional information.

### IMPORTANT:

This furnace requires a minimum of 24 inches of front clearance for service purposes. For this purpose, service clearance takes precedence over clearance to combustibles.

See the appliance rating plate affixed to the furnace for specific model number, serial number and clearance to combustibles information.

### **▲WARNING**

**UPFLOW FURNACES ARE DESIGN CERTIFIED FOR INSTALLATION ON COMBUSTIBLE FLOORS. THIS SHALL BE INTERPRETED AS A WOOD FLOOR ONLY.**

**THE FURNACE MUST NOT BE INSTALLED DIRECTLY ON CARPETING, TILE, OR OTHER COMBUSTIBLE MATERIAL EXCEPT WOOD.**

**INSTALLATION ON COMBUSTIBLE MATERIAL CAN RESULT IN FIRE, CAUSING PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.**

### **▲WARNING**

**COMBUSTIBLE MATERIAL MUST NOT BE PLACED ON OR AGAINST THE FURNACE JACKET.**

**THE AREA AROUND THE FURNACE MUST BE KEPT CLEAR AND FREE OF ALL COMBUSTIBLE MATERIALS INCLUDING GASOLINE AND OTHER FLAMMABLE VAPORS AND LIQUIDS.**

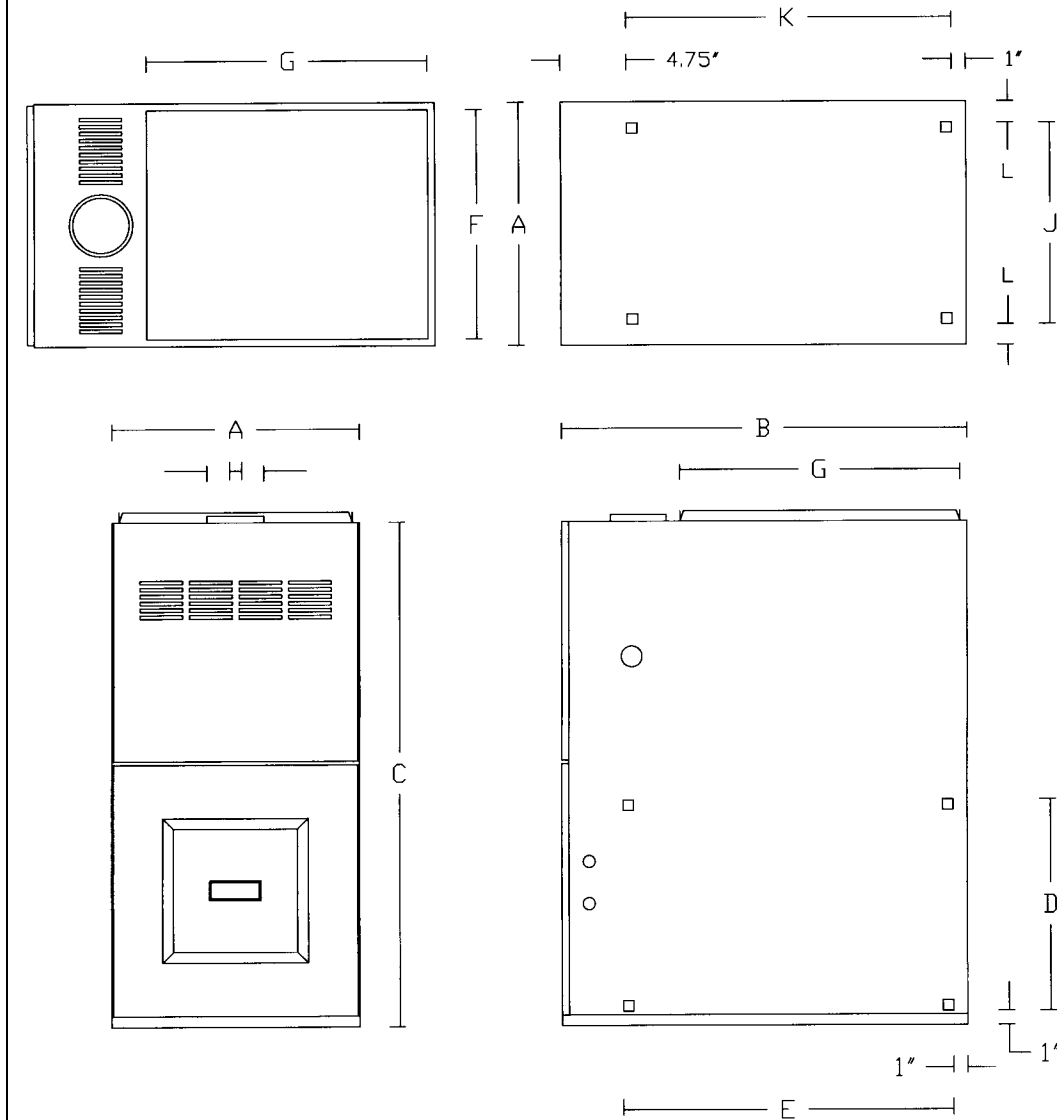
**PLACEMENT OF COMBUSTIBLE MATERIALS ON, AGAINST OR AROUND THE FURNACE JACKET CAN CAUSE AN EXPLOSION OR FIRE RESULTING IN PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.**

**THE HOMEOWNER SHOULD BE CAUTIONED THAT THE FURNACE AREA MUST NOT BE USED AS A BROOM CLOSET OR FOR ANY OTHER STORAGE PURPOSE.**

### INSPECTION / ACCESS PANEL

If an air conditioning coil is not to be used in the supply air plenum, it is recommended that the outlet duct be provided with a removable access panel which is accessible when installed so the heat exchanger may be viewed for possible openings using light assistance or a probe that can be inserted for sampling the air stream. The access cover must be fabricated in such a manner as to prevent leaks.

**FIGURE 2: GTM DIMENSIONS and CLEARANCE TO COMBUSTIBLES**



DIMENSIONS (Inches)				
MODEL	WIDTH	DEPTH	HEIGHT	SUPPLY
GTM	A	B	C	F x G
050	17 1/2	29 1/4	36	16 1/2 x 20
070	17 1/2	29 1/4	36	16 1/2 x 20
085	21 1/4	29 1/4	36	20 x 20
100	21 1/4	29 1/4	36	20 x 20
MODEL	RETURN		VENT	
GTM	SIDE	BOTTOM		H
	D x E	J x K	L	
050	15 x 23 1/2	14 1/2 x 22	1 1/2	4
070	15 x 23 1/2	14 1/2 x 22	1 1/2	4
085	15 x 23 1/2	14 1/2 x 22	3 5/8	4
100	15 x 23 1/2	14 1/2 x 22	3 5/8	4

CLEARANCE TO COMBUSTIBLES (Inches)			
SURFACE	UPFLOW	HORIZONTAL	
TOP	1	2	
FRONT	3	3	
FLUE	6	6	
BACK	0	0	
SIDE or END	0	SUPPLY	RETURN
		6	0
FLOOR	COMBUSTIBLE	COMBUSTIBLE	



## DUCTWORK

Proper airflow is required for the correct operation of this furnace. Insufficient airflow may cause erratic operation, could cause the furnace to cycle on the high temperature limit, and may damage the heat exchanger. Excessive airflow may result in an excessively noisy duct system and may result in undesirable consequences such as creating uncomfortable drafts and causing drapes or curtains to blow around.

If air conditioning is to be used with the furnace, the duct system must be capable of delivering the correct amount of airflow for each system.

The ductwork should be sized and constructed in accordance with accepted industry standards. Duct sizing and construction information may be obtained from:

- A.C.C.A. (Air Conditioning Contractors of America).
- A.S.H.R.A.E. (American Society of Heating, Refrigeration and Air Conditioning Engineers).
- H.R.A.I. (Heating, Refrigerating and Air Conditioning Institute (Canada))
- S.M.A.C.N.A. (Sheet Metal and Air Conditioning Contractors' National Association (United States))

All of the above professional organizations have duct sizing manuals available.

The total static pressure drop of the air distribution system should not exceed 0.5 inches water column.

### **▲WARNING**

**DO NOT ALLOW GAS PIPING TO BE ROUTED THROUGH JOIST SPACES THAT ARE USED FOR RETURN AIR PURPOSES. DO NOT USE JOIST SPACES FOR RETURN AIR PURPOSES IF THE JOIST SPACE ALREADY CONTAINS PLUMBING STACKS, CHIMNEY COMPONENTS, ETC. UNLESS THE PORTION USED FOR RETURN AIR PURPOSES CAN BE COMPLETELY ISOLATED FROM PORTIONS WITH OTHER USEAGES.**

### **▲WARNING**

**NEVER ALLOW THE PRODUCTS OF COMBUSTION FROM THE FLUE TO ENTER THE RETURN AIR OR SUPPLY AIR DUCTWORK.**

**ALL RETURN AIR DUCTWORK MUST BE ADEQUATELY SEALED AND SECURED TO THE FURNACE WITH SHEET METAL SCREWS. TAPE THE SHEET METAL SEAMS IN THE VICINITY OF THE FURNACE WITH DUCT TAPE OR SIMILAR MATERIAL.**

**WHEN THE FURNACE IS MOUNTED ON A PLATFORM WITH RETURN AIR THROUGH THE BOTTOM, IT MUST BE SEALED AIR TIGHT BETWEEN THE FURNACE AND THE RETURN AIR PLENUM. THE FLOOR OR PLATFORM MUST PROVIDE SOUND PHYSICAL SUPPORT OF THE FURNACE WITHOUT SAGGING, CRACKS OR GAPS AROUND THE BASE, PROVIDING A SEAL BETWEEN THE SUPPORT AND THE BASE.**

**FAILURE TO PREVENT PRODUCTS OF COMBUSTION FROM BEING CIRCULATED INTO THE LIVING SPACE CAN CREATE POTENTIALLY HAZARDOUS CONDITIONS, INCLUDING CARBON MONOXIDE POISONING THAT COULD RESULT IN PERSONAL INJURY OR DEATH.**

**DO NOT, UNDER ANY CIRCUMSTANCES, CONNECT RETURN OR SUPPLY AIR DUCTWORK TO OR FROM ANY OTHER HEAT PRODUCING DEVICE SUCH AS A FIREPLACE INSERT, STOVE, ETC. DOING SO MAY RESULT IN FIRE, CARBON MONOXIDE POISONING, EXPLOSION, PERSONAL INJURY, LOSS OF LIFE, OR PROPERTY DAMAGE.**

**IMPORTANT:** Some high efficiency filters have a greater than normal resistance to airflow. This can adversely affect furnace operation. Be sure to check the airflow if using any filter other than the factory supplied filter.

#### **DUCTWORK STEPS:**

1. Position the furnace to minimize ductwork length and fittings.
  2. Cut open a return air inlet. The choices are:
    - a) either side
    - b) furnace bottom
    - c) any combination, i.e. two sides or a side and the bottom.
    - d) **DO NOT USE THE REAR PANEL AS A RETURN AIR INLET.** There is insufficient room to permit adequate airflow.
- In all cases, cut the inlet air opening the full width of the knock-outs.
4. Install the filter rack.
  5. Connect the return air duct or fitting to the furnace. The connection should be as air tight as possible to prevent entraining combustion gases from an adjacent fuel-burning appliance, or entraining combustion air for this furnace or adjacent fuel burning appliances.
  6. Ensure that there is adequate space and accessibility for the air filter.

**NOTE:** If two return air inlets are used, both must be equipped with filters.

7. If an air conditioning evaporator coil is required, position it on the top of the furnace. Ensure that no air can bypass the evaporator coil.
8. Connect the supply air plenum to the supply air outlet.

**FLEXIBLE DUCT CONNECTORS** are an effective device to prevent the telegraphing of mechanical noise from the furnace to other parts of the home via the ductwork. If using flexible connectors, ensure that the adjoining duct is independently supported.

# VENTILATION AND COMBUSTION AIR

## WARNING

READ, UNDERSTAND AND FOLLOW ALL INSTRUCTIONS IN THIS SECTION. FAILURE TO PROPERLY VENT OR SUPPLY COMBUSTION AIR TO THIS FURNACE CAN CAUSE CARBON MONOXIDE POISONING, OR AN EXPLOSION OR FIRE, RESULTING IN PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.

## WARNING

THIS FURNACE AND ANY OTHER FUEL BURNING APPLIANCE MUST BE PROVIDED WITH ENOUGH FRESH AIR FOR PROPER COMBUSTION AND VENTILATION OF THE FLUE GASES. MOST HOMES WILL REQUIRE THAT OUTSIDE AIR BE BROUGHT TO THE FURNACE AREA. FAILURE TO DO SO CAN CAUSE PERSONAL INJURY, OR DEATH FROM CARBON MONOXIDE POISONING.

Adequate provisions for combustion and ventilation air must be in accordance with CAN/CGA-B149 in Canada, and ANSI Z223.1 (NFPA 54), section 5.3 "Air for Combustion and Ventilation" in the United States. Check with local authorities for any additional building codes bylaws or regulations.

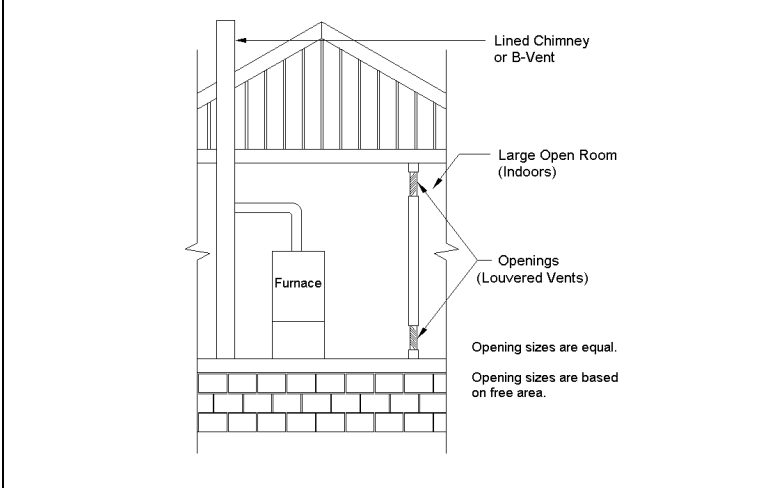
## CAUTION

Air for combustion and ventilation purposes must not originate from a corrosive atmosphere. Any furnace failure caused by corrosive elements is excluded from warranty coverage.

The following types of installation sites (but not limited to the following) will require OUTDOOR AIR for combustion because of chemical exposures:

- Commercial buildings
- Buildings with indoor swimming pools

Figure 3 Combustion / Dilution Air from Heated Inside Sources. (CASE 2)



- Furnaces installed in laundry rooms
- Furnaces in hobby or craft rooms
- Furnaces installed near chemical storage areas.

Exposure to the following substances in the combustion air supply (but not limited to the following) will also require OUTDOOR AIR for combustion:

- Aerosols, particularly CFC based or propelled aerosols
- Air fresheners
- "Airplane Glue" and similar adhesives and cements
- Ammonia, as commonly found in permanent wave solutions used in hair dressing salons
- Anti-static fabric softeners used in clothes dryers
- Carbon tetrachloride
- Chlorinated cleaners and waxes
- Chlorine and bromine based swimming pool chemicals
- De-icing salts or chemicals, e.g. rock salt, etc.
- Dry cleaning fluids such as perchloroethylene

- Fumes from curing polyurethane and similar substances
- Halogen based refrigerants including R-12 and R-22
- Hydrochloric acid, muriatic acid and other acid based masonry washing and curing materials
- Printer's inks, paint removers, varnishes, varsol, toluene, etc.
- Water softener salt and chemicals

Combustion air must be free of acid forming chemicals such as sulphur, fluorine and chlorine. These elements are found in aerosol sprays, detergents, bleaches, cleaning solvents, air fresheners, paint and varnish removers, refrigerants, and many other commercial and household products. When burned in a gas flame, vapors from these products form acid compounds. Acid compounds increase the dew point temperature of the flue products and are highly corrosive after they condense.

## DETERMINING COMBUSTION AIR

### CASE 1: FURNACE LOCATED IN AN UNCONFINED SPACE.

Unconfined space does not necessarily mean that combustion and ventilation will not have to be introduced from the outdoors, particularly in air tight

homes. The minimum requirement for unconfined space is a volume of 50 cubic feet for each 1000 BTU/Hr for all fuel burning appliances located within the unconfined area.

If the amount of combustion and ventilation air is insufficient to properly operate the furnace and other fuel burning appliances within the unconfined area, it will be necessary to supply it from the outdoors based on the criteria used when calculating the air supply for a confined space. The following table shows the minimum area required for the furnace only.

Table 2: Unconfined space

Furnace	Min. ft <sup>2</sup> w/ 8' Ceil.	Typical Rm. Size w/ 8' Ceiling
GTM050	313	14 x 22 or 16 x 20
GTM070	438	16 x 28 or 20 x 22
GTM085	532	18 x 30 or 22 x 24
GTM100	625	20 x 32 or 25 x 25

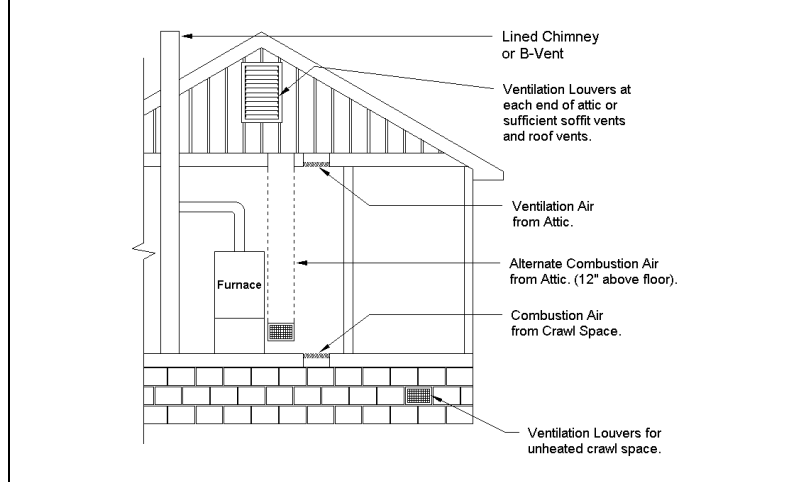
**NOTE:** If planning to use the inside air in an unconfined space, remember to test for proper furnace operation (as well as other fuel burning appliances located within the unconfined space) with respect to adequate combustion and ventilation air with fireplace dampers open, clothes dryer running, bathroom exhaust fans on, kitchen range hood on, etc.

**CASE 2:FURNACE LOCATED IN A CONFINED SPACE.**

A confined space, (any space smaller than the minimums discussed in CASE 1), must have two air openings; one within 12" of the ceiling and the other within 12" of the floor. The air openings must be sized based on whether the combustion and ventilation air is being taken from indoors or outdoors, the method outdoor air (if used) is introduced, and taking into account any other fuel burning appliances in the confined space.

If sufficient indoor combustion and ventilation air is available for the furnace and all other fuel burning appliances, even when clothes dryers, bathroom fans, range hoods, etc. are running, size each opening on the basis of 1 square inch of free area per 1000 BTU/Hr., See Figure 3.

**Figure 4: Outside Air for Combustion, Attic or Crawl Space. (CASE 3).**



The minimum requirement for these openings is 100 square inches, even for the furnace models under 100,000 BTH/Hr.

**NOTE:** If using grilles to cover the two openings, factor in the free area of the grille. Typically, a side wall grille will have a free area approximately 50% of its nominal size. Consequently, if the required opening is 10 x 10, it will have to be doubled if using a side wall grille with 50% free area.

**IMPORTANT:** If an exhaust fan, fireplace, clothes dryer or any similar device is present in the indoor area from which the combustion and ventilation air will be drawn, negative pressure could be a problem if natural infiltration from the outdoors does not match the rate at which air is exhausted.

**CASE 3:FURNACE LOCATED IN A CONFINED SPACE, OUTDOOR AIR FROM ATTIC OR CRAWL SPACE.**

In this circumstance, the free area of each of the two combustion and ventilation air openings is based on a minimum of 1 square inch per 4000 BTU/Hr. In this configuration, one opening can originate from the floor drawing combustion and ventilation air from the ventilated crawl space.

The other opening may communicate freely with a ventilated the attic. If using the attic air, ensure that the opening is ducted from the ceiling high enough to be above the insulation. The attic must be adequately vented with soffit vents or gable vents, see Figure 4.

As an alternative to creating an opening in the floor to draw air from a crawl space, a duct may be dropped from the attic terminating 12" above the floor, see Figure 4.

The following table shows minimum free areas and round pipe sizes when drawing combustion air vertically from the attic or crawl space for the furnace only. If other fuel burning appliances are present, their combustion air and ventilation air requirements must be added to those of the furnace.

Table 3: Vertical Air Supply

Furnace	Free Area Ea. Opening	Round Pipe Size
GTM050	12.5 in. <sup>2</sup>	4 in.
GTM070	17.5 in. <sup>2</sup>	5 in.
GTM085	21.25 in. <sup>2</sup>	6 in.
GTM100	25 in. <sup>2</sup>	6 in.

**IMPORTANT:** If the attic has an exhaust fan (power vent), it may create a negative pressure sufficiently large enough to prevent the attic from being an effective source of combustion and ventilation air. Powered attic fans do not customarily run during the heating season; however, some are controlled by a humidistat as well as a thermostat, which may allow some operation during the heating season. The choices are a) use the direct vent option, b) obtain outdoor air from elsewhere, or c) interlock the attic exhaust fan with the furnace such that the two cannot operate simultaneously.

**CASE 4: FURNACE LOCATED IN A CONFINED SPACE, OUTDOOR AIR DUCTED HORIZONTALLY**

Similar to CASE 3, outdoor air for combustion and ventilation may be drawn through horizontal ducting. The free area for each opening is calculated on the basis of a minimum of 1 square inch per 2000 BTU/Hr input.

The following table shows minimum free areas and round pipe sizes when drawing combustion air horizontally from the outdoors for the furnace only. If other fuel burning appliances are present, their combustion air and ventilation air requirements must be added to those of the furnace.

**IMPORTANT:** The outdoor grilles must be installed in a location where they will not be obstructed in any manner.

**Figure 5: Outdoor Air for Combustion, Horizontal. (CASE 4).**

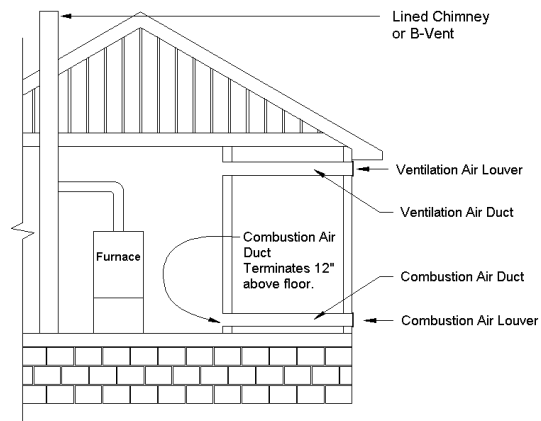


Table 4: Horizontal Air Supply

Furnace	Free Area Ea. Opening	Round Pipe Size
GTM050	25 in. <sup>2</sup>	6 in.
GTM070	35 in. <sup>2</sup>	7 in.
GTM085	42.5 in. <sup>2</sup>	8 in.
GTM100	50 in. <sup>2</sup>	8 in.

**IMPORTANT:** If grilles are used on the outside wall, they must be sized properly. Most side wall grilles have only 50% free area. In the case of a GTM100 which requires a pair of 8" round pipes to obtain sufficient combustion and ventilation air, the duct could be an equivalent rectangular duct; 8 x 7 for example. Based on 50% free area for the inlet grilles, the actual grille size would have to be 14 x 8 or its equivalent. A transition may be used to reduce to the smaller duct size if necessary.

# FURNACE VENTING

## FURNACE VENTING

### DEFINITIONS:

"Vent" and "Chimney" refer to open passageways that convey vent gases from the furnace, or its vent connector, to the outside. Vents and chimneys usually run vertically or nearly vertically. When they serve only one gas appliance, they are called "dedicated" vents or chimneys. When they serve multiple gas appliances, they are called "common" vents or chimneys.

"Vent Connector" refers to a pipe or duct that connects the furnace to a vent or chimney. Vent connectors usually run from the furnace's vent collar to the vent or chimney. Vent connectors may have vertical and horizontal runs.

"Venting System" refers to a continuous open passageway from the vent collar to the outside. Venting systems usually have a vent connector(s) and a vent or chimney. Venting systems commonly serve a single furnace, or a single furnace and a hot water heater. Other multiple-appliance venting systems are less common.

"Fan Assisted Combustion System" refers to an appliance equipped with an integral mechanical means to either draw or force products of combustion through the combustion chamber and/or heat exchanger. The GTM Series furnace uses a draft inducer to draw combustion products through the heat exchanger and is considered to have a fan-assisted combustion system. Category I furnaces with fan-

assisted combustion systems must not be vented into single wall metal vents.

### DESIGN CONSIDERATIONS

The furnace is design-certified as a Category I appliance, which means that the furnace relies on the buoyancy of combustion products to vent properly. Since buoyancy decreases with temperature, the chimney size and properties are very important. An oversized chimney, or one that is exposed to the cold will not maintain the required buoyancy as well as it should, and may allow excessive condensation to form.

**IMPORTANT:** Do not vent the furnace in common with Category III or IV gas-fired appliances.

The furnace must be vented in accordance with these instructions, the Venting Tables and rules published in the current editions of B149, Natural Gas and Propane Installation Code in Canada, or ANSI Z223.1 / NFPA 54, National Fuel Gas Code in the United States, and within the requirements of the codes of the local authority having jurisdiction.

Refer to section 7 of B149 or ANSI Z223.1/NFPA 54 for venting requirements and details.

The furnace is not equipped with a draft hood to introduce dilution air to the chimney. The products of combustion will therefore have a higher concentration of water vapour within them.

If the furnace is the only appliance served by the chimney, a tiled masonry chimney, regardless of tile size, must not be used without a suitably sized certified chimney liner and termination. Consider dedicated venting with a B-Vent used as a liner in this case. See Dedicated Venting.

### **⚠ WARNING**

**SELECT APPROPRIATE VENTING MATERIALS AND ENSURE PROPER CLEARANCES TO COMBUSTIBLES. INADEQUATE VENTING OR FAILURE TO MAINTAIN PROPER CLEARANCES TO COMBUSTIBLES MAY ALLOW THE ACCUMULATION OF THE PRODUCTS OF COMBUSTION WITHIN THE BUILDING RESULTING IN FIRE, NAUSEA, OR ASPHYXIATION.**

### **⚠ WARNING**

**DO NOT USE AN UNLINED MASONRY CHIMNEY TO VENT THIS FURNACE. THE USE OF AN UNLINED MASONRY CHIMNEY INCREASES THE RISK OF CONDENSATE FORMATION, WHICH MAY CAUSE THE CHIMNEY TO DETERIORATE, ALLOWING COMBUSTION PRODUCTS AND CONDENSATE TO COLLECT IN THE BUILDING.**

Multi-storey and common venting with other Category I gas-fired appliances is

permitted. The venting system must be in accordance with the national gas code, B149 in Canada, ANSI Z223.1/NFPA 54 in the United States, local codes, and approved engineering practices.

**IMPORTANT:** This furnace is not to be vented in the same chimney or venting system serving a solid fuel appliance (wood or coal). If the furnace is to be vented into a chimney serving a fireplace, the fireplace opening is to be permanently sealed.

The furnace must connect to a listed chimney (B-1 Vent), or vent complying with a recognized standard, or a suitably sized, constructed and lined masonry chimney. The chimney lining method and material must comply with local requirements. Use corrosion-resistant material meeting nationally recognized standards for vent construction.

Avoid oversizing the furnace for the application. A furnace selected as close as possible for the actual building heat loss will have longer firing cycles which will reduce the potential for damaging condensate formation in the venting system.

Take the building orientation and the presence of other buildings or other nearby structures into consideration when planning the venting system location. Certain external structures could create air turbulence around the vent termination leading to downdrafts and similar venting problems.

If local experience indicates that condensation problems are probable, provide for drainage and disposal of venting system condensate.

### **VENT SIZING**

The venting system, taking all appliances to be vented into consideration, must be sized in accordance with the Venting Tables and rules published in the current editions of B149, Natural Gas and Propane Installation Code in Canada, or ANSI Z223.1 / NFPA 54, National Fuel Gas Code in the United States. An undersized venting system will not permit the complete removal of products of combustion, and an oversized venting system will not heat up quickly enough to avoid condensation formation

### **INSTALLATION:**

Vents and chimneys usually extend vertically with offsets not exceeding 45° from vertical. Consider all offsets greater than 45° from vertical as horizontal runs. Include their length in the total horizontal run calculation.

Horizontal runs should be as short as practical and not exceed 75% of the vent height.

The vent height must be a minimum of 5 feet above the highest appliance in a Category I venting system.

Minimize vent connector horizontal runs to the extent possible for best performance. Avoid unnecessary fittings. For example, an offset constructed of 45° elbows is generally better than one made of 90° elbows.

Support all horizontal sections of the venting system with pipe hangers, strap or equivalent at each joint to prevent sagging. Horizontal segments must slope upward from the furnace to vent or chimney with a minimum ¼ inch per foot.

When the vent tables from B149 or ANSI Z223.1/NFPA 54 permit more than one pipe diameter for the vent or vent connector, the smallest size is usually the best choice to help reduce the potential for condensation formation.

When using manufactured venting (B-1 Vent for example), follow the vent manufacturer's instructions. UL listed B-1 venting; both flexible and rigid are suitable venting materials for the furnace.

The installer must ensure that the venting of the furnace and all other gas appliances connected to the vent or chimney function properly.

### **VENT CONNECTOR**

The furnace may be vented with a listed single wall or Type B double wall vent connector to a B-Vent or lined masonry chimney. Most United States jurisdictions require a minimum 28-gauge galvanized single wall vent connector. Most Canadian jurisdictions require the vent connector to have corrosion resistance equivalent to 24-gauge galvanized sheet metal.

Observe the rules concerning clearance to combustibles.

The vent connector must be readily accessible for inspection, cleaning or replacement.

Keep the vent connector as short as possible by locating the furnace as close as practical to the vent or chimney.

Avoid unnecessary turns or bends that create resistance to the flow of the vent gases. Fittings such as elbows add resistance to the vent connector.

Use Type B vent connectors in attics, crawl spaces, or other cold areas. Install thimbles that meet clearance to combustibles requirements and local code requirements if the vent connector must pass through a wall or partition constructed of combustible material.

The preferred method to join vent connectors to a vent or chimney is by individually connections. If two vent connectors must be joined before the vent or chimney, use a correctly sized wye or tee-wye fitting as close to the vent or chimney as practical.

All GTM Series furnace collars are 4 inch. When the Canadian B149, or United States ANSI Z223.1 / NFPA 54 venting tables specify the use of 3 inch venting, use a 4 to 3 reducer at the furnace collar.

Secure all single wall vent connector segments together with a minimum of two sheet metal screws per joint. Secure the vent connector to the furnace collar with a minimum of 2 sheet metal screws. Type B vent connectors do not require sheet metal screws since they have their own locking system.

**VENT TERMINATION**

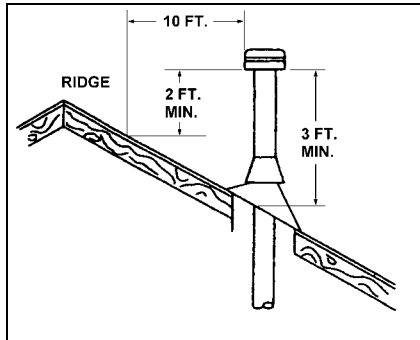
Terminate all vertical vents with a listed vent cap or roof assembly unless local codes require otherwise. Locate the termination in an area free of positive pressure or wind eddies. Eddies may occur when wind swirls over roof peaks. They can cause downdrafts and interfere with normal vent operation.

Some manufactured vent caps are resistant to wind and eddies; their use is recommended.

The vent termination must be a minimum of 5 feet above the highest gas appliance connection. The vent must extend a minimum of 3 feet above the point that it passes through the roof.

The vent termination must be a minimum of 2 feet higher than any part of the building horizontally within 10 feet of the vent.

**Figure 6: Vent Termination**



**DEDICATED VENTING**

Figure 7 shows a good method to permit dedicated venting making use of B-Vent within a masonry chimney.

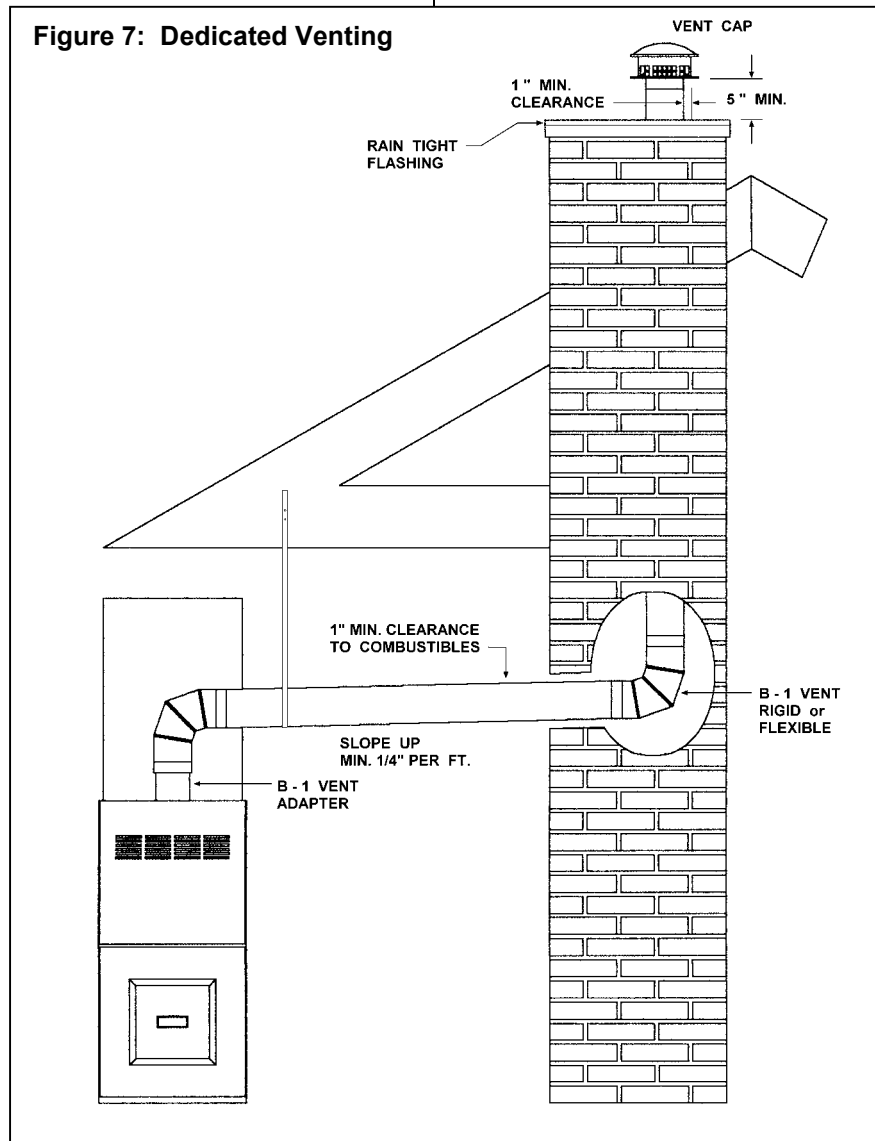
**WARNING**

Failure to properly terminate the vent or chimney systems could allow combustion products to collect inside the building causing personal injury or death.

When using this method, provide support for the B-Vent.

**IMPORTANT:** maintain at least 1-inch clearance between the B-Vent and the chimney tile or chimney. This will help prevent the formation of condensation.

**Figure 7: Dedicated Venting**



## EXISTING VENT CONSIDERATIONS

If this furnace is to replace a Category I type furnace connected to a chimney serving other appliances, steps must be taken to ensure that this furnace and the remaining appliances will vent properly after the removal of the existing furnace. There is a chance that the existing chimney will be too large.

Check the size of the existing vent or chimney. It should be sized as though this is a new installation. If it is not, undertake remedies to correct the size.

Check the condition of the existing vent or chimney. Examine vent or chimney clean-outs to make sure that they remain tightly closed when not in use. Ensure that the vent or chimney passageway is clear and free from obstructions. Look for evidence of condensation damage or deterioration in the vent or chimney. Either of these conditions indicates an inadequate vent. Missing mortar in the top few courses of brick in a masonry chimney is a definite sign of condensation damage.

If the vent or chimney is found to be damaged or inadequate, it must be repaired or replaced. The repaired or replacement vent or chimney must meet the standards prescribed in CAN/GGA-B149, Natural Gas and Propane Installation Code in Canada or ANSI Z223.1 National Fuel Gas Code (NEPA 54), in the United States.

When the new furnace is connected to a common vent, the new furnace and the other appliances connected to the common vent must be tested individually following these steps:

1. Permanently seal any unused openings into the common vent system.
2. Visually inspect the venting system for proper size and horizontal pitch and determine that there is no blockage, restriction, leakage, corrosion, collapsed materials such as fallen bricks, or any other deficiency that could lead to an unsafe condition.
3. Insofar as practical, duplicate winter operating conditions such as closing all windows and doors in the building. If the remaining appliances are in a mechanical room, close the door to the room.
4. Close the fireplace dampers if any.
5. Turn on any appliances that exhaust air to the outdoors on maximum speed. This would include clothes dryers, range hoods, bathroom fans, etc. Attic fans or other fans used only in summer should be exempted from the test.
6. Follow the lighting instructions of the appliance being tested and turn it on to continuous operation.
7. For appliances equipped with draft hoods, test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Detect for spillage using a match flame, taper (candle), or the smoke from a cigarette, cigar or pipe.
8. After it has been proven that each appliance to remain connected to the common venting system properly vents when tested as listed above, return the windows, doors, fireplace dampers, appliances, etc. to the condition they were in prior to the test.
9. If improper venting is observed during any of the tests, the common venting system must be re-sized. In Canada, refer to the latest addition if CAN/GGA-B149, Natural Gas and Propane Installation Code. In the United States, refer to the latest ANSI Z223.1 National Fuel Gas Code (NEPA 54), or AGA-GAMA Venting Tables for Category I furnaces.

# GAS SUPPLY & PIPING

## GAS SUPPLY

### **⚠ WARNING**

THIS FURNACE IS FACTORY EQUIPPED TO BURN NATURAL GAS ONLY.

CONVERSION TO L.P. GAS REQUIRES SPECIAL KIT No. 28851.

FAILURE TO USE THE PROPER CONVERSION KIT CAN CAUSE FIRE, EXPLOSION, CARBON MONOXIDE POISONING, PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.

### **⚠ IMPORTANT:**

Conversion of this furnace requires specialized equipment. Conversion must be completed by a trained and qualified installer, service agency or gas supplier.

### **⚠ IMPORTANT:**

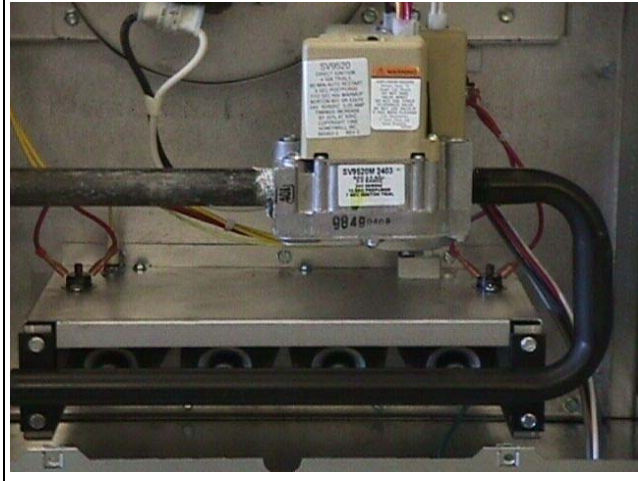
Connect this furnace only to gas supplied by a commercial utility or supplier. Private gas wells do not generally provide gas with consistent, uniform and predictable heating values and densities. Many non-commercial wells contain impurities such as sulphur, which may damage the furnace. This furnace cannot operate properly or safely using fuels outside normal commercial standards.

## GAS PIPING

In Canada, the gas piping should be installed in accordance with CAN/CGA-B149, and in accordance with any local codes.

In the United States, the gas piping should be installed in accordance with NFPA 54 / ANSI Z223.1 and any local codes.

Figure 8: Furnace Gas Pipe Connection



The gas piping may enter the furnace from either side; however, the left hand side is the standard configuration. If the right side is to be used, interchange the plug from the right hand side and the grommet from the left hand side.

Install a BMI ground joint union between the gas valve and the side panel to allow easy removal of the burner for service purposes.

**⚠ IMPORTANT:** Always use a backup wrench to prevent twisting of the control assembly and gas valve. Any strains on the gas valve can affect positioning of the orifices relative to the burners. This could result in faulty burner operation.

Install a manual gas shut-off valve and dirt pocket as close to the furnace as possible. Some local codes call for the manual gas shut-off valve to be located between 4 to 5 feet above floor level to prevent tampering by small children. Ensure that the valve is readily accessible.

**⚠ IMPORTANT:** Ensure that the manual shut-off valve and gas valve are not subjected to high pressures.

**Disconnect the manual shut-off valve and gas valve during any pressure testing that exceeds ½ p.s.i.g. (3.45 kPa).**

## GAS INLET PRESSURE

The natural gas inlet supply pressure should be 5 to 7 inches water column; 7 in. w.c. is recommended.

The L.P. gas inlet supply pressure should be 11 to 14 inches water column; 12 in. w.c. is recommended.

These pressures must be maintained while all other gas fired appliances are operating at maximum conditions.

Do not exceed 14 inches w.c. inlet pressure with either fuel.

The gas valve has an adjustable internal regulator for controlling burner manifold pressure. Burner manifold pressure is listed on the furnace rating plate.



## LEAK TESTING

All new gas piping installations should be pressure tested as specified by CAN/CGA-B149 or NFPA 54 ANSI Z223.1 or ANSI/NFPA 58, *Standard for the Storage and Handling of Liquefied Petroleum Gases*.

Gas piping that has not been pressure tested, from the manual shut-off valve to the furnace gas valve for example, should be leak tested using an electronic combustible gas detector, a commercially prepared leak detector such as *Gas Leak Detector*<sup>®</sup> or *Search*<sup>®</sup>, or other locally approved method. A leak detector solution can be prepared by mixing a small quantity of dish detergent with water and daubing it onto the gas piping; especially the joints.

## PURGING GAS LINES

### **⚠ WARNING**

**NEVER PURGE A GAS LINE INTO THE COMBUSTION CHAMBER.**

**NEVER USE A MATCH, TAPER, CIGARETTE LIGHTER, FLAME OR ANY OTHER IGNITION SOURCE TO CHECK FOR LEAKS IN A GAS LINE.**

**FAILURE TO ADHERE TO THIS WARNING CAN CAUSE A FIRE OR EXPLOSION RESULTING IN PROPERTY DAMAGE, PERSONAL INJURY, OR LOSS OF LIFE.**

## CONVERSIONS

### HIGH ALTITUDE

In Canada, the furnace may be converted for high altitude (2000 - 4500 feet) by changing the burner orifices. Use Kit No. 28882. The kit contains both natural gas and L.P. gas orifices; see Table 5.

In the United States, the modifications for high altitude are based on a 4 per cent reduction of input capacity for every 1000 feet above sea level. Table 6 illustrates the impact of altitude for selected elevations. Ratings shown apply to the highest elevation in range. Consult with local fuel suppliers or authorities to determine local regulations or customs.

**TABLE 5: HIGH ALTITUDE SPECIFICATIONS - CANADA**

MODEL	ALTITUDE feet	INPUT BTU/hr	OUTPUT BTU/hr	NAT. ORIFICE	L.P. ORIFICE	QTY
GTM-050	0 - 2000	50,000	40,000	1.95 mm	1.20 mm	3
	2000 - 4500	45,000	36,000	1.90 mm	1.15 mm	
GTM-070	0 - 2000	68,000	54,400	1.95 mm	1.20 mm	4
	2000 - 4500	61,200	48,960	1.90 mm	1.15 mm	
GTM-085	0 - 2000	85,000	68,000	1.95 mm	1.20 mm	5
	2000 - 4500	76,500	61,200	1.90 mm	1.15 mm	
GTM-100	0 - 2000	100,000	80,000	1.95 mm	1.20 mm	6
	2000 - 4500	90,000	72,000	1.90 mm	1.15 mm	

**TABLE 6: HIGH ALTITUDE SPECIFICATIONS - UNITED STATES**

MODEL	ALTITUDE feet	INPUT BTU/hr	OUTPUT BTU/hr	NAT. ORIFICE	L.P. ORIFICE	QTY
GTM-050	0 - 2000	50,000	40,000	1.95 mm	1.20 mm	3
	2000 - 3000	44,000	35,200	1.83 mm	1.13 mm	
	3000 - 4000	42,000	33,600	1.79 mm	1.10 mm	
	4000 - 5000	40,000	32,000	1.74 mm	1.07 mm	
	5000 - 6000	38,000	30,400	1.70 mm	1.05 mm	
GTM-070	0 - 2000	68,000	54,400	1.95 mm	1.20 mm	4
	2000 - 3000	59,840	47,872	1.83 mm	1.13 mm	
	3000 - 4000	57,120	45,696	1.79 mm	1.10 mm	
	4000 - 5000	54,400	43,520	1.74 mm	1.07 mm	
	5000 - 6000	51,680	41,344	1.70 mm	1.05 mm	
GTM-085	0 - 2000	85,000	68,000	1.95 mm	1.20 mm	5
	2000 - 3000	74,800	59,840	1.83 mm	1.13 mm	
	3000 - 4000	71,400	57,120	1.79 mm	1.10 mm	
	4000 - 5000	68,000	54,400	1.74 mm	1.07 mm	
	5000 - 6000	64,600	51,680	1.70 mm	1.05 mm	
GTM-100	0 - 2000	100,000	80,000	1.95 mm	1.20 mm	6
	2000 - 3000	88,000	70,400	1.83 mm	1.13 mm	
	3000 - 4000	84,000	67,200	1.79 mm	1.10 mm	
	4000 - 5000	80,000	64,000	1.74 mm	1.07 mm	
	5000 - 6000	76,000	60,800	1.70 mm	1.05 mm	

### NATURAL TO L.P. GAS

The GTM Series furnace is manufactured as a natural gas (sea level) appliance. It may be converted to L.P. gas with the use of Kit No. 28851. The kit contains the orifices needed for all GTM models, the regulator spring for the gas valve, and a label to affix adjacent to the appliance rating plate to alert subsequent service technicians of the conversion.

### L.P. TO NATURAL GAS

Although the furnace is manufactured initially as a natural gas appliance, if after an L.P. Gas conversion it becomes necessary to convert back to natural gas, and if the original parts are unavailable, Kit No. 28852 may be purchased. It is similar in nature and content to the L.P. Gas conversion kit.

## CONVERSION STEPS

To convert from sea level to high altitude, from natural gas to L.P. gas, or from L.P. gas to natural gas, follow these steps:

1. Turn off gas supply to the furnace if applicable.
2. Shut off electrical power to the furnace if applicable.
3. Remove the upper front door to expose the gas train and burner assembly.
4. Unfasten the ground joint union between the gas valve and gas supply piping if applicable.
5. Unfasten the burner manifold pipe from the burner assembly. It is held in place by 2 screws on either end of the manifold pipe.
6. Remove the existing orifices with a 7/16 inch socket, box or open end wrench. Install the replacement orifices. The orifice spuds are brass, and do not normally require pipe dope. A light grease may be used to lubricate the threads. The orifice spuds have taped threads; do not over-tighten them.

If completing a fuel conversion, remove the protective screw cap from the gas valve regulator adjustment. Remove the regulator adjustment screw by turning it counter-clockwise. Remove the existing regulator spring.

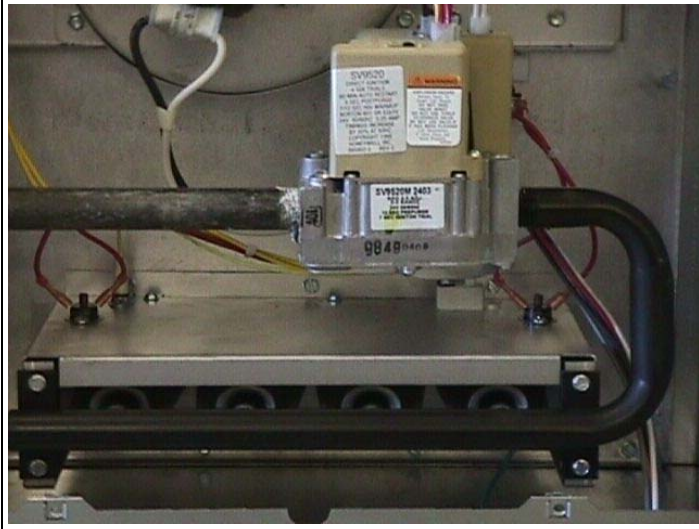
7. Install the new regulator spring. **NOTE:** If converting the Honeywell gas valve, the regulator spring is tapered. The tapered end (small end) is inserted back into the gas valve regulator adjustment cavity.

Re-install the adjustment. Give it 3 full clockwise turns initially. Do not re-install the protective screw cap yet.

8. Re-install the burner manifold pipe assembly following steps 4, 5, and 6 in reverse order.

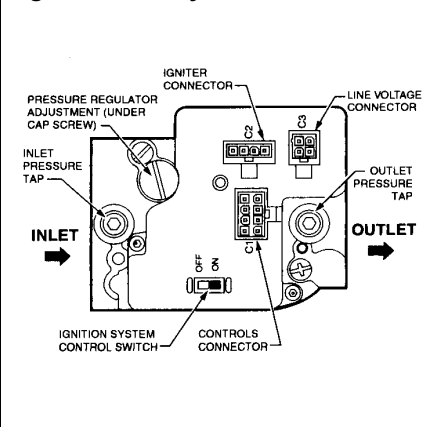
If, in all other respects the furnace is ready to be fired, continue with the following steps. If not, complete the remainder of the installation then return to these steps before starting the *Start-up & Set-up* section.

**Figure 9: Inshot Burner Assembly**



## SETTING THE GAS PRESSURE

**Figure 10: Honeywell Gas Valve**



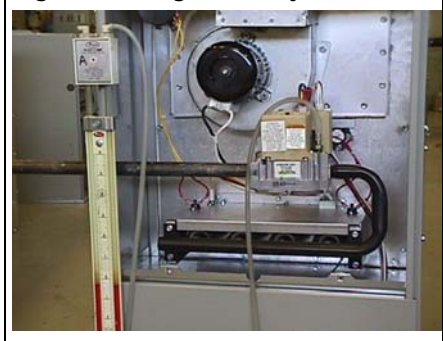
1. Remove the manifold pressure tap plug from the gas valve with a 3/16 inch Allen wrench. Install a 1/8" MPT to 1/8" barb fitting.
2. Connect a U-tube manometer to the gas valve pressure tap adapter fitting. The manometer should be capable of reading 0 - 15 inches water column.
3. Turn on the gas supply and electrical power to the furnace.
4. Start the furnace.
5. Note the gas manifold pressure. It should be:

**Natural Gas: 3.5 inches water column.**

**L.P. Gas: 10 inches water column.**

6. Turn the adjustment screw clockwise to increase manifold pressure or counter-clockwise to reduce manifold pressure.
7. When the correct pressure has been established, securely replace the regulator protective screw cap.
8. If the pressure remains steady and on target after tightening the cap, shut off the gas at the manual valve and remove the U-tube manometer.
9. Remove the barb adapter and replace the pressure tap plug.

**Figure 11: Regulator Adjustment**



If problems were encountered with obtaining enough pressure on the manifold, first examine the gas piping system to ensure that it is correctly sized. Pipe sizing is specified in CAN/CGA-B-149, and in NFPA 54 / ANSI Z223.1. Be sure to check for restrictions, partially closed valves, etc.

When the installation is completed to Start-up & Set-up stage, test the gas input pressure by following these steps:

1. Remove the inlet pressure tap plug from the gas valve with a 3/16 inch Allen wrench. Install a 1/8" MPT to 1/8" barb fitting.
2. Connect a U-tube manometer to the gas valve pressure tap adapter fitting. The manometer should be capable of reading 0 - 15 inches water column.
3. Turn on the gas supply and electrical power to the furnace.
4. Start the furnace, and any other gas burning appliances on the same gas piping system.
5. Note the gas inlet pressure. It should be:

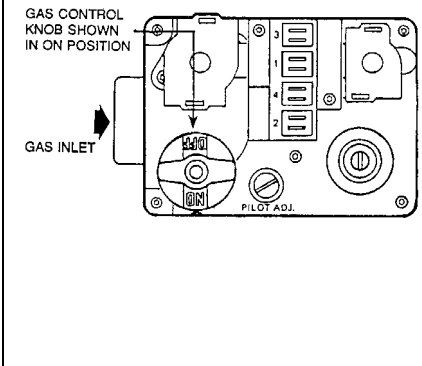
**Natural Gas: 5 to 7 inches water column.**

**L.P. Gas: 11 to 14 inches water column.**

6. If working on a natural gas system, contact the gas utility. They may insist on any service regulator adjustments being made by their own staff.

If working on a propane system, consult the fuel supplier. They too may insist on any service regulator adjustments being completed by their own staff. If permission is granted to adjust the regulator, adjustments are made in a similar fashion as the gas valve regulator. Turn the adjustment screw clockwise to increase manifold pressure or counter-clockwise to reduce manifold pressure.

**Figure 12: White-Rodgers gas valve**



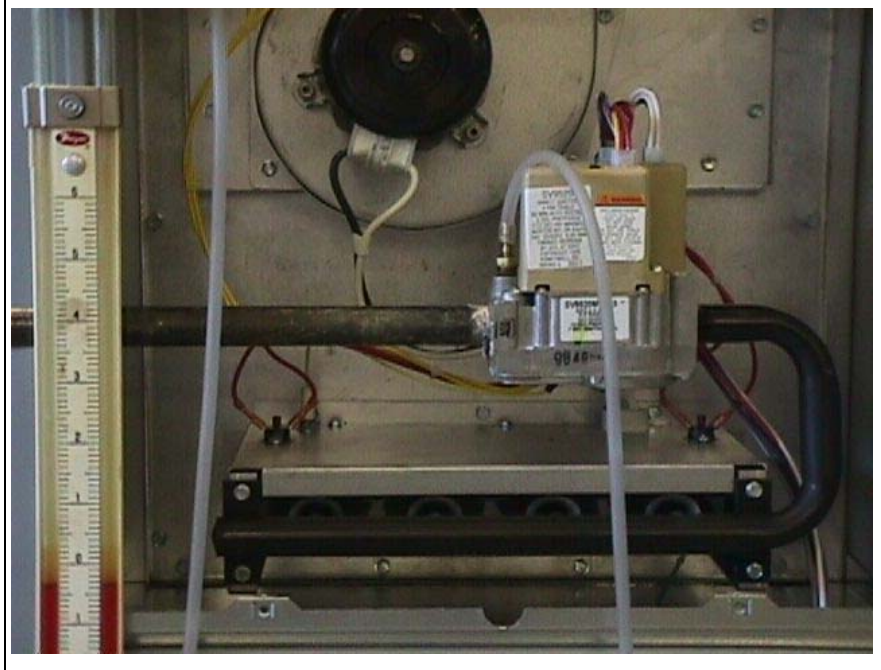
**WARNING**

**ALL REGULATOR ADJUSTMENTS MUST BE DONE BY A TRAINED, QUALIFIED TECHNICIAN. IMPROPER MODIFICATIONS OR ADJUSTMENTS CAN RESULT IN FIRE OR EXPLOSION CAUSING PROPERTY DAMAGE, SEVERE PERSONAL INJURY OR LOSS OF LIFE.**

7. When the correct pressure has been established, securely replace the service regulator protective screw cap.
8. Shut off the gas at the manual valve and remove the U-tube manometer.
9. Remove the barb adapter and replace the pressure tap plug.
10. Re-check, and adjust if necessary, burner manifold pressure if changes were made to the inlet pressure.

In some circumstances, high inlet pressure can be remedied with the use of an inline appliance regulator. If an inline appliance regulator is used, ensure that it has the capacity to adequately handle the gas volume required by the furnace and any other appliances receiving gas from the header serving the furnace.

**Figure 13: Manometer measuring gas inlet pressure.**



# ELECTRICAL WIRING & CONNECTIONS

## ELECTRICAL SPECIFICATIONS

Before proceeding with the electrical connections, ensure that the available electrical supply is compatible with the voltage, frequency and phase listed on the appliance rating plate.

All GTM Series furnaces are rated 120 vac, 60 Hz, 1 Ø. The amperage rating is 12 amps or less.

Each furnace requires a dedicated 15 amp over-current device; either a 15 amp circuit breaker or a 15 amp Type D, time delay fuse. It is permissible to connect furnace accessories such as humidifier transformers, condensate pumps and electronic air cleaners. If adding accessory equipment to the furnace circuit, ensure that the combined amperages listed on the appliance rating plates does not exceed the rating of the over-current device.

### **WARNING**

**SHUT OFF ELECTRICAL POWER AT THE FUSE BOX OR SERVICE PANEL BEFORE MAKING ANY ELECTRICAL CONNECTIONS. FAILURE TO DO SO CAN CAUSE ELECTRICAL SHOCK RESULTING IN PERSONAL INJURY OR LOSS OF LIFE.**

### **WARNING**

- THE FURNACE CABINET MUST HAVE AN UNINTERRUPTED GROUND.
- A GROUND WIRE IS PROVIDED IN THE ELECTRICAL JUNCTION BOX.
- DO NOT USE GAS PIPING AS A GROUND.

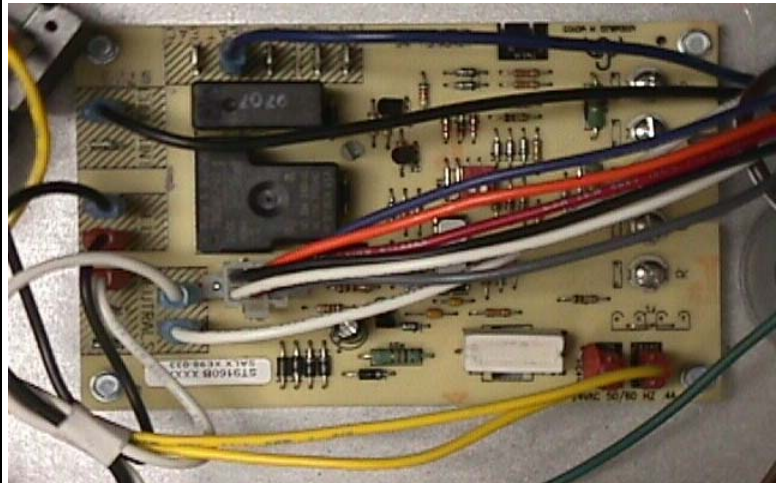
**FAILING TO GROUND THE FURNACE PROPERLY CAN RESULT IN ELECTRIC SHOCK RESULTING IN PERSONAL INJURY OR DEATH.**

In Canada, all electrical work must be in accordance with the latest edition of CSA-C22.1, Canadian Electrical Code Part 1, and any applicable local code.

Figure 14: Electrical Connections / Molex Connector



Figure 15: Honeywell Control Board with Wiring



In the United States, all electrical work must be in accordance with the latest edition of the National Electrical Code, ANSI / NFPA 70.

Although a suitably located circuit may serve as a service switch, a separate service switch is recommended. A separate service switch is necessary if the circuit breaker is in a location where accessing it would require getting close to the furnace, or if the furnace is located between the main electrical panel and the entry to the furnace

room. The furnace switch (service switch) should be clearly labeled, and installed in a location where it is not likely to be mistaken as being a light switch or similar control.

## FURNACE CONNECTION

**120V:** The furnace is shipped fully wired except for the connections to the house wiring. The furnace power connections are made in a junction box inside the blower compartment. The junction box is factory installed on the

left hand side; however, it may be moved to the right hand side. The junction box contains a BLACK wire to be connected with L1 (hot), a WHITE wire to be connected with L2, the Neutral, and a GREEN wire to be connected to the ground.

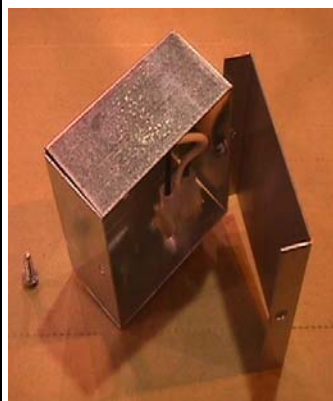
Use good quality wire nuts; e.g. Marrette® connectors, Ideal® wire nuts, etc.

**IMPORTANT:  
USE COPPER CONDUCTORS ONLY.**

If the junction box must be moved to the right hand side:

1. Unfasten the junction box from the left hand side.
2. Remove the right side panel knock-out.
3. Remove the junction box cover hook screw and re-install it on the opposite side of the box; see Figure 16.
4. Fasten the junction box to the right hand panel.

**Figure 16: Junction Box**



**NOTE:** L1 (hot) and L2 (Neutral) polarity must be observed when making field connections to the furnace. The ignition control may not sense flame if L1 and L2 are reversed. The ground is also essential.

**IMPORTANT:**  
Electrical wiring and components must be protected from moisture including water and condensate.

**WARNING**

**THIS FURNACE IS EQUIPPED WITH A BLOWER DOOR SAFETY SWITCH. DO NOT DISABLE THIS SWITCH. FAILURE TO FOLLOW THIS WARNING CAN RESULT IN ELECTRICAL SHOCK, PERSONAL INJURY, OR LOSS OF LIFE.**

**LOW VOLTAGE WIRING**

The low voltage terminals are located in the control box mounted to the blower assembly; see Figure 15.

The furnace is pre-wired for air conditioning. Insert the thermostat and air conditioner contactor low voltage wiring through the bushing provided in the side panel. Route the control wiring through the control box panel to gain access to the 24 volt terminal screws.

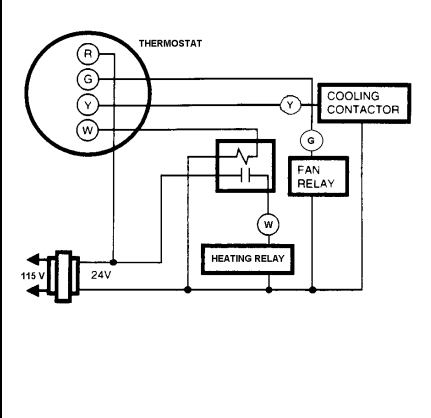
**THERMOSTAT**

The room thermostat must be compatible with the integrated control in the furnace. Electro-mechanical thermostats should be rated 30 V / 1.5 amps.

Most electronic or microprocessor based thermostats except those with “current robbing” circuits should work satisfactorily. Consult the instructions of the thermostat manufacturer for technical and installation details.

Most compatibility problems can be overcome by the use of an isolation relay. The isolation relay should be SPST with a 24 volt coil. The switch ratings should be a minimum of 0.5 amps; see Figure 17.

**Figure 17: Isolation Relay**



The thermostat and control wiring should be a minimum of 18 AWG copper. Excessive lengths of wire may result in enough voltage drop to impair the proper functioning of the furnace. For thermostat wires in excess of 25 feet, use 16 AWG; 50 feet, use 14 AWG.

**THERMOSTAT LOCATION**

The thermostat should be located approximately 5 feet above the floor, on an inside wall where there is good natural air circulation, and where the thermostat will be exposed to average room temperatures. Avoid locations where the thermostat will be exposed to cold drafts, heat from nearby lamps or appliances, exposure to sunlight, heat from inside wall stacks, etc.

**THERMOSTAT HEAT ANTICIPATOR SETTING: 0.1 AMP (Honeywell)**

**ACCESSORIES**

**FIELD SUPPLIED AND INSTALLED OPTIONAL ACCESSORIES**

**ELECTRONIC AIR CLEANER**

Both the Honeywell and White-Rodgers control modules have provisions to supply power and control an electronic air cleaner rated at 120vac, 1.0 amp max.

ST9160B: Line voltage for an electronic air cleaner may be picked up from the “EAC” terminal (L1 - Hot) and from one of the “NEUTRALS” terminals (L2 - Neutral). 120 volt power will be available at these terminals whenever the circulating fan is operating in the heating or cooling modes.

50A65: Line voltage for an electronic air cleaner may be picked up from the “HOT 120V AC” “EAC” terminal (L1 - Hot) and from the “NEUTRAL 120V AC” “EAC” terminal (L2 - Neutral). 120 volt power will be available at these terminals whenever the circulating fan is operating in the heating or cooling modes.

**POWER HUMIDIFIER**

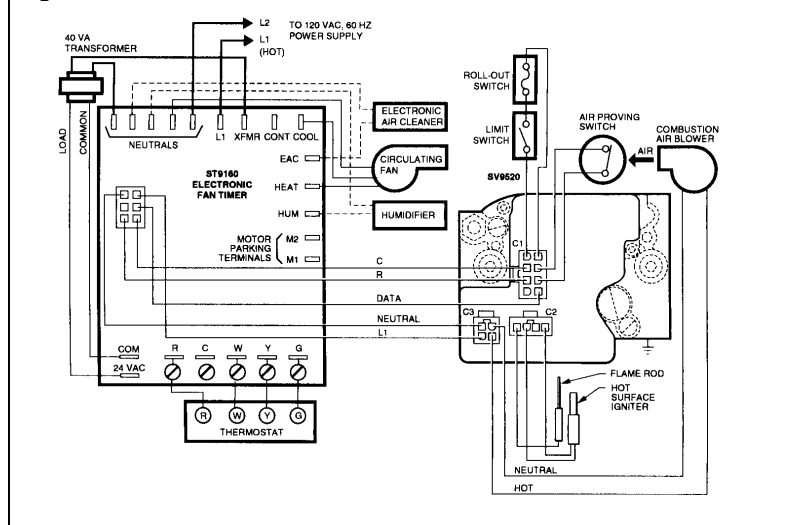
Both the Honeywell and White-Rodgers control modules have provisions to supply power and to control a line voltage humidifier or the primary of a 120 / 24 volt humidifier step down transformer, rated at 120vac, 1.0 amp max.

ST9160B: Line voltage for a humidifier may be picked up from the "HUM" terminal (L1 - Hot) and from one of the "NEUTRALS" terminals (L2 - Neutral). 120 volt power will be available at these terminals whenever the circulating fan is operating in the heating mode.

50A65: Line voltage for a humidifier may be picked up from the "HOT 120V AC" "HUM" terminal (L1 - Hot) and from the "NEUTRAL 120V AC" "HUM" terminal (L2 - Neutral). 120 volt power will be available at these terminals whenever the circulating fan is operating in the heating mode.

**⚠ NOTE:** All HUM and EAC terminals are 120v. Do not directly connect 24v equipment to them.

Figure 18: ST9160B/SV9520M



## START UP PROCEDURES

This furnace is equipped with a hot surface ignition (HSI) device. Each time that the room thermostat calls for heat, the HSI lights the main burners directly. See the lighting instructions on the furnace.

### TO START THE FURNACE:

1. Remove the burner compartment access door.
  2. **IMPORTANT:** If equipped with the White-Rodgers 36E36 gas valve, ensure that the manual gas control knob has been in the "OFF" position for at least 5 minutes. Do not attempt to manually light the main burners.
  3. Shut off the electrical power to the furnace and set the room thermostat to its lowest setting.
  4. If equipped with a Honeywell SV9520M gas valve, ensure that the ignition system control switch is in the "ON" position.
- If equipped with a White-Rodgers 36E36 gas valve, turn the gas control knob to the "ON" position.
5. Replace the burner compartment access door.

6. Restore electrical power to the furnace.
7. Set the room thermostat to a point above room temperature to light the furnace.
8. After the burners are lit, set the room thermostat to the desired temperature.

### TO SHUT DOWN THE FURNACE:

1. Set the room thermostat to its lowest setting.
  2. Remove the burner compartment access door.
  3. If equipped with the White-Rodgers 36E36 gas valve, turn the gas control knob to the "OFF" position.
- If equipped with a Honeywell SV9520M gas valve, the ignition system control switch may be switched to the "OFF" position.
4. The furnace appliance shut-off valve may be closed if desired.

### ⚠ WARNING

**SHOULD OVER-HEATING OCCUR, OR THE GAS BURNERS FAIL TO SHUT OFF, CLOSE THE MANUAL GAS VALVE FOR THE FURNACE BEFORE SHUTTING OFF THE ELECTRICAL POWER TO THE FURNACE. FAILURE TO DO SO CAN CAUSE AN EXPLOSION OR FIRE RESULTING IN PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.**

## SEQUENCE OF OPERATION

### HONEYWELL SYSTEM

#### SV9520M Smart Valve & ST9160B Fan Timer Board.

1. Room temperature drops causing the room thermostat heating contacts to close.
2. The induced blower begins a pre-purge cycle of 15 seconds.
3. The pressure switch contacts close.
4. After the pre-purge period, the hot surface igniter heats up; 5 seconds on a first try, 10 seconds on a subsequent retry.
5. The gas valve opens for a 7 second trial for ignition. The igniter shuts off. The gas burners light. *(See next section for sequence of operation in the event of a flame failure).*
6. The circulating fan begins 30 seconds after the trial for ignition.
7. Furnace continues to run in this state until the room thermostat heating contacts open in response to raised room temperature.
8. With the thermostat heating contacts open, the burner flames extinguish immediately, the induced blower stops after a 5 second post-purge period. The pressure switch contacts open.
9. The circulating fan continues to run until timed out in 60 to 150 seconds, depending on the ST9160B dip switch settings.

#### Sequence if the furnace does not light up or detect flame:

1. Room temperature drops causing the room thermostat heating contacts to close.
2. The induced blower begins a pre-purge cycle of 15 seconds.
3. If pressure switch contacts are closed; and have failed to open since the last cycle, all subsequent steps will fail to occur.
4. The pressure switch contacts close. The pressure switch contacts must close within 30 seconds. If they fail to do so, the in-

duced blower will shut off for a five minute period, then the sequence will begin again at Step 2.

5. After the pre-purge period, and after pressure switch contacts have closed, the hot surface igniter heats up; 5 seconds on a first try, 10 seconds on a subsequent retry.
6. The gas valve opens for a 7 second trial for ignition. If the burners fail to light, or if the flame is not sensed, the gas valve closes, and, providing that there have been less than 4 trials for ignition, sequence returns to Step 5. If this was the 4th trial for ignition, the ignition sequence goes into a 5 second post-purge; the induced blower stops, and after a brief delay (within 150 seconds), the circulating fan stops.
7. The ignition system goes into a 60 minute lock-out condition, then re-attempts the sequence at Step 2.

In addition, if during the burner firing, the flame signal is lost, the gas valve will close and the ignition sequence will begin again at Step 4. If the flame sensing signal is lost more than 5 times during a furnace cycle, the gas valve will close, and the ignition sequence goes into a 5 second post-purge; the induced blower stops, and after a brief delay (within 150 seconds), the circulating fan stops. The ignition system goes into a 60 minute lock-out condition, then re-attempts the sequence at Step 2.

The 60 minute lock-out sequence will repeat itself indefinitely. The 60 minute lock-out may be interrupted by lowering the room thermostat setting below room temperature for approximately 10 seconds, or shutting off the electrical supply to the furnace for approximately 10 seconds.

8. The circulating fan begins 30 seconds after the first trial for ignition.
9. Furnace continues to run in this state until the room thermostat heating contacts open in response to raised room temperature.
10. With the thermostat heating contacts open, the burner flames extinguish immediately, the induced blower stops after a 5 second

post-purge period. Pressure switch contacts open.

11. The circulating fan continues to run until timed out in 60 to 150 seconds, depending on the ST9160B dip switch settings.

Additional information is available in the Troubleshooting section of this manual.

### WHITE-RODGERS SYSTEM

#### 50A65 Integrated Control Module and 36E36 Gas Valve.

1. Room temperature drops causing the room thermostat heating contacts to close.
2. The induced blower begins a pre-purge cycle of 30 seconds.
3. The pressure switch contacts close.
4. After the pre-purge period, the hot surface igniter heats up for 20 seconds.
5. The gas valve opens for a 5 second trial for ignition. The gas burners light and the igniter shuts off. *(See next section for sequence of operation in the event of a flame failure).*
6. The circulating fan begins 30 seconds after a successful trial for ignition.
7. Furnace continues to run in this state until the room thermostat heating contacts open in response to raised room temperature.
8. With the thermostat heating contacts open, the burner flames extinguish immediately, the induced blower stops after a 5 second post-purge period. Pressure switch contacts open.
9. The circulating fan continues to run until timed out in 60 to 180 seconds, depending on the 50A65 dip switch settings.

**Sequence if the furnace does not light up or detect flame:**

1. Room temperature drops causing the room thermostat heating contacts to close.
2. The induced blower begins a pre-purge cycle of 15 seconds.
3. If pressure switch contacts are closed; and have failed to open since the last cycle, all subsequent steps will fail to occur.
4. The pressure switch contacts close. *If pressure switch contacts fails to close, the ignition sequence will not continue.*
5. After the pre-purge period, the hot surface igniter heats up for 20 seconds.
6. The gas valve opens for a 5 second trial for ignition. The gas burners light and the igniter shuts off. If the burners fail to light, or if the flame is not sensed, the gas valve closes, and, providing that there have been less than 4 trials for ignition, sequence returns to Step 5. There is a 60 second inter-purge between trials. If this was the 4th trial for ignition, the ignition sequence goes into a 62 minute soft lock-out. After a 15 second post-purge; the induced blower stops, and both sets of pressure switch contacts open.
7. The 62 minute lock-out will repeat up to 3 times before going into a hard lock-out. The hard lock-out is canceled by either lowering the room thermostat setting below room temperature for approximately 10 seconds, or interrupting the electrical power supply to the furnace for approximately 10 seconds.
8. The circulating fan begins 30 seconds after a successful trial for ignition.
9. Furnace continues to run in this state until the room thermostat heating contacts open in response to raised room temperature.
10. With the thermostat heating contacts open, the burner flames extinguish immediately, the induced blower stops after a 5 second post-purge period. The pressure switch contacts open.

11. The circulating fan continues to run until timed out in 60 to 180 seconds, depending on the 50A65 dip switch settings.

**CHECKING FURNCE INPUT**

The natural gas supply pressure should be a maximum of 7" w.c. and minimum of 5" w.c.

The burner manifold pressure is normally set to 3.5" w.c.

The input rating of the furnace is based on 1075 / cu. ft. gas with a specific gravity of 0.60.

Since heating values for the gas vary geographically, the actual furnace input and output will vary accordingly.

For example, natural gas with a 1000 BTU / cu. ft. heating value will reduce the input to 93% of the rated input. Natural gas with a 1100 BTU / cu. ft. heating value will increase the input to approximately 103% of the rated input. This is not usually a problem; however, adjustments to compensate for this can be made by minor adjustments to the burner manifold pressure or by changing the burner orifice size.

Any adjustments to the burner manifold pressure should be carried out with the use of a manometer or calibrated magnehelic gauge. Do not adjust the gas valve pressure regulator more than ± 0.30 inches water column.

**IMPORTANT:** Never adjust the input of the furnace to exceed the input shown on the rating plate.

In the previous example where the heating value of the gas is 1100 BTU / cu. ft., the burner manifold pressure can be reduced 3 % to 3.4" w.c., which is within the ± 0.30" w.c. specification to bring the input into compliance. Refer also to *Setting the Gas Pressure*, and *High Altitude* in the Gas Supply & Piping section of this manual. Contact the fuel supplier for specific gas heating content values.

TABLE 7 on the following page may be used to evaluate furnace input with a gas meter.

If using a gas meter to check the furnace input, be sure that all gas fired appliances other than the furnace are off during the test.

The formula for determining the furnace input via the gas meter test dial is:

$$\text{input} = \frac{\text{heating value of gas} \times 3600}{\text{Time in Sec. for 1 cu. ft}}$$

where:

Input is expressed in BTU / Hr.

Heating value of the gas is expressed in BTU / cubic feet

Time means time required for the test dial to indicate 1 cubic foot in seconds.

If using a gas meter with SI (metric) units:

1 cubic foot = 0.0283 cubic metres.

1 cubic metre = 35.315 cubic foot.

0.01cubic metre = 0.3531 cubic foot.

0.5 cubic metre = 1.766 cubic feet.

TABLE 7 shows the actual input of the furnace based on the heating value of the natural gas in BTU / ft<sup>3</sup>.

TABLE 8 shows the meter timings when the furnace is running at rated input, with respect to the heating value of the gas.



TABLE 7: INPUT VALUES

MODEL	INTERVAL TO CONSUME 1 FT <sup>3</sup>	HEATING VALUE OF NATURAL GAS in BTU / FT <sup>3</sup>				
	(SECONDS)	900	950	1000	1050	1100
GTM-050	72	41,860	44,186	46,512	48,837	51,163
GTM-070	51	58,605	61,860	65,116	68,372	71,628
GTM-085	42	71,163	75,116	79,070	83,023	86,977
GTM-100	36	83,721	88,372	93,023	97,674	102,326
$\text{Input BTU/Hr} = \frac{\text{Heating Value of Gas (BTU/Cu.Ft.)} \times 3600}{\text{Time in Seconds (for 1cu. ft.) of Gas}}$						

TABLE 8: GAS METER TIMINGS

METER TEST DIAL TIMINGS FOR FULL RATED INPUT													
MODEL	METER TEST DIAL	HEATING VALUE OF GAS - BTU / FT <sup>3</sup>											
		900		950		1000		1050		1100		2520 (L.P.)	
		MIN	SEC	MIN	SEC	MIN	SEC	MIN	SEC	MIN	SEC	MIN	SEC
GTM-050	1/4 ft <sup>3</sup>	-	15	-	16	-	17	-	18	-	18	-	42
	1/2 ft <sup>3</sup>	-	30	-	32	-	33	-	35	-	37	1	24
	1 ft <sup>3</sup>	1	0	1	4	1	7	1	10	1	14	2	49
	2 ft <sup>3</sup>	2	1	2	7	2	14	2	21	2	27	5	38
	0.01 m <sup>3</sup>	-	21	-	22	-	24	-	25	-	26	-	60
	0.05 m <sup>3</sup>	1	46	1	52	1	58	2	4	2	10	4	58
GTM-070	1/4 ft <sup>3</sup>	-	11	-	11	-	12	-	13	-	13	-	30
	1/2 ft <sup>3</sup>	-	22	-	23	-	24	-	25	-	26	-	60
	1 ft <sup>3</sup>	-	43	-	45	-	48	-	50	-	53	2	1
	2 ft <sup>3</sup>	1	26	1	31	1	36	1	40	1	45	4	2
	0.01 m <sup>3</sup>	-	15	-	16	-	17	-	18	-	19	-	43
	0.05 m <sup>3</sup>	1	16	1	20	1	24	1	29	1	33	3	33
GTM-085	1/4 ft <sup>3</sup>	-	9	-	9	-	10	-	10	-	11	-	25
	1/2 ft <sup>3</sup>	-	18	-	19	-	20	-	21	-	22	-	50
	1 ft <sup>3</sup>	-	35	-	37	-	39	-	41	-	43	1	39
	2 ft <sup>3</sup>	1	11	1	15	1	19	1	23	1	27	3	19
	0.01 m <sup>3</sup>	-	13	-	13	-	14	-	15	-	15	-	35
	0.05 m <sup>3</sup>	1	3	1	6	1	10	1	13	1	17	2	55
GTM-100	1/4 ft <sup>3</sup>	-	8	-	8	-	8	-	9	-	9	-	21
	1/2 ft <sup>3</sup>	-	15	-	16	-	17	-	18	-	18	-	42
	1 ft <sup>3</sup>	-	30	-	32	-	33	-	35	-	37	1	24
	2 ft <sup>3</sup>	1	0	1	4	1	7	1	10	1	14	2	49
	0.01 m <sup>3</sup>	-	11	-	11	-	12	-	12	-	13	-	30
	0.05 m <sup>3</sup>	-	53	-	56	-	59	1	2	1	5	2	29

## AIR FLOW

For proper furnace operation, airflow over the heat exchanger is of utmost importance. Insufficient airflow accelerates metal fatigue and failure in the heat exchanger and excessive airflow promotes accelerated corrosion of the heat exchanger.

**IMPORTANT:** Do not bypass this step of the start up procedures.

## TEMPERATURE RISE CHECK

When the duct system is complete and the air filter or filters are in place, determine if the airflow is correct.

1. Insert a duct thermometer in the supply air duct. The thermometer should be placed as close as practical to the furnace, but out of the "line of sight" of the heat exchanger; (this prevents false readings owing to radiant heat). Ensure that the thermometer location is within the duct air stream. Avoid locations such as the inside radius of an elbow, etc.
2. Insert a duct thermometer in the return air duct as close to the furnace as practical. Ensure that the thermometer location will be unaffected by humidifier bypass ducts, etc. Choose a location well within the main air stream.
3. Operate the furnace long enough to obtain steady state conditions.
4. When the two thermometers have stabilized, usually within 5 - 8 minutes, compare the two readings. Subtract the return air temperature from the supply air temperature. The difference is the temperature rise, also called  $\Delta T$ .
5. Compare the measured  $\Delta T$  to the temperature rise range shown on the rating plate.

Unless stated differently on the rating plate, the temperature rise should normally range between 35° to 65°F. When adjusting the temperature rise, the ideal temperature is approximately mid-range.

If the measured  $\Delta T$  is above the approved temperature range, there is too little airflow. The airflow must be increased by selecting a faster fan speed, removing restrictions in the

**TABLE 9: AIR FLOW SPECIFICATIONS**

MODEL GTM – <i>Inlet</i>	FAN HP	SPEED	AIR FLOW - CFM						
			EXTERNAL STATIC PRESSURE - Inches w.c.						
			0.10	0.20	0.30	0.40	0.50	0.60	0.70
050 070 <i>Side</i>	G10-8 DD 1/3	HIGH	1204	1193	1181	1147	1123	1061	996
		MED	851	882	882	866	858	842	801
		LOW	565	571	573	567	555	531	501
050 070 <i>End</i>	G10-8 DD 1/3	HIGH	1248	1226	1187	1135	1086	1035	968
		MED	889	889	886	858	850	818	784
		LOW	565	573	570	567	555	531	491
085 100 <i>Side</i>	G10-10 DD 1/2	HIGH	1728	1656	1572	1475	1390	1290	1169
		M-HI	1573	1512	1448	1389	1300	1204	1086
		M-LO	1141	1141	1123	1099	1061	1009	926
		LOW	768	768	768	750	732	674	589
085 100 <i>End</i>	G10-10 DD 1/2	HIGH	1632	1538	1457	1361	1269	1158	1048
		M-HI	1521	1457	1371	1280	1204	1111	982
		M-LO	1170	1135	1111	1074	1023	954	850
		LOW	768	776	768	732	703	654	566
085 100 <i>Side</i>	GT12- 10 DD 3/4	HIGH	2136	2072	2020	1966	1903	1839	1754
		M-HI	1840	1823	1789	1755	1720	1666	1610
		M-LO	1721	1712	1685	1648	1611	1573	1493
		LOW	1453	1443	1432	1389	1367	1321	1251
085 100 <i>End</i>	GT12- 10 DD 3/4	HIGH	1967	1904	1856	1772	1720	1648	1572
		M-HI	1839	1772	1702	1648	1611	1534	1473
		M-LO	1755	1685	1648	1592	1544	1473	1410
		LOW	1535	1494	1432	1389	1345	1275	1215

ductwork, or adding supply or return ductwork.

If the measured  $\Delta T$  is too low, there is too much airflow. Use a lower speed tap on the multi-speed motor.

## CALCULATING AIRFLOW

There are circumstances where it may be desirable to know the airflow delivery through the duct system, such as when estimating the amount of airflow available for air conditioning. This can be done by direct measurement with electronic or sloped manometers and

velometers, or by using the formulae below.

$$Cfm = \frac{\text{Bonnet Output}}{1.085 \times \Delta T}$$

Where:

Cfm is airflow in cubic feet per minute

$\Delta T$  is the temperature rise

Bonnet output is the furnace output capacity from the rating plate.

NOTE: The bonnet output will vary directly with the input. If the actual input is below the stated input, the output will be reduced in the same ratio.

### ADJUSTING BLOWER SPEEDS

If the blower speeds require adjusting, follow these steps:

#### **⚠ WARNING**

DISCONNECT THE ELECTRICAL SUPPLY TO THE FURNACE BEFORE ATTEMPTING TO CHANGE THE BLOWER SPEED. FAILURE TO DO SO COULD RESULT IN ELECTRICAL SHOCK RESULTING IN PERSONAL INJURY OR LOSS OF LIFE.

1. Remove the blower compartment door.
2. Unfasten the two sheet metal screws securing the blower assembly to the blower division panel.
3. Slide the blower assembly out far enough to access the motor electrical wiring.
4. If the motor is equipped with a power block, remove the blue wire from the existing terminal and re-install it on the desired terminal.

If the motor has permanent leads, the speed is changed at the control module. Remove the wire from the "HEAT" terminal of the control module (ST9160B or 50A65) and plug in the desired wire on the HEAT" terminal. When this configuration is used, the following color codes are used: Black - High Speed, Blue - Medium-High

#### Figure 19: Piggy-back Connector

Remove blue wire from HEAT terminal, tape it off, replace it with a jumper. Connect the black wire and jumper to COOL.

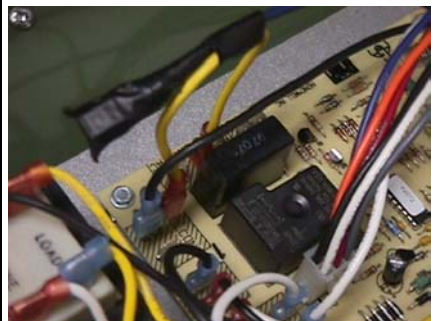


Figure 20: Honeywell ST9160B Dip Switch Settings

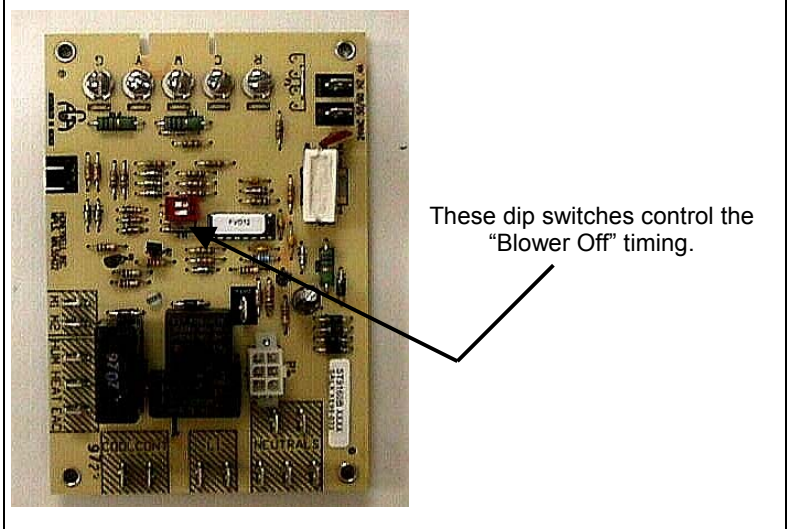
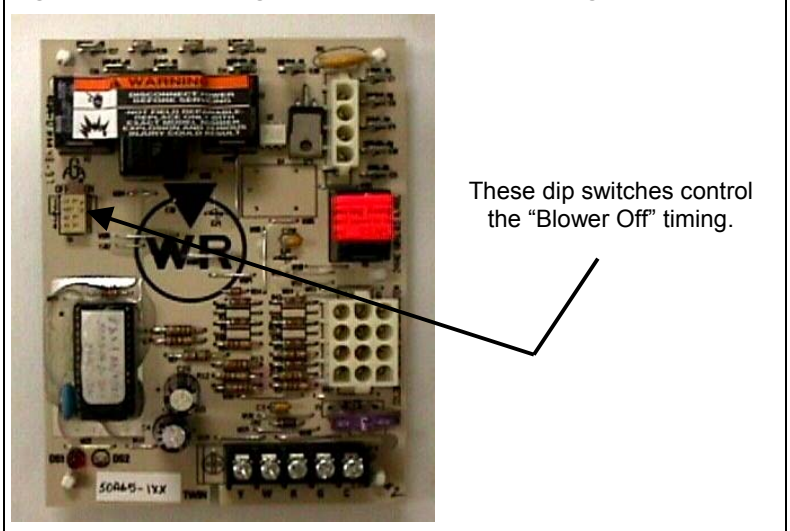


Figure 21: White-Rodgers 50A65 Dip Switch Settings



Speed, Yellow - Medium-Low Speed and Red - Low Speed. The unused leads are connected to the M1, M2 terminals on the ST9160B Control, or the "PARK" terminals on the 50A65 Control.

**IMPORTANT:** If the heating speed and cooling speed are to be the same, remove the cooling lead from the control, tape it off, then install a "piggyback" connector from the control "HEAT" terminal to the "COOL" terminal. UNDER NO CIRCUMSTANCE MAY TWO MOTOR WINDINGS BE POWERED SIMULTANEOUSLY.

The piggy-back connector is used for both types of motor wiring configuration; wiring block and permanent lead.

5. Slide the blower assembly back into position, and refasten with the sheet metal screws.
6. Re-install the blower compartment door.
7. Re-check temperature rise.

**NOTE:** Temperature rise should always be re-checked whenever blower speed changes are done.

### SETTING BLOWER "OFF" TIMINGS

Both control systems allow flexibility in the FAN OFF delay function. The control is located in the blower compartment. Follow the same steps as listed in blower speed adjustment to access the control.

HONEYWELL ST9160B		
FAN "OFF" DELAY		
SEC.	SW 1	SW-2
60	OFF	OFF
100	ON	OFF
140	OFF	ON
180	ON	ON

WHITE RODGERS 50A65		
Fan "OFF" Delay		
SEC	SW1	SW2
60	OFF	OFF
90	OFF	ON
120	ON	OFF
180	ON	ON

## MAINTENANCE

### MAINTENANCE

#### **⚠ WARNING**

DISCONNECT THE ELECTRICAL POWER SUPPLY TO THE FURNACE BEFORE ATTEMPTING ANY MAINTENANCE. FAILURE TO DO SO CAN CAUSE ELECTRICAL SHOCK RESULTING IN PERSONAL INJURY OR LOSS OF LIFE.

#### AIR FILTER

The furnace is equipped with a reusable 16 x 25 x 1 sponge air filter. If it becomes torn, it should be replaced with the same size and type.

The filter should be inspected frequently and cleaned as necessary. We recommend a monthly inspection at first, perhaps coinciding with the arrival of the monthly fuel bill as a reminder. The frequency may be increased or decreased depending on experience and conditions.

Avoid the use of the fiberglass throw-away filters. They tend to block up quickly, which may result in higher than normal operating temperatures, and lower efficiency.

Some paper media high efficiency filters, sometimes identified as HEPA filters can do an effective and excellent filtration of the air; however, some models may also cause a large pressure drop across the filter. The contractor should access the capabilities of

Figure 22: Air filter Maintenance.



the duct system to deliver sufficient airflow if this type of filter is considered.

Recommended: Electronic air filters using electrostatic precipitation to remove dust are excellent filtration devices. A 16" x 25" model is an ideal fit with this furnace in the case of a side mounted return air inlet. The furnace control module is supplied with electrical terminals for use with electronic air cleaners.

We do not recommend the use of the low voltage electronic air cleaners designed to directly replace the 16 x 25 x 1 sponge air filter supplied with the

furnace. They are efficient, but block up very quickly.

#### **⚠ CAUTION**

Do not operate the furnace for prolonged periods of time without an air filter.

A portion of the dust entrained in the air may lodge in the supply air ductwork and registers. Any recirculated dust particles will be heated and charred by contact with the furnace heat exchanger. This residue will soil ceilings, walls, drapery, carpets, and other household articles.

## LUBRICATION

Both the induced draft blower motor and circulating fan motor are ball-bearing type motors. Neither requires routine lubrication.

**IMPORTANT:** The motor bearings were pre-lubricated by the motor manufacturer. Do not attempt to lubricate them. Excess lubrication will void the warranty, shorten the service life if the motors, and will attract the buildup of dust and dirt.

The induced blower motor and circulating fan motor must be cleaned on a periodic basis by a qualified service technician. Dust buildup in the ventilation ports of the motor will cause the motor to not dissipate heat properly resulting in reduced service life.

## VENT CONNECTOR

The exhaust venting between the furnace vent box and chimney should be inspected periodically for sags, pitting, evidence of leakage etc. If any of these conditions exist, contact your installation contractor, service agency or fuel supplier.

### **WARNING**

HOLES IN THE EXHAUST PIPING OR FURNACE HEAT EXCHANGER CAN ALLOW TOXIC FUMES TO ENTER THE HOME AND CIRCULATE THROUGH THE DUCT SYSTEM RESULTING IN CARBON MONOXIDE POISONING OR DEATH. IF LEAKS ARE FOUND IN THE FURNACE HEAT EXCHANGER, IT MUST BE REPLACED.

## OPERATING TIPS

1. Clean air filters maximize efficiency and reduce heating costs.
2. During the heating season, keep windows and doors closed to reduce the heating load on the system.
3. Avoid excessive use of kitchen exhaust hoods and other exhaust fans to reduce the heating load on the system.
4. Arrange the furniture and drapes so that the supply air registers and return air grilles are unobstructed.
5. If you have a perimeter duct system, ideally, the warm air should

bathe the cold exterior walls. Avoid the use of plastic deflectors on the supply air registers that tend to short circuit the warm air straight into the return air grilles. These deflectors are often the cause of cool draughts across the floor.

6. Avoid placing heat-producing appliances such as televisions, radios, lamps, etc. in a location to influence the thermostat.
7. Keep combustible articles at least 3 feet away from the furnace. Do not block access for servicing the furnace. Do not use the vent connector as a hanger for clothes or anything else.
8. **IMPORTANT:** Never attempt to operate the furnace without the blower door in place.

## ANNUAL INSPECTION / SERVICE

A qualified installation contractor, service agency or fuel supplier must inspect the furnace annually.

Your annual inspection will normally cover the following:

### HEAT EXCHANGER

The heat exchanger should be inspected for corrosion. The flue passages (heat exchanger tubes) should be free of scale or excessive corrosion. The top row of heat exchanger tubing is the only portion accessible for cleaning with a small diameter wire-handled brush. After clearing accumulated scale, observe the burner flames. If there appears to be flame distortion, check venting for blockage. Also check for signs of inadequate combustion air supply. If flame distortion continues after eliminating the blockage in the venting as the cause, it may be necessary to replace the tubular heat exchanger. The tubular heat exchanger cannot be field cleaned. If the tubular heat exchanger is blocked by soot or excess scale, replace it.

### BURNERS

The burners should be inspected to ensure that they are free of deterioration, dust and debris, and properly aligned with the heat exchanger. In most cases, a simple vacuuming with a brush attachment will adequately clean the burner assembly and burner compartment.

### **CAUTION**

Be careful when working on the burner assembly. The hot surface igniter is fragile and can break easily.

The flame sensor should be inspected and cleaned with fine steel wool or Scotch-Brite™ scrubbing pad. The wiring connection should be checked to ensure that it is tight and corrosion free.

**NOTE:** This is a critical connection. Small amounts of corrosion can significantly increase the internal resistance of the connection. A relatively small increase in resistance can result in a large decrease in flame signal.

## INDUCED BLOWER

The induced blower motor should be inspected and cleaned if necessary. Clear any dust buildup from the ventilation ports.

## CIRCULATING FAN

The condition of the circulating fan should be checked to ensure that it is free of excessive dust buildup, debris, etc. The mechanical fasteners should be inspected and checked for proper tightness and parts alignment. The motor ventilation ports should be cleaned if necessary to prevent restriction to cooling by air over the motor.

## ELECTRICAL

### **WARNING**

**DISCONNECT THE ELECTRICAL POWER SUPPLY TO THE FURNACE BEFORE ATTEMPTING THIS MAINTENANCE PROCEDURE. FAILURE TO DO SO CAN CAUSE ELECTRICAL SHOCK RESULTING IN PERSONAL INJURY OR LOSS OF LIFE.**

All electrical connections should be examined to ensure that they are tight and corrosion free. Repair any connections that have become loose or corroded.

**▲ CAUTION**

Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation.

Always verify proper operation after servicing.

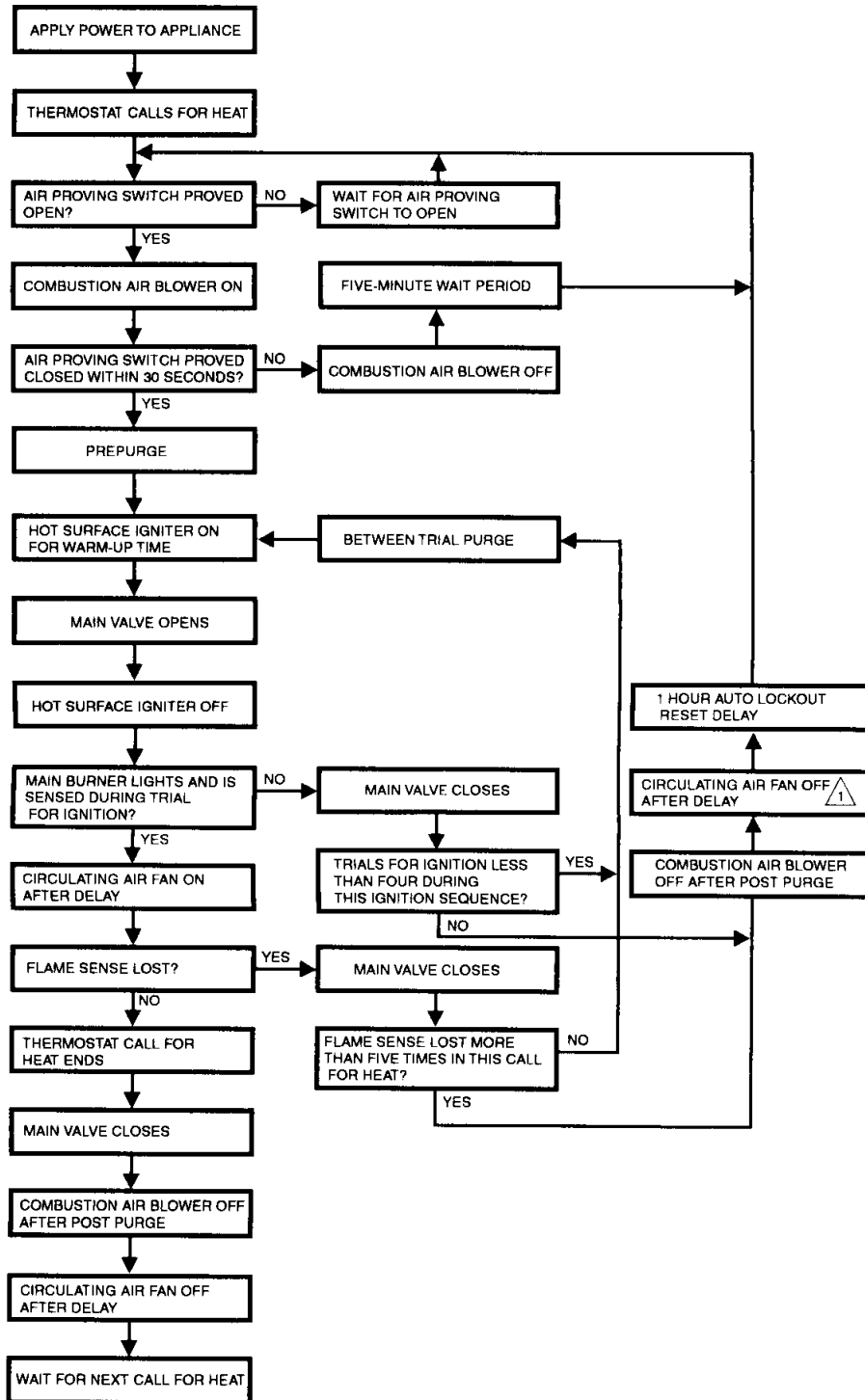
**FURNACE OPERATION**

The furnace should be cycled during the annual inspection and servicing to:

1. Test all safety related controls.
  2. Determine that the temperature rise falls within the range shown on the appliance rating plate.
  3. Ensure that the burner ignition is smooth and that the flames are smooth soft blue, and not impinging on the heat exchanger.
-

# TROUBLESHOOTING

SEQUENCE OF OPERATION: HONEYWELL ST9160B FAN TIMER with SV9520 SMARTVALVE IGNITION SYSTEM



<b>TABLE 10: TROUBLESHOOTING - HONEYWELL ST9160B / SV9520M by LED DIAGNOSTIC LIGHT</b>		
<b>LED STATUS</b>	<b>INDICATES</b>	<b>CHECK or REPAIR</b>
OFF	No power to system control.	<ol style="list-style-type: none"> <li>1. Line voltage input power at L1 and L2 connectors on ST9160B Electronic Fan Timer (ETF) Terminal Board.</li> <li>2. Low voltage (24v) power at 24VAC and COM terminals on ST9160B ETF.</li> <li>3. System wiring harness in good condition and securely connected at both ends.</li> </ol>
Bright - Dim	<p>Normal Operation</p> <p>This indication shows whenever the system is powered, unless some abnormal event has occurred.</p>	Not applicable.
2 Flashes	<p>Pressure switch remains closed longer than 30 seconds after a call for heat begins.</p> <p>Induced blower is not energized until the pressure switch opens.</p>	<ol style="list-style-type: none"> <li>1. Pressure switch stuck closed.</li> </ol> <p>Pressure switch mis-wired or jumpered.</p>
3 Flashes	<p>Pressure switch remains open longer than 30 seconds after induced blower is energized.</p> <p>System goes into a 5-minute delay period, with induced blower off. At the end of the 5-minute delay, another ignition cycle will begin.</p>	<ol style="list-style-type: none"> <li>1. Ignition system control switch must be in the ON position.</li> <li>2. Pressure switch operation, tubing and wiring.</li> </ol> <p>Obstructions or restrictions in venting preventing proper air flow.</p>
4 Flashes	<p>Limit string is open. (High Limit and Roll-out)</p> <p>Induced blower is energized. Circulating fan heating speed will be energized until the limit string resets.</p>	<ol style="list-style-type: none"> <li>1. Open flame roll-out switch.</li> <li>2. Open high temperature switch.</li> </ol> <p>Limit and Rollout switch wiring in good condition and securely connected.</p>
5 Flashes	<p>Flame signal sensed out of proper sequence.</p> <p>Induced blower is energized. The circulating fan heating speed will be energized after the 30-second "fan ON" delay.</p>	Flame at main burner.
6 Flashes	<p>System Lockout.</p> <p>After 1 hour lockout, control will reset and initiate a new ignition sequence, if call for heat is still present.</p>	<ol style="list-style-type: none"> <li>1. Gas supply OFF, or gas supply pressure too low to operate furnace.</li> <li>2. Damaged or broken HSI element.</li> <li>3. Line voltage HOT leadwire not connected to L1 on ST9160B EFT.</li> <li>4. Furnace not properly earth grounded.</li> <li>5. Flame sensor rod contaminated or in incorrect position.</li> <li>6. HSI element located in wrong position.</li> <li>7. Hot surface element or flame sensor wiring in good condition and properly connected.</li> <li>8. 5 flame failures caused by opening limit switch or flame rollout switch, within the thermostat call for heat. Turn thermostat down below room temperature to reset control. Check for blocked air filter, closed ducts, etc.</li> </ol>



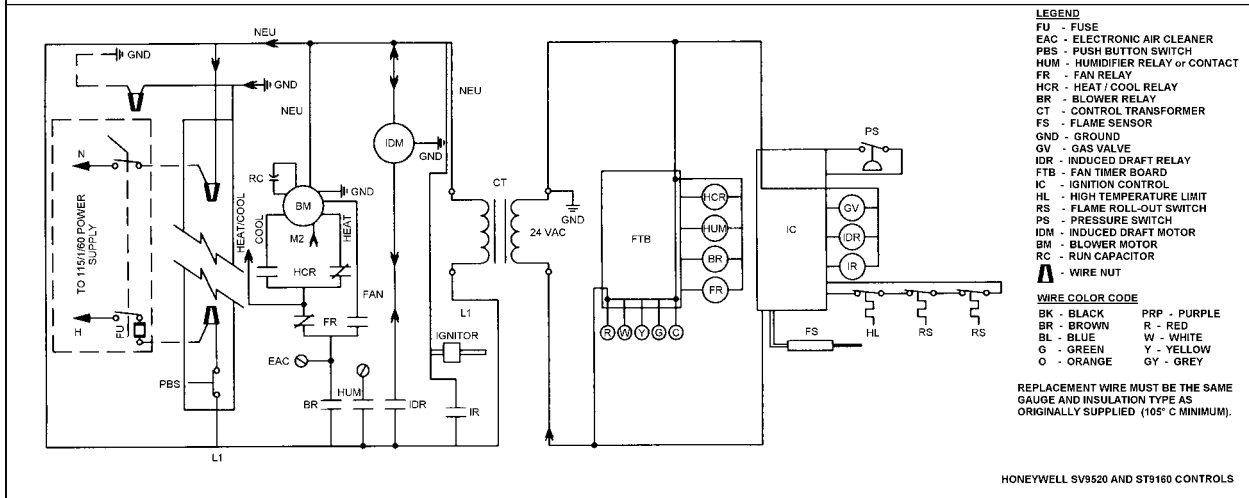
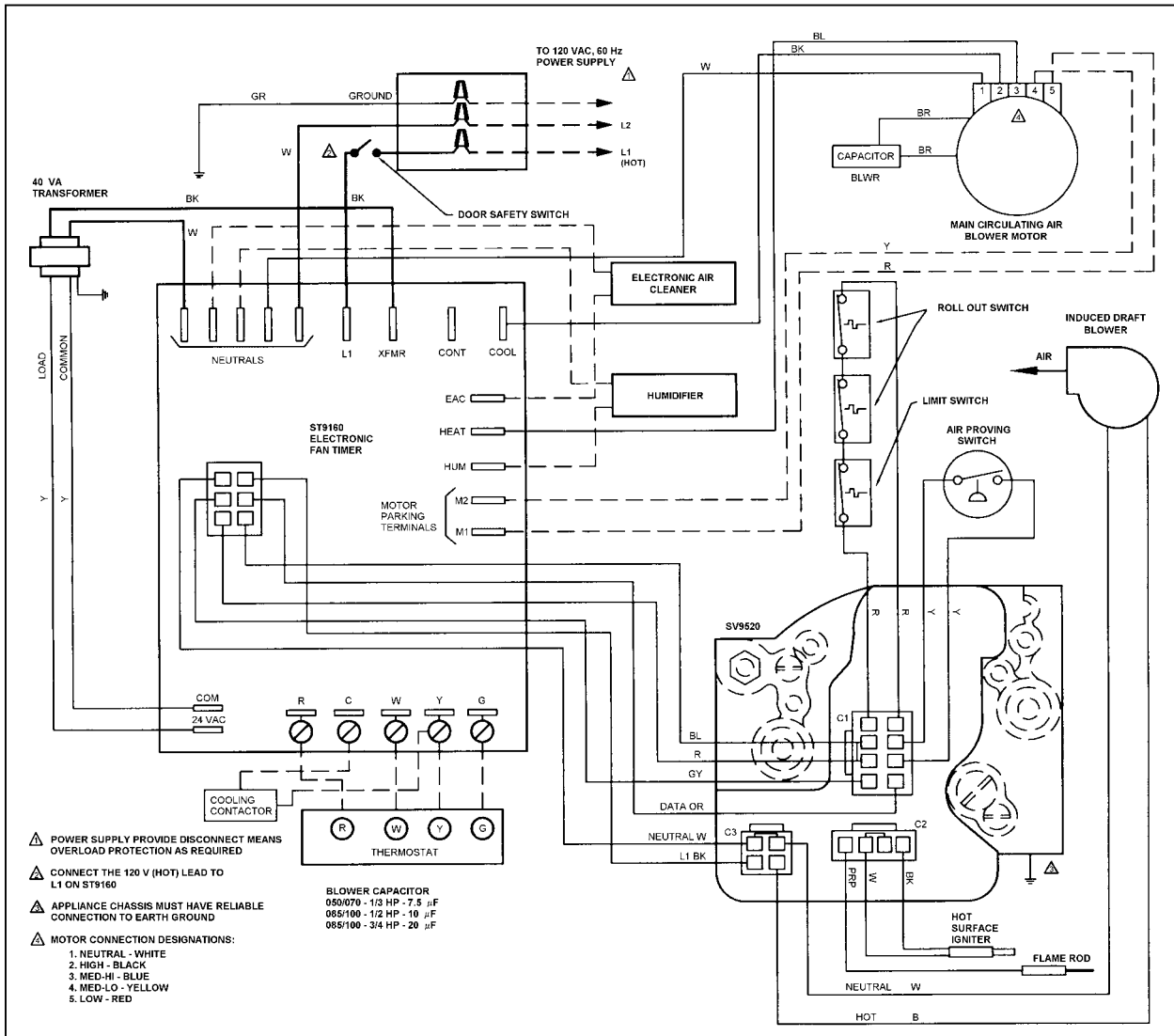
<b>TABLE 10: TROUBLESHOOTING - HONEYWELL ST9160B / SV9520M by LED Diagnostics</b> <i>continued</i>		
<b>LED STATUS</b>	<b>INDICATES</b>	<b>CHECK or REPAIR</b>
Bright - constant	System Lockout.	Interrupt and then restore power to the furnace. If the LED continues to indicate bright only (instead of bright-dim), replace the SV9520M gas valve.

<b>TABLE 11: GENERAL TROUBLESHOOTING - HONEYWELL ST9160B / SV9520M</b>		
<b>IF</b>	<b>AND</b>	<b>CHECK or REPAIR</b>
Induced blower does not energize.	2 Flash code does not come on 30 seconds after call for heat starts.	<ol style="list-style-type: none"> <li>1. Induced blower wiring.</li> <li>2. Induced blower.</li> </ol>
Induced blower does not energize.	2 Flash code does come on 30 seconds after call for heat starts.	<ol style="list-style-type: none"> <li>1. Pressure switch stuck closed.</li> <li>2. Pressure switch is mis-wired or jumpered.</li> </ol>
Induced blower is energized.	3 Flash code does not come on after 30 seconds.	Wait for the pre-purge to expire.
3 Flash code comes on 30 seconds after induced blower is energized.	Induced blower turns off.	<ol style="list-style-type: none"> <li>1. Ignition system control switch must be in the ON position.</li> <li>2. Pressure switch stuck in the open position.</li> <li>3. Pressure switch, tubing and wiring.</li> <li>4. Obstruction in furnace venting that is preventing proper combustion air flow.</li> </ol>
Pre-purge time has expired	HSI element does not glow red within 10 seconds.	<ol style="list-style-type: none"> <li>1. Broken or damaged HSI element.</li> <li>2. Broken or damaged HSI element lead-wires.</li> <li>3. SV9520M failure to power HSI element.</li> </ol>
HSI element is glowing red.	No other visible control system action.	Wait for HSI element warm up time to expire.
HSI element warm up time has expired and main valve has been energized.	Main valve does not light within trial for ignition period.	<ol style="list-style-type: none"> <li>1. Induced blower moving main burner gas away from the HSI element.</li> <li>2. Inlet gas pressure too low for main burner ignition.</li> <li>3. Input line voltage too low to heat HSI element.</li> <li>4. HSI element incorrectly positioned.</li> <li>5. Clogged or incorrect main burner orifice</li> </ol>
Main burner lights within trial for ignition period.	<p>Main valve is de-energized at the end of the trial for ignition period.</p> <p>If main flame is not sensed during trial for ignition, system will shut off HSI element and main gas flow, then go through another purge period and initiate another ignition trial. A total of 4 ignition trials will be attempted before the system goes into lock-out.</p>	<ol style="list-style-type: none"> <li>1. Line voltage to L1 terminal of ST9160B must be 120 volts with reference to furnace chassis.</li> <li>2. Furnace must be reliably connected to earth ground.</li> <li>3. induced blower moving main burner flame away from the flame sensor rod.</li> <li>4. Inlet gas pressure too low for proper flame sensing.</li> <li>5. Flame sensor rod contaminated or in incorrect position.</li> <li>6. Wiring between SV9520M and flame sensor rod must be in good condition and properly connected.</li> </ol>

**TABLE 11: GENERAL TROUBLESHOOTING - HONEYWELL ST9160B / SV9520M - continued**

IF	AND	CHECK or REPAIR
Main burner stays on after the end of the trial for ignition period.	Circulating fan is not turned on after 30 second time delay.	<ol style="list-style-type: none"> <li>1. Wiring between system control and EFT.</li> </ol> Proper operation of ST9160B EFT.
Main burner goes out before thermostat call for heat ends.	4 Flash code comes on.	<ol style="list-style-type: none"> <li>1. Open burner roll-out switch.</li> <li>2. Open high limit switch.</li> <li>3. High limit and burner roll-out switch wiring in good condition and securely connected.</li> </ol>
Main burner goes out before thermostat call for heat ends.	4 Flash code does not come on.	<ol style="list-style-type: none"> <li>1. Intermittent wiring connection between SV9520M and flame sensor rod.</li> <li>2. Induced blower moving main burner flame away from flame sensor rod.</li> <li>3. Pressure switch has opened.</li> <li>4. Flame sensor rod ceramic or leadwire overheated.</li> <li>5. Gas supply / flow reduced or interrupted.</li> </ol>
5 Flash code comes on.		Flame at main burner.
6 Flash code comes on. After 1 hour lock-out reset delay, control will reset and initiate a new ignition sequence if the call for heat is still present.		<ol style="list-style-type: none"> <li>1. Gas supply off or at too low a pressure to operate furnace.</li> <li>2. Damaged or broken HSI element.</li> <li>3. Line voltage to L1 terminal of ST9160B EFT must be 120 volts with reference to the furnace chassis.</li> <li>4. Furnace is not properly connected to earth ground.</li> <li>5. Flame rod contaminated or in incorrect location.</li> <li>6. Hot surface element located in incorrect position.</li> <li>7. Hot surface element or flame sensing rod wiring in good condition and properly connected.</li> <li>8. 5 flame failures caused by opening limit switch or flame roll-out switch, within the thermostat call for heat. Turn thermostat down below room temperature to reset control. Check for blocked air filter, closed ducts, etc.</li> </ol>

# GTM SERIES WIRING DIAGRAM



**HOMEOWNER'S REFERENCE TABLE**

Model No.	
Serial No.	
Date Installed	
Contractor	
Contact	
Address	
Postal Code	
Telephone No.	
After Hours No.	

**If different from Installation Contractor:**

Service Tech.	
Telephone No.	
After Hours No.	

**Fuel Supplier:**

Gas Supplier	
Contact	
Telephone No.	
After Hours No.	



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