



ECR International

INSTALLATION, OPERATION & MAINTENANCE MANUAL

THESE INSTRUCTIONS APPLY TO THE MODEL GTH CATEGORY IV NATURAL GAS AND LP GAS HIGH EFFICIENCY (CONDENSING) 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.

CLICK ANYWHERE on THIS PAGE TO RETURN TO ECR HVAC EQUIPMENT MANUALS, TROUBLESHOOTING, REPAIR INFORMATION at InspectApedia.com

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 GTH gas fired high efficiency (condensing) furnace is an up-flow warm air furnace suitable for residential and light commercial heating applications from 50,000 to 100,000 BTU/Hr.

Model GTH is CGA / AGA design certified as a Category IV direct vent central forced air furnace with all combustion air supplied directly to the furnace burners through a special air intake system. (See section on Combustion Air).

All GTH models may be fired by natural gas or LP gas (propane). GTH 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 for the drain trap assembly and 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.
3. in accordance with local plumbing or waste water codes to dispose of the condensate.

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

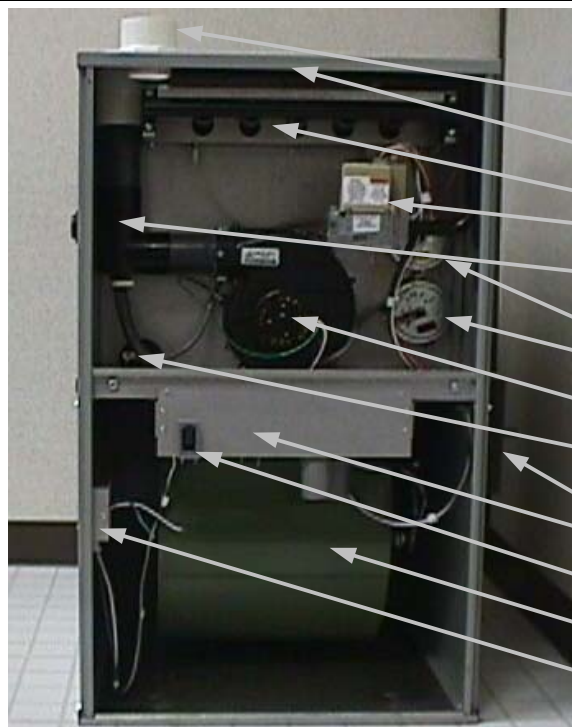


FIGURE 1: FURNACE COMPONENTS

1. Combustion Air Intake Fitting
2. Flame Roll-out Switch
3. Burner Assembly
4. Gas Valve
5. Vent Drain Assembly
6. Pressure Switch - Recovery Coil
7. Pressure Switch - Induced Draft
8. Induced Blower Assembly
9. Condensate drain - Recovery Coil
10. Drain Trap Assembly
11. Control Panel / Drawer
12. Door Switch
13. Circulating Blower
14. Junction Box

▲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 retro-fit 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 GTH Series furnace is designed to

be operated with a system temperature rise (ΔT) of 35 - 65°F. If the furnace selected has an identical output capacity as the original furnace, a substantial increase in system air flow will be required. See Table 1 and the airflow characteristics in Appendix A.

TABLE 1. TYPICAL AIR FLOW

GTH	CFM Required for a ΔT 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 GTH070, 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, (ΔT).

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 exhaust and combustion air piping can be routed between the furnace and their terminations with a minimum of lengths and fittings. Be sure to check that the proposed termination location will meet code requirements with respect to location and minimum clearances. See venting section for minimum and maximum limits.
- 1.2. Select a location as near as possible to the existing or proposed duct system.
- 1.3. The furnace location must have provisions for condensate drainage. If a suitable drain is unavailable near the furnace, a condensate pump must be used. The condensate pump drain tubing

must not terminate outdoors; similar to some air conditioning condensate installations. Be sure to select a condensate pump that has been approved for furnace condensate applications.

- 1.4. The furnace location must permit access for servicing, and be within the *clearance to combustibles guidelines* as marked on the appliance rating plate.
- 1.5. The furnace must be installed level to allow for the proper drainage of condensate. The furnace may shut down during winter operation if the condensate does not drain freely away from the furnace.

2. OTHER CONSIDERATIONS:

2.1. 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, var-sol, toluene, etc.,
- Water softener salts and chemicals.

IMPORTANT

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

2.2. IMPORTANT

If this furnace 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).

2.3. IMPORTANT

If the furnace is installed in an area where freezing may occur, a garage, an attic, a crawl space or any unconditioned space, steps must be taken to protect the condensate trap and drain line from freezing.

One possible measure could be to use a self-regulating 5 or 6 watt per foot heat tape covered with a jacket of insulation. Heat tapes are available in plumbing supply houses.

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.

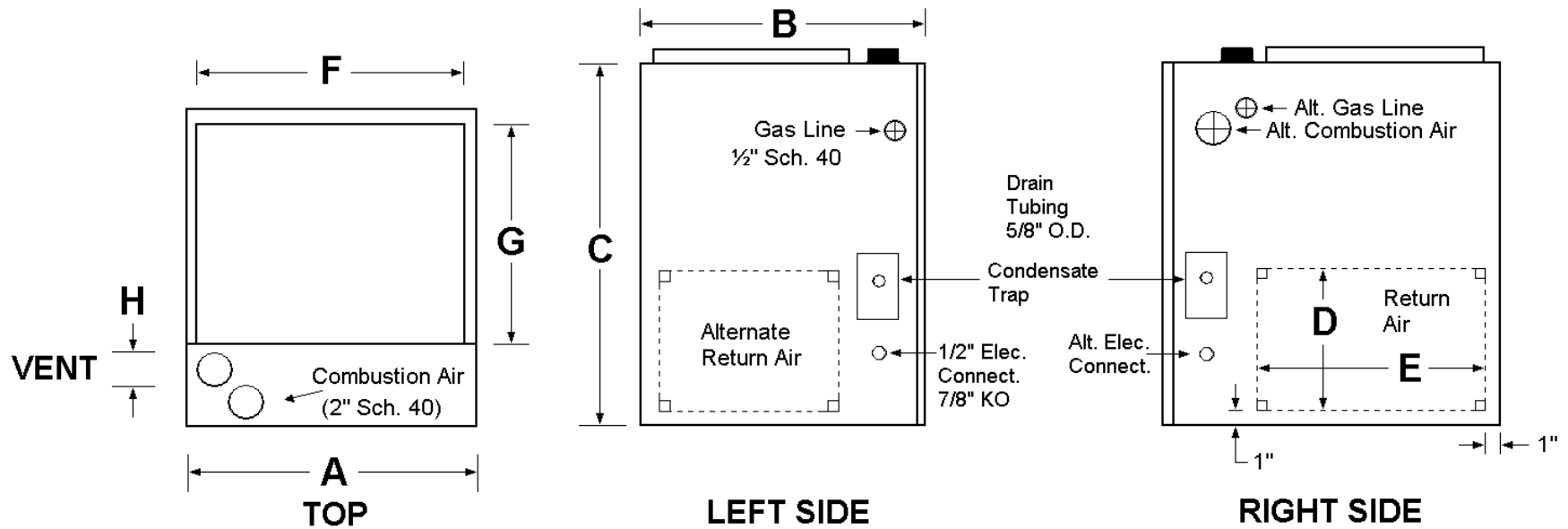
PLACEMENT OF COMBUSTIBLE MATERIALS ON, AGAINST OR AROUND THE FURNACE JACKET CAN CAUSE AN EXPLOSION OR FIRE RESULTING IN PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.

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: GTH DIMENSIONS and CLEARANCE TO COMBUSTIBLES



DIMENSIONS (Inches)

MODEL GTH	WIDTH A	DEPTH B	HEIGHT C	S / A F x G	R / A D x E	VENT H
50	17½	29¼	36	16½ x 20	15 x 23	2 or 3
70	17½	29¼	36	16½ x 20	15 x 23	2 or 3
85	21¼	29¼	36	20 x 20	15 x 23	3
100	21¼	29¼	36	20 x 20	15 x 23	3

CLEARANCE TO COMBUSTIBLES	
TOP:	1 INCH
FRONT:	2 INCHES - (24" for servicing)
SIDES:	0 INCHES
REAR:	0 INCHES
BOTTOM:	NON-COMBUSTIBLE or WOOD FLOOR
ALL MODELS APPROVED FOR CLOSET INSTALLATION.	
RETURN:	BOTTOM or EITHER SIDE

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 support rails. For the side inlet case, one on the bottom, one on top. Both rails are secured in place with one screw each.

Filter Rail



5. Connect the return air duct or fitting to the furnace. The connection should be sealed air tight 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.

VENTILATION AND COMBUSTION AIR

GENERAL 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 the remaining appliances will vent properly after the removal of the existing furnace. There is a probability that the existing chimney will be too large.

Remove the vent connector of the furnace being replaced, seal off the inlet to the vent from that furnace, then test the remaining appliances connected to the common vent 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. Close the fireplace dampers if any, turn on any appliances that exhaust air to the outdoors on maximum speed. This would include clothes dryers, range hoods, bath-

room fans, etc. Attic fans or other fans used only in summer should be exempted from the test.

4. Follow the lighting instructions of the appliance being tested and turn it on to continuous operation.
5. 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.
6. 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.
7. 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 or 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.

VENTING AND COMBUSTION AIR PIPING

The furnace products of combustion include both flue gases and condensate. All venting and drain materials are plastic.

ACCEPTABLE MATERIALS

The combustion air and vent piping and fittings may be comprised of:

- Schedule 40 PVC, ASTM D1785
- PVC-DWV, ASTM D2665
- Schedule 40 ABS, ASTM F628
- ABS-DWV, ASTM D2661
- Schedule 40 CPVC, ASTM F441
- Cellular core Schedule 40 PVC-DWV, ASTM F891 manufactured for non-pressurized applications.

In Canada, the piping materials and fittings must be CSA or ULC Certified.

JOINING PIPE AND FITTINGS

WARNING

SOLVENT CEMENTS AND PRIMERS ARE HIGHLY FLAMMABLE. PROVIDE ADEQUATE VENTILATION AND DO NOT ASSEMBLE NEAR HEAT SOURCE OR OPEN FLAME. DO NOT SMOKE. AVOID SKIN OR EYE CONTACT. OBSERVE ALL CAUTIONS AND WARNINGS PRINTED ON MATERIAL CONTAINERS.

FAILURE TO FOLLOW THESE GUIDELINES MAY RESULT IN FIRE, EXPLOSION OR ASPHYXIATION CAUSING PERSONAL INJURY OR LOSS OF LIFE.

All pipe, fittings, solvent cement, primers and procedures must conform to American National Standards Institute and American Society for Testing Materials (ANSI / ASTM) standards.

Pipe and Fittings: ASTM D1785, D2466 and D2564.

PVC Primer and Solvent Cement: ASTM D2564

ABS Pipe and Fittings - Use ABS Primer and Solvent Cement D2235

CPVC Solvent Cement F493

Procedure for Cementing Joints - ASTM D2855

It is preferable to use a single type of plastic throughout the venting and combustion air piping; however, if dissimilar piping or fitting materials are used, they must be joined with an appropriate transition cement. Dissimilar pipe segments may be joined together by mechanical means; e.g. 2" rubber coupling.

CEMENTING PIPES

This guide is intended specifically for PVC pipe; however, the general procedure applies to all plastic piping systems.

Materials: PVC Cleaner / Primer and PVC Solvent Cement.

IMPORTANT: After cutting pipe, remove all ragged edges and burrs. This will reduce restriction (pressure drop) throughout the venting and combustion air system.

Procedure:

1. Cut the pipe end square. Chamfer edge of pipe. Clean the fitting socket and pipe joint area of all dirt, grease and moisture.
2. After checking the pipe and socket for proper fit, wipe socket and pipe with cleaner / primer. Apply a liberal coat of primer to inside surface of socket and outside surface of pipe. **DO NOT ALLOW THE PRIMER TO DRY BEFORE APPLYING THE CEMENT.**

NOTE: If alignment is critical, make an alignment mark with a lead pencil on the outside of the socket to the portion of pipe beyond the joint. This will allow proper alignment as the joint is processed.

3. Apply a thin coat of solvent cement to the inside surface of the fitting socket. Quickly apply a heavy coat of solvent cement to the pipe end and insert it into the socket with a slight twisting motion until it bottoms out. If alignment is critical, match up the pencil marks made prior to this step.
4. **NOTE:** Cement must be fluid; if not, re-coat.
5. Hold the pipe in the fitting for 30 seconds to prevent the tapered socket from pushing the pipe out of the fitting. Failure to do this may result in a weak or leaky joint.

6. Wipe all excess cement from the joint with a rag. Allow 15 minutes before handling. Cure time varies according to fit, temperature and humidity.

NOTE: Stir the solvent cement frequently while using. Use a natural bristle brush or the dauber supplied with the container. If a dauber was not supplied, a 1 inch brush is ideal.

IMPORTANT: For proper installation -

DO NOT use solvent cement that has become curdled, lumpy or thickened.

DO NOT thin. Observe shelf precautions printed on containers.

Minimize the exposure of the container's contents to air.

For applications below 32°F (0° C), use only low temperature-type solvent cement.

NON-DIRECT VENT FURNACE INSTALLATIONS

NON-DIRECT VENT FURNACE INSTALLATIONS

The furnace, although designed as a direct vent type appliance, may be installed in a non-direct vent manner.

⚠ 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 - 1992, 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
- 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.

DETERMING 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 airtight 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 burn-

ing 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 1: Unconfined space

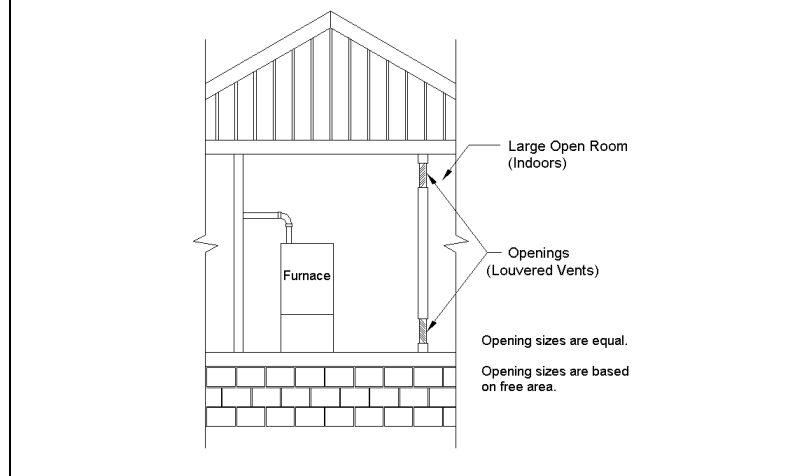
Furnace	Min. ft ² w/ 8' Ceil.	Typical Rm. Size w/ 8' Ceiling
GTH050	313	14 x 22 or 16 x 20
GTH070	438	16 x 28 or 20 x 22
GTH085	532	18 x 30 or 22 x 24
GTH100	625	20 x 32 or 25 x 25

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

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



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 BTH/Hr., See Figure 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 sidewall 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 sidewall 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 2: Vertical Air Supply

Furnace	Free Area Ea. Opening	Round Pipe Size
GTH050	12.5 in. ²	4 in.
GTH070	17.5 in. ²	5 in.
GTH085	21.25 in. ²	6 in.
GTH100	25 in. ²	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 calcu-

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

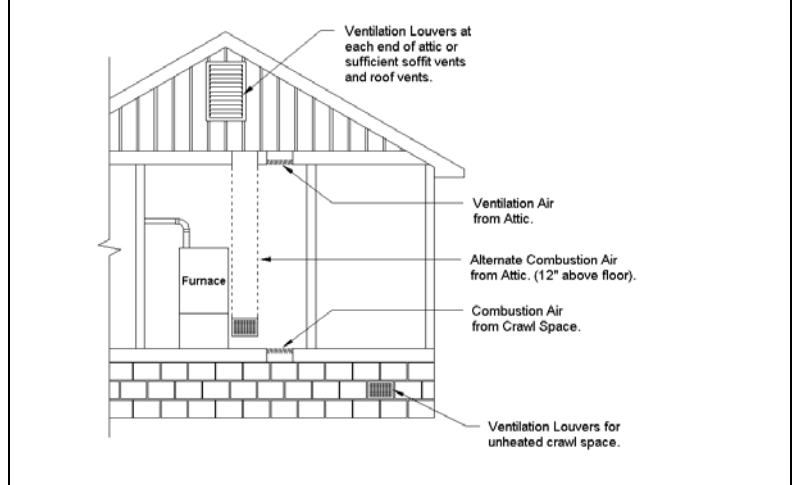
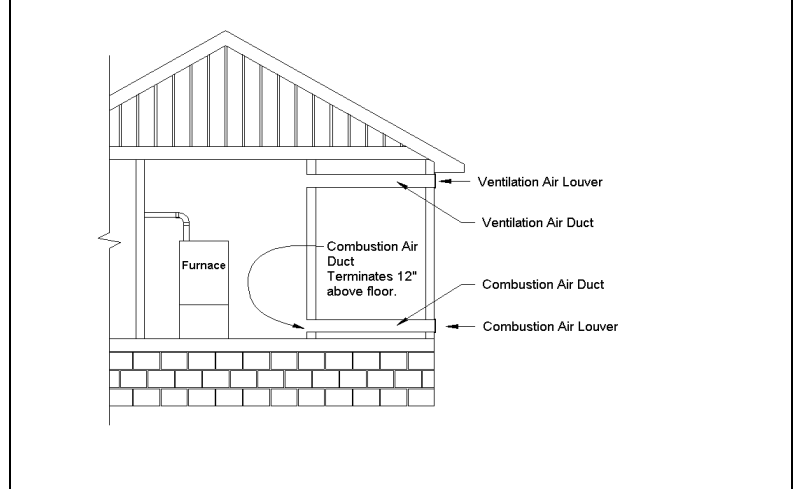


Figure 5: Outdoor Air for Combustion, Horizontal. (CASE 4).



lated 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.

Table 3: Horizontal Air Supply

Furnace	Free Area Ea. Opening	Round Pipe Size
GTH050	25 in. ²	6 in.
GTH070	35 in. ²	7 in.
GTH085	42.5 in. ²	8 in.
GTH100	50 in. ²	8 in.

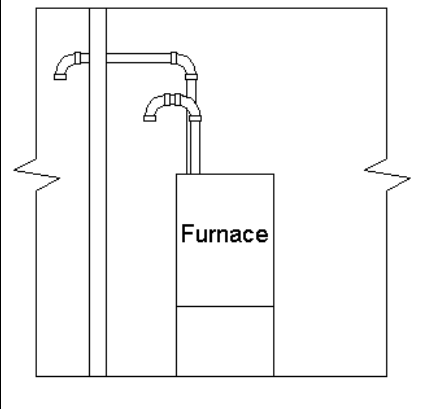
IMPORTANT: If grilles are used on the outside wall, they must be sized properly. Most sidewall grilles have only 50% free area. In the case of a GTH100 which requires a pair of 8" round pipes to obtain sufficient combustion and ventilation air, the duct could be an equivalent rectangular duct; 8 x 7 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.

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

CONNECTION TO FURNACE

When using indoor air or the non-direct vent configuration, the combustion air inlet to the furnace must be protected from blockage. Use a double elbow arrangement if supplying combustion air through the top, or a downward pointing single elbow if supplying combustion air through the side, See Figure 6.

Figure 6: Non-Direct Combustion Air Inlet



NON-DIRECT VENT INSTALLATION

CAUTION

FAILURE TO FOLLOW ALL VENTING GUIDELINES MAY RESULT IN ERRATIC FURNACE OPERATION, FREEZE-UP OF THE EXHAUST AIR PIPING OR SOOTING OF THE FURNACE.

All exhaust piping must be installed in accordance with CAN/CGA-B149.1 and .2 in Canada; The latest edition of National Fuel Gas Code, NFPA 54 / ANSI Z223.1 in the United States, as well as in accordance with local codes.

GUIDELINES

- Venting may be vertical or horizontal.
- Minimum vent length: 20 total effective feet
- Horizontal piping must slope back towards the furnace at a minimum rate of 1/4 inch to the foot, so that condensate drains towards the furnace.

TABLE 4: VENT LENGTHS - NON-DIRECT VENT APPLICATIONS

		MAXIMUM ALLOWABLE LENGTH OF PIPING - FEET						
MODEL	PIPE SIZE	NO. OF 90° ELBOWS						
		0	1	2	3	4	5	6
050	2"	70	60	50	40	30	20	10
	3"	100	90	80	70	60	50	40
070	2"	50	40	30	20	10	N/R	N/R
	3"	100	90	80	70	60	50	40
085	2"	N/R	N/R	N/R	N/R	N/R	N/R	N/R
	3"	100	90	80	70	60	50	40
100	2"	N/R	N/R	N/R	N/R	N/R	N/R	N/R
	3"	100	90	80	70	60	50	40

NOTES:

1. N/R - Not Recommended.
2. Do not count termination fittings in this calculation.
3. Use medium or long sweep elbows.
4. One 90° elbow is equivalent to two 45° elbows.

- Horizontal runs must be supported at least every 3 feet. Horizontal sections must not dip or sag.
- All vent runs through unconditioned space where freezing might occur should be insulated with 1 inch thick, medium density, foil-faced Fiberglas insulation. An equivalent "arm-a-flex" or "rub-a-tex" may also be used as long as there is no heat tape applied to the vent pipe. For horizontal runs where water may collect, wrap the vent pipe with self regulating 3 or 5 watt heat tape. The heat tape must be CSA, UL, or ULC listed and installed per the manufacturer's instructions.
- DO NOT COMMON VENT WITH ANY OTHER APPLIANCE.
- If venting vertically, do not vent up a chimney serving another appliance or install in a chase with a metal or high temperature plastic pipe from another gas or fuel burning appliance unless the required clearances to combustibles can be maintained between the PVC pipe and other pipes.

VENT TERMINATION

Horizontal vents should pass through the exterior wall to terminate into the side branch of a 2 inch tee or tee-wye fitting, approximately between 10" to 14" away from the wall, see Figure 7.

A tee is the preferred termination fitting; however, a 45° or 90° elbow may be used to help direct the flue gases.

If it is not possible to obtain proper clearance to grade or anticipated snow level by a straight out configuration, the

termination may be raised by the use of a pair of 2 inch elbows, see Figure 8.

Figure 7: Standard Termination



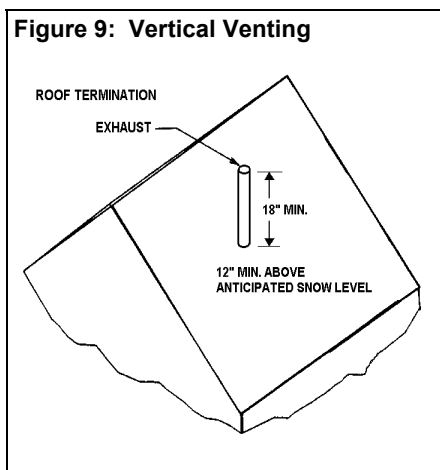
The vent may also terminate in a vertical venting configuration through the roof. No termination fitting is required; however, the pipe may be terminated into the side branch of a 2 inch tee or tee-wye fitting, see Figure 9. If 3 inch pipe is used, it should be reduced in the attic to 2" pipe within 18 inches of the roof.

Figure 8: "Periscope" Venting



The external portion of the vent in all cases is to consist of 2" pipe. If 3 inch pipe is used between the furnace and terminal, reduce down to 2 inches within 18 inches to the exterior wall.

The exhaust pipe extending through the roof must extend 18 inches above the highest point where it extends through the roof, surface and above any obstruction within an 18 inch horizontal distance. The exhaust pipe must extend a minimum of 12 inches above the anticipated snow level.



Size the exhaust pipe as specified in Table 4. This table lists the maximum allowable length of pipe with respect to the number of 90° elbows used. For the purposes of this calculation, one 90° elbow is equivalent to two 45° elbows.

Avoid locating the terminal in locations where dripping condensate may cause problems such as sidewalks, patios, above planters, near windows where exhaust gases may cause fogging, etc. Avoid locating the termination too close to shrubs and other vegetation. The condensate may stunt or kill them.

Caulk all cracks, seams or joints within a 6 foot radius of the termination.

Do not terminate under a deck unless there is adequate clearance to prevent damage from the flue gases. A termination may be located at the end of a patio deck. Piping running beneath the deck must be suitably insulated and suspended in a manner to prevent condensate from collecting and freezing.

Do not locate the terminal on the side of the building facing the prevailing winter winds.

CAUTION

MOISTURE IN THE FLUE GASES CONDENSES AS IT LEAVES THE TERMINAL. THIS MOISTURE CAN FREEZE ON EXTERIOR WALLS, ON SOFFITS, AND OTHER NEARBY OBJECTS. SOME DISCOLORATION IS TO BE EXPECTED; HOWEVER, IMPROPER LOCATION OR INSTALLATION CAN CAUSE STRUCTURAL OR EXTERIOR FINISH DAMAGE TO THE BUILDING.

In addition to the general guidelines, In Canada, the non-direct vent exhaust shall not terminate:

- a) directly above a paved sidewalk or paved driveway which is located between two single-family dwellings and serves both dwellings;
- b) less than 7 feet above a paved sidewalk or paved driveway located on public property;
- c) within 6 feet of a mechanical air supply inlet to any building;
- d) above a meter / regulator assembly within 3 feet horizontally of the centerline of the regulator;
- e) within 6 feet of any service regulator vent outlet;
- f) less than 12 inches above grade level or anticipated snow level;
- g) within 12 inches of a window or door which can be opened in any building;
- h) within 12 inches of any non-mechanical air supply inlet to any building;
- i) within 12 inches of the combustion air inlet of any other appliance;
- j) underneath a veranda, porch or deck, unless
 - i) the veranda, porch or deck is fully open on a minimum of two sides beneath the floor, and
 - ii) the distance between the top of the vent termination and the underside of the veranda, porch or deck is greater than 12 inches.

In addition to the general guidelines, In the United States, the non-direct vent exhaust shall be installed in accordance with the following:

1. The clearance from the bottom of the terminal to grade shall be 12 inches, or increased to maintain 12 inches above the anticipated accumulated snow level.
2. The vent shall not terminate over public walkways or over an area where condensate or vapor could create a nuisance or hazard.
3. The vent terminal shall be installed 4 feet below, 4 feet horizontally from, or 1 foot above any door, window, soffit, under eave vent or gravity air inlet to the building.
4. The vent terminal shall have a minimum horizontal clearance of 4 feet from electric meters, gas meters, regulators and relief equipment.
5. Locate the vent terminal 3 feet above any forced air inlet located within 10 feet. Any fresh air or make-up air inlet, such as for a dryer or furnace area is considered a forced air inlet.

The vent terminal should be located no fewer than 6 feet from an inside corner formed by two exterior walls; a 10 foot distance is recommended.

Recommended clearance for overhangs is a minimum of 1 foot vertically for each foot horizontally up to 6 feet.

DIRECT VENT INSTALLATIONS

WARNING

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

DIRECT VENT FURNACE INSTALLATIONS

The direct vent configuration is the preferred installation method. The primary advantages are:

- Dedicated combustion air and vent piping eliminates the need to use already heated air for combustion purposes;
- The probability of corrosives being present in the combustion air is greatly reduced;
- The direct vent configuration is unaffected by any other appliances, exhaust fans, or other devices that tend to create negative pressure conditions while operating.
- No vents for combustion and ventilation air are required in confined spaces

IMPORTANT: If other fuel burning equipment is present, in confined space, combustion and ventilation air provisions must be made for them; see Ventilation and Combustion Air section.

GUIDELINES

All exhaust piping must be installed in accordance with CAN/CGA-B149 in Canada; The latest edition of National Fuel Gas Code, NFPA 54 / ANSI Z223.1 in the United States, as well as in accordance with local codes.

- Venting may be vertical or horizontal.
- Horizontal piping must slope back towards the furnace at a minimum rate of ¼ inch to the foot, so that

TABLE 5: VENT LENGTHS - DIRECT VENT APPLICATIONS

MAXIMUM ALLOWABLE LENGTH OF PIPING - FEET								
MODEL	PIPE SIZE	NUMBER OF 90° ELBOWS						
		0	1	2	3	4	5	6
050	2	70	60	50	40	30	20	10
	3	100	90	80	70	60	50	40
070	2	50	40	30	20	10	N/R	N/R
	3	100	90	80	70	60	50	40
085	2	N/R	N/R	N/R	N/R	N/R	N/R	N/R
	3	100	90	80	70	60	50	40
100	2	N/R	N/R	N/R	N/R	N/R	N/R	N/R
	3	100	90	80	70	60	50	40

NOTES:

1. N/R - Not Recommended
2. Do not count termination fittings in this calculation
3. Use medium or long sweep elbows.
4. One 90° elbow is equivalent to two 45° elbows

condensate drains towards the furnace.

- Horizontal runs must be supported at least every 3 feet. Horizontal sections must not dip or sag.
- All vent runs through unconditioned space where freezing might occur should be insulated with 1 inch thick, medium density, foil-faced Fiberglas insulation. An equivalent "arm-a-flex" or "rub-a-tex" may also be used as long as there is no heat tape applied to the vent pipe. For horizontal runs where water may collect, wrap the vent pipe with self-regulating 3 or 5-watt heat tape. The heat tape must be CSA, UL, or ULC listed and installed per the manufacturer's instructions.
- DO NOT COMMON VENT WITH ANY OTHER APPLIANCE.
- If venting vertically, do not vent up a chimney serving another appliance or install in a chase with a metal or high temperature plastic pipe from another gas or fuel burning appliance unless the required clearances to combustibles can be

maintained between the PVC pipe and other pipes.

- The minimum vent length is 20 total effective feet; e.g., 10 feet linear with one 90° elbow.

Figure 10: Standard Termination



Size the combustion air and exhaust piping in accordance with Table 5: Vent Lengths - Direct Vent Applications. When calculating allowable vent lengths, do not count the termination fittings, unless the termination is going to involve more fittings than required for the standard or "periscoped" terminations shown in Figures 10, 11, and 12.

Figure 11: Periscoped Termination



Figure 12: Concentric Venting



COMBUSTION AIR

This furnace is certified as a Category IV Type FSP Direct Vent Furnace. When installed as a direct vent furnace, all combustion air is supplied from the outdoors via the plastic piping system. All components are field supplied except for the adapter used to connect the PVC piping to the furnace.

The combustion air piping, like the exhaust piping, must be air tight throughout the system. The adapter joining the combustion air to the furnace is supplied with a washer or O ring to maintain the seal.

IMPORTANT: The supplied adapter is made of PVC. If planning to use ABS pipe, use an all-purpose cleaner and ABS to PVC transition cement. If planning to use CPVC pipe, use an all-purpose cleaner, a clear or purple primer and all-purpose cement approved for the purpose.

Additional information about cleaners, primers, solvents and cements may be

Figure 13: Horizontal Vent Detail

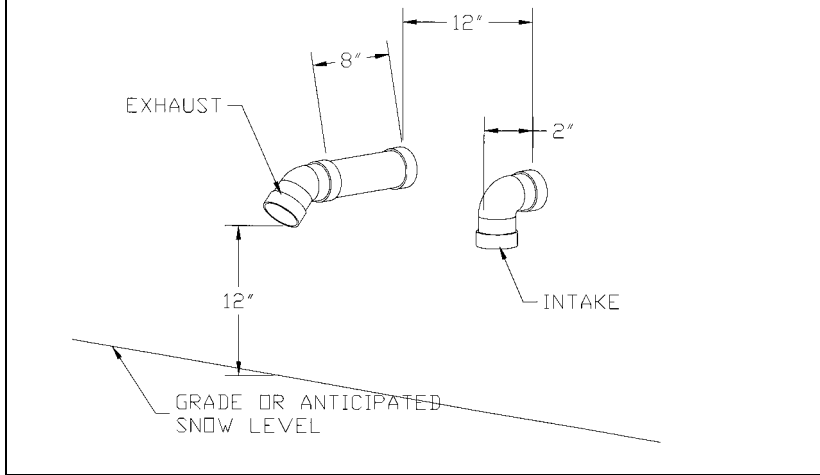


Figure 14: Horizontal Detail for 3" Vent (085 / 100)

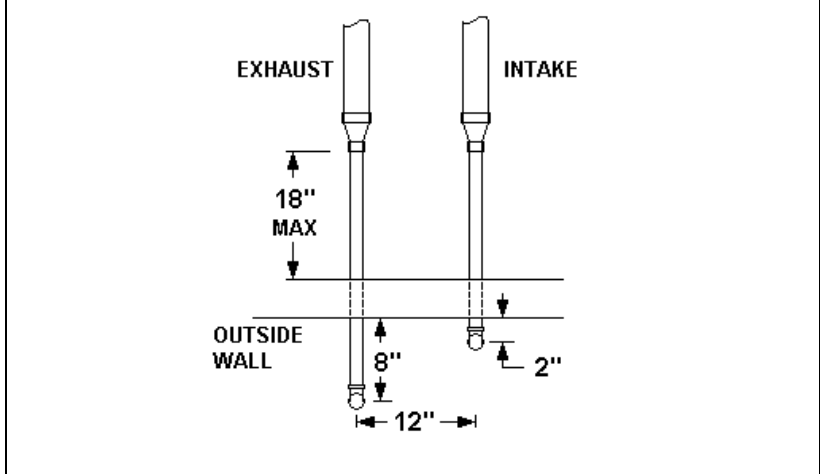
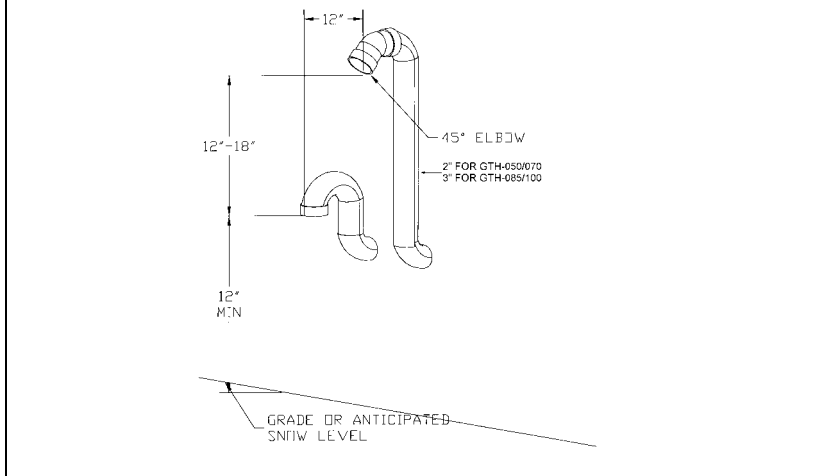


Figure 15: Periscoped Vent Detail



obtained from their manufacturers. One such manufacturer is the Oatey Company of Cleveland Ohio, 216-267-7100 and Toronto, Ontario, 416-213-8474. Oatey has an informative website at www.oatey.com.

IMPORTANT: If the furnace is to be installed in the vicinity of other fuel burning appliances, adequate combustion air must be available for the non-direct vent appliances. Review the section on Determining Combustion Air, (page 12).

HORIZONTAL TERMINATIONS

COMBUSTION AIR

HORIZONTAL: The combustion air termination is a 2-inch medium or long sweep 90° elbow pointing downward to prevent rain from readily entering the combustion air intake piping. An intake screening is optional; however, unless there is a compelling reason to use one, the screen may actually encourage the formation of rime ice, which could cause the intake to become blocked in certain weather conditions.

The termination fitting is 2 inch. If 3 inch piping is used, it should be reduced to 2 inch within 18 inches of the exterior wall, unless "periscoping". See Figure 14.

If the required clearance to grade or anticipated snow level cannot be obtained with the "straight through" configuration, the combustion air intake pipe may be "periscoped" up to 24 inches to gain extra height; see Figure 13. Note: Use 3" pipe and fittings for GTH-085 - 100. 2" is acceptable for GTH 050 - 070, as shown in Fig. 15.

The concentric venting terminal has the combustion air intake built into the assembly. If using the concentric vent terminal, there must be a minimum of 12 inches clearance to grade or anticipated snow level. There are no means available to raise the terminal externally. If planning to use this terminal kit, use the P/N 29570 (2") for the GTH-050/070, or P/N 29571 (3") for the GTH-085/100. (See Figure 16).

VERTICAL: The combustion air termination is a pair of 2 inch medium or long sweep 90° elbow pointing downward to prevent rain from entering the combustion air intake piping. If 3 inch piping is used, it should be reduced to

Figure 16: Concentric Vent Detail

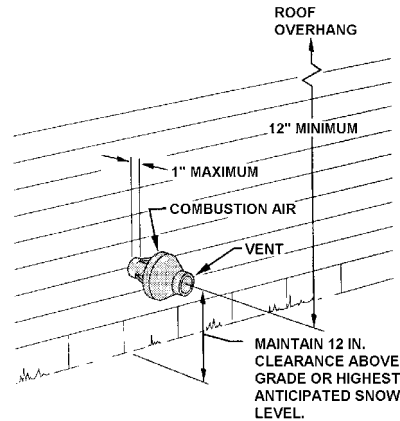


Figure 17: Concentric Vent Indoor Detail

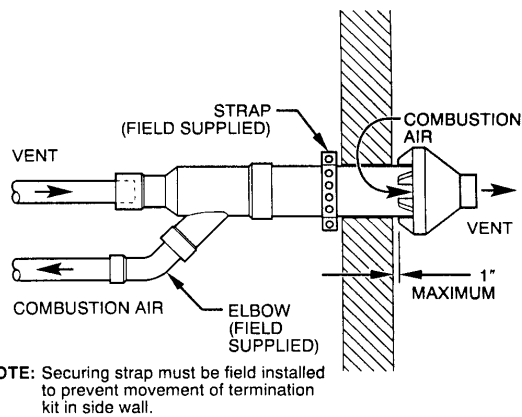
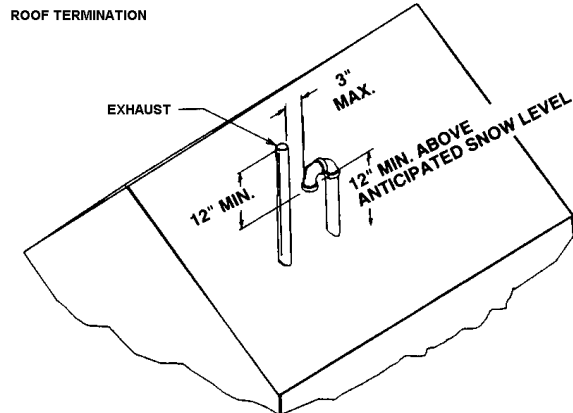


Figure 18: Standard Vertical Venting Detail



2 inch within 18 inches of the point where the pipe penetrates the roof. The termination inlet must be positioned within 3 inches of the companion exhaust piping.

The combustion air inlet must be located a minimum of 12 inches above the anticipated snow level, and 12 inches below the exhaust outlet; see Figure 18.

The concentric vent termination kits may also be used in the vertical position, see Figures 18 and 19.

EXHAUST

HORIZONTAL: The exhaust termination is normally a 2 inch 45° elbow or a medium or long sweep 90° elbow pointing within 45° of the downward position, away from the combustion air intake terminal.

The termination fitting is 2 inch. If 3 inch piping is used, it should be reduced to 2 inch within 18 inches of the exterior wall, unless “periscoping”.

If the required clearance to grade or anticipated snow level cannot be obtained with the “straight through” configuration, the exhaust pipe may be “periscoped” up to 24 inches to gain extra height; see Figure 15. In this case, the flue gases may be expelled horizontally. Use 3” pipe and fittings for GTH-085 - 100. 2” is acceptable for GTH 050 - 070

If winter prevailing wind conditions are variable and likely to occasionally blow flue gases back in on the combustion air intake, the exhaust termination may be raised 18 to 24 inches above the combustion air intake terminal to take advantage of the natural buoyancy of the flue gases to help prevent re-circulation of the exhaust; see Figure 15.

VERTICAL: No termination fitting is required if venting vertically through a roof. The end of the exhaust pipe must be 12 inches higher than the entrance of the combustion air intake terminal; see Figure 18.

The exhaust pipe extending through the roof must extend a minimum of 18 inches above any obstruction within an 18 inch horizontal distance.

Figure 19: Vertical Concentric Venting

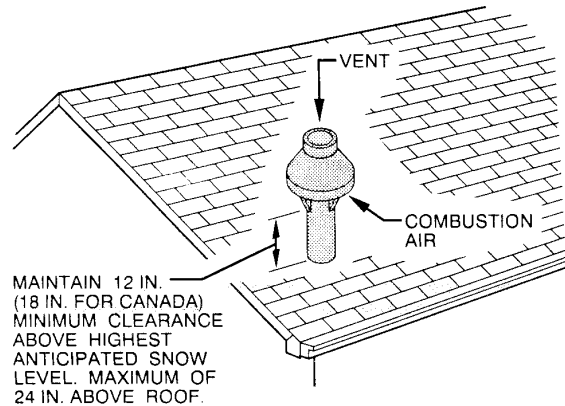
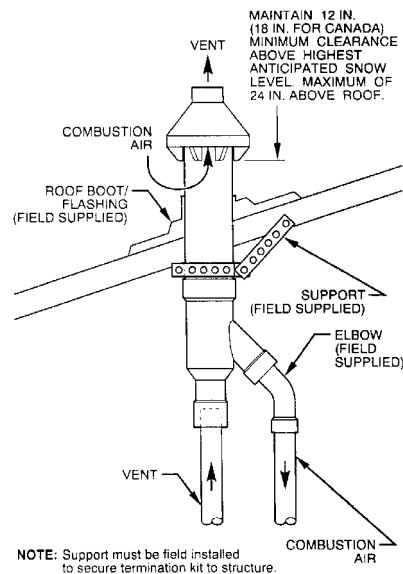


Figure 20: Vertical Concentric Venting Support



CONCENTRIC VENTING KIT

Concentric venting terminal kits are available for the GTH series furnace. They provide a means of obtaining combustion air and exhausting products of combustion utilizing a single penetration through the exterior wall. This can be useful when there is limited wall space available.

The kits are available in the 2-inch size, Part No. 29570, for GTH-050 and GTH-070, and the 3-inch size, Part No. 29571, for GTH-085 and GTH-100.

Read the instructions supplied with the kit for additional installation instructions and details.

LOCATION

Avoid locating the terminals where the flue gas could become stagnant and allow re-circulation into the combustion air intake.

Avoid locating the terminal in locations where dripping condensate may cause problems such as sidewalks, patios, above planters, near windows where exhaust gases may cause fogging, etc.

Avoid locating the termination too close to shrubs and other vegetation. The condensate may stunt or kill them.

Caulk all cracks, seams or joints within a 6-foot radius of the termination.

Do not terminate under a deck unless there is adequate clearance to prevent damage from the flue gases. A termination may be located at the end of a patio deck. Piping running beneath the deck must be suitably insulated and suspended in a manner to prevent condensate from collecting and freezing.

Do not locate the terminal on the side of the building facing the prevailing winter winds.

CAUTION

IMPROPER LOCATION OR INSTALLATION CAN RESULT IN STRUCTURAL DAMAGE TO THE BUILDING, DAMAGE TO THE EXTERIOR FINISH OF THE BUILDING OR MAY ALLOW RE-CIRCULATION OR FREEZING OF THE FLUE GASES ONTO OR INTO THE COMBUSTION AIR INTAKE.

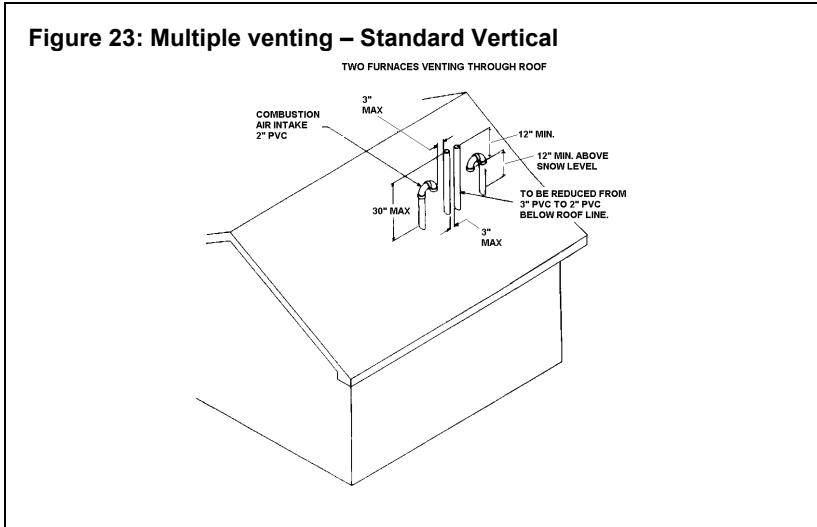
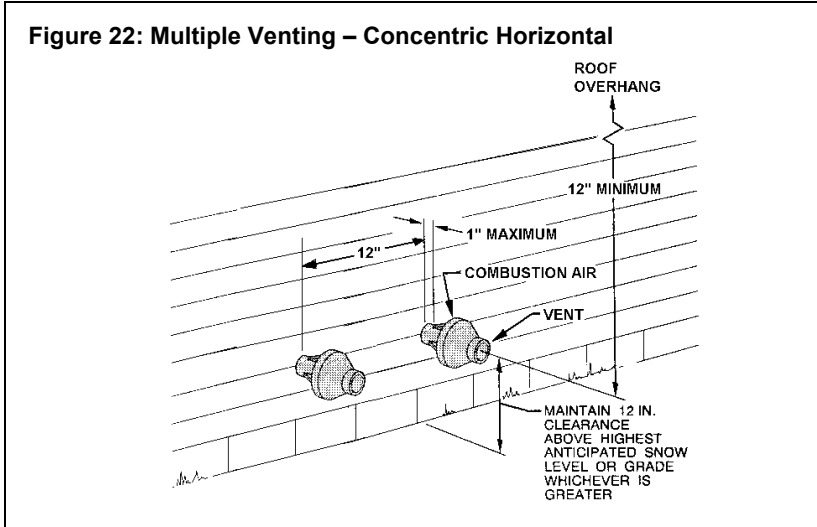
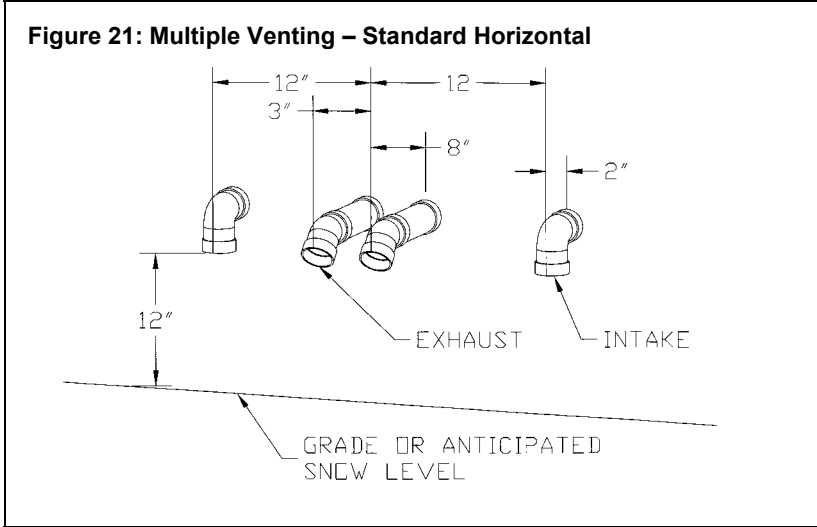
MOISTURE IN THE FLUE GASES CONDENSES AS IT LEAVES THE TERMINAL. THIS MOISTURE CAN FREEZE ON EXTERIOR WALLS, ON SOFFITS, AND OTHER NEARBY OBJECTS. SOME DISCOLORATION IS TO BE EXPECTED.

The vent terminal should be located no fewer than 6 feet from an inside corner formed by two exterior walls; a 10 foot distance is recommended.

Recommended clearance for overhangs is a minimum of 1 foot vertically for each foot horizontally up to 6 feet.

As a protection against freezing, do not expose a 3 x 2 reducing coupling to outdoor ambient temperatures.

Any adjacent painted surfaces should be in good condition; no cracks, peeling paint, etc. If wooden surfaces that may be periodically exposed to flue gases are present, consider treating with a sealer such as Thompson's Water Seal®. Additional information about sealers may be obtained from the Thompson's Water Seal website: <http://www.thompsonsonline.com/>



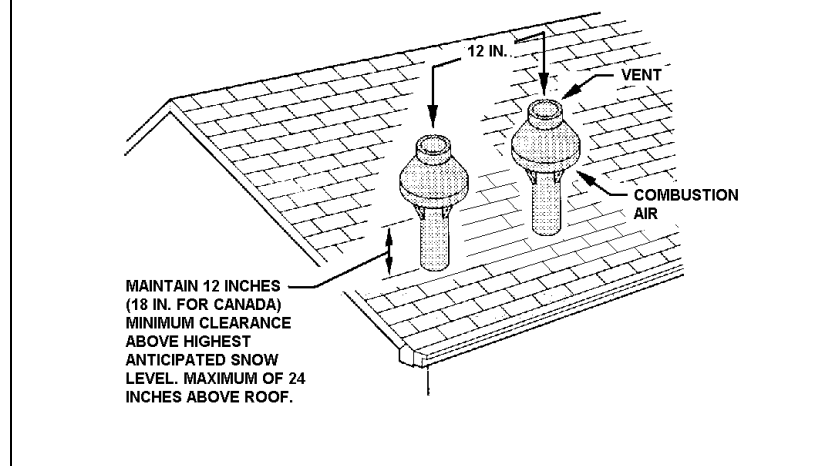
In addition to the general guidelines, In Canada, the exhaust shall not terminate:

- a) directly above a paved sidewalk or paved driveway which is located between two single-family dwellings and serves both dwellings;
- b) less than 7 feet above a paved sidewalk or paved driveway located on public property;
- c) within 6 feet of a mechanical air supply inlet to any building;
- d) above a meter / regulator assembly within 3 feet horizontally of the centerline of the regulator;
- e) within 6 feet of any service regulator vent outlet;
- f) less than 12 inches above grade level or anticipated snow level;
- g) within 12 inches of a window or door which can be opened in any building;
- h) within 12 inches of any non-mechanical air supply inlet to any building;
- i) within 12 inches of the combustion air inlet of any other appliance;
- j) underneath a veranda, porch or deck, unless
 - i) the veranda, porch or deck is fully open on a minimum of two sides beneath the floor, and
 - ii) the distance between the top of the vent termination and the underside of the veranda, porch or deck is greater than 12 inches.

In addition to the general guidelines, In the United States, the direct vent exhaust shall be installed in accordance with the following:

1. The clearance from the bottom of the terminal to grade shall be 12 inches, or increased to maintain 12 inches above the anticipated accumulated snow level.
2. The vent shall not terminate over public walkways or over an area where condensate or vapor could create a nuisance or hazard.
3. The vent terminal shall be installed at least 1 foot from any opening through which flue gases could enter a building.

Figure 24: Multiple Venting – Vertical Concentric



4. The vent terminal shall have a minimum horizontal clearance of 4 feet from electric meters, gas meters, regulators and relief equipment.
5. Locate the vent terminal 10 feet horizontally from the vent of any side wall vented fuel gas appliance or electric clothes dryer, except in the case where two or more of these furnaces are multi-vented; see Multiple Venting.

MULTIPLE VENTING

⚠ IMPORTANT:

WHEN INSTALLING MULTIPLE FURNACES IN CLOSE PROXIMITY, EACH REQUIRES DEDICATED COMBUSTION AIR AND EXHAUST VENTING.

COMMON VENTING IS PROHIBITED UNDER ALL CIRCUMSTANCES.

If two of these furnaces are to be installed in close proximity, the combustion air intake and exhaust terminations may be installed as shown in Figures 21, 22, 23, and 24.

If more than two furnaces are being installed in close proximity, each additional combustion air intake and exhaust termination set must be installed a minimum of 4 feet apart. This is an exception to the 10-foot requirement mentioned in the *Location - Requirements - United States* section above. If using the concentric venting kits, two

terminals may be centered 12 inches apart.

FURNACE CONNECTION

IMPORTANT: Clean and de-burr all pipe cuts. The shavings must not be allowed to block the exhaust, combustion air inlet or condensate drain lines.

The exhaust pipe connection is a 2-inch PVC female socket adapter located in the left rear corner of the top panel. If using 2 inch PVC pipe, connect it to the adapter using the procedures mentioned in *cementing pipes* (page 11). If 3 inch pipe is to be used, use a short piece of 2" PVC to connect the adapter to a PVC 3 x 2 reducing coupling, then continue with 3 inch PVC.

IMPORTANT: If the pipe and fittings are to be other than PVC, use the proper cleaner, primer and cement for the dissimilar materials.

The combustion air inlet fitting is a 2 x 2 PVC Socket to MPT adapter. The standard location for it is on the left front top panel, in front of the exhaust fitting. If using 2 inch PVC pipe, connect it to the adapter using the procedures mentioned in *cementing pipes* (page 11). If 3 inch pipe is to be used, use a short piece of 2" PVC to connect the adapter to a PVC 3 x 2 reducing coupling, then continue with 3 inch PVC.

The combustion air intake fitting may also be located on the right side panel. If the right side panel is to be used, remove the plug from the side panel, and re-install it in the top panel combustion air intake hole. Install the

adapter to the side panel using the O ring and the 2 inch lock nut.

If the right side panel combustion air intake position is used, use a short piece of 2 inch PVC and a medium or long sweep 90° elbow to start the riser. If using 3 inch pipe, it is also permissible to use a short piece of PVC pipe, a 3 x 2 PVC Reducing Coupling, then a 3 inch 90° elbow.

Ensure that the adapter O rings are properly positioned and that the adapters are properly sealed to the panel.

CONDENSATE DRAINS

The furnace will condensate as much as a half pound of water per hour (approximately 2 imperial quarts, 2½ U.S. quarts or 2¼ litres). It is necessary to make provisions for draining the condensate away. The furnace is supplied with a drain trap assembly that may be installed on either the left or right side panel.

IMPORTANT: The drain trap assembly must be installed, and must be filled with water before running the furnace. A dry trap may cause the pressure switch to behave erratically, preventing the furnace from operating normally.

The drain hose supplied with the furnace is long enough to reach either side panel; however, it must be cut near the blower division panel and fitted with the elbows and clamps provided. This is to prevent kinking in the drain lines.

CAUTION

The two inlets to the drain trap are for **VENT PIPE** and **CONDENSATE COLLECTION**. The vent pipe inlet is smaller than the condensate collection inlet. Ensure that the drain hoses are properly connected.

DRAIN HOSE INSTALLATION:

1. Affix the drain trap assembly to the exterior of the side panel.
2. Slide a hose clamp over the end of each hose.
3. Slide each hose over the appropriate inlet.
4. Slide each hose clamp to approximately one-eighth inch from the end of the hose.

Figure 25: Exhaust Vent / Combustion Air Intake



5. Fasten each drain hose to its inlet by tightening the hose clamps.
6. Cut each drain hose near the blower division panel, at the point where kinking is able to occur.
7. Slide a hose clamp over the ends of the hose connecting to the vent drain and condensate drain.
8. Insert an end of the plastic elbow (supplied) into each hose.
9. Trim the remaining lengths of hose from the drain trap inlets to fit properly with the elbows from the vent drain and condensate drain.
10. Slide a hose clamp over the ends of the hoses. Slide the trimmed hose ends onto their appropriate elbow. Slide each hose clamp to approximately one-eighth to one-quarter inch from the end of the hose then tighten.

Figure 26: Drain Trap



DRAIN PIPING

Condensate from the outlet of the drain trap assembly must be conveyed to a floor drain, sump pit, or, if these are unavailable, to a condensate pump. If using a condensate pump, be sure that it is approved for use for furnace condensate.

CAUTION

DO NOT DRAIN THE CONDENSATE OUTDOORS. DO NOT RUN THE CONDENSATE LINE THROUGH AREAS WHERE FREEZING MIGHT OCCUR. FREEZING OF CONDENSATE CAN RESULT IN ERRATIC FURNACE OPERATION AND IN PROPERTY DAMAGE.

The condensate drainage configuration requires a vent. It takes less than a one inch rise anywhere along the horizontal route of the drain tube to create a vapor lock, which will prevent condensate from draining away freely, and result in erratic furnace operation; see Figure 19. A typical configuration would be to cement the side branch of a ½ inch CPVC tee to the drain trap assembly outlet, with the end branches oriented vertically. A 1 inch piece of ½ CPVC pipe cemented to the upper end branch will serve as a vent, which will prevent the creation of a vapor lock, and serve as an overflow in the event that the drain line becomes blocked. A similarly sized piece of pipe cemented to the lower end branch will permit connection to the condensate outlet with 5/8" ID / 7/8" OD flexible tubing, or, the condensate may be piped entirely in CPVC to the floor drain / sump / condensate pump.

IMPORTANT: If an air conditioning evaporator coil drain is to share the furnace drain line, it should be connected with a tee fitting downstream from the vent. Do not connect the evaporator coil condensate drain to the vent serving the furnace drain trap assembly.

CONDENSATE NEUTRALIZERS

Some local codes may require the use of a condensate neutralizer. If the furnace condensate is to be routed to a septic system, it may be advisable to use a condensate neutralizer.

Figure 27: Condensate trap / Condensate Drainage with Vent

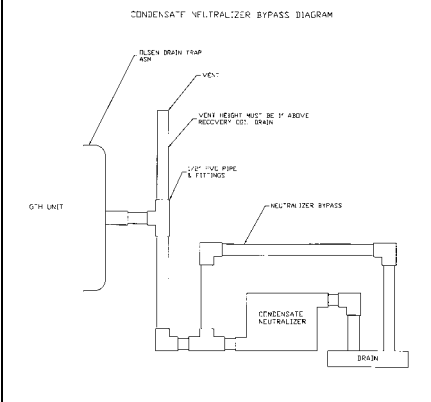


Condensate neutralizers such as the *Ward Industries 90+ Neutralizer* are available through heating supply wholesalers.

When condensate neutralizers are used, it is advisable to install it with an overflow bypass tube.

Approximately one cup of water down the hose. Water will begin running out the condensate drain trap outlet when it is full. Re-fasten the vent drain hose to the induced blower assembly elbow / drain fitting.

Figure 28: Condensate By-pass.



IMPORTANT: The condensate drain trap assembly should be full of water before starting the furnace. To fill the condensate drain trap assembly, temporarily remove the vent drain hose from the induced blower assembly elbow / drain fitting, and pour approxi-

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-B149.1 and 2, 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 29: Furnace Gas Pipe Connections - Note Rubber Grommet



⚠ IMPORTANT:

To maintain a good seal in the burner area, the gas piping through the side panel into the furnace must be half inch A53 black iron pipe. The pipe passes through a special rubber grommet that is custom manufactured to seal tightly around the gas pipe.

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-B149.1 & 2, 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*[®] or *Search*[®], 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



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 6.

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 2000 feet above sea level. Table 7 illustrates the impact of altitude for selected elevations. Consult with local fuel suppliers or authorities to determine local regulations or customs.

TABLE 6: HIGH ALTITUDE SPECIFICATIONS - CANADA

MODEL	ALTITUDE feet	INPUT BTU/hr	OUTPUT BTU/hr	NAT. ORIFICE	L.P. ORIFICE	QTY
GTH-050	0 - 2000	50,000	47,000	1.95 mm	1.20 mm	3
	2000 - 4500	45,000	42,300	1.90 mm	1.15 mm	
GTH-070	0 - 2000	70,000	65,800	1.95 mm	1.20 mm	4
	2000 - 4500	63,000	59,220	1.90 mm	1.15 mm	
GTH-085	0 - 2000	85,000	80,750	1.95 mm	1.20 mm	5
	2000 - 4500	76,500	72,675	1.90 mm	1.15 mm	
GTH-100	0 - 2000	100,000	95,000	1.95 mm	1.20 mm	6
	2000 - 4500	90,000	85,500	1.90 mm	1.15 mm	

TABLE 7: HIGH ALTITUDE SPECIFICATIONS - UNITED STATES

MODEL	ALTITUDE feet (max.)	INPUT BTU/hr	OUTPUT BTU/hr	NAT. ORIFICE	L.P. ORIFICE	QTY
GTH-050	0 - 2000	50,000	47,000	1.95 mm	1.20 mm	3
	2000 - 3000	44,000	41,360	1.83 mm	1.13 mm	
	3000 - 4000	42,000	39,480	1.79 mm	1.10 mm	
	4000 - 5000	40,000	37,600	1.74 mm	1.07 mm	
	5000 - 6000	38,000	35,720	1.70 mm	1.05 mm	
GTH-070	0 - 2000	70,000	65,800	1.95 mm	1.20 mm	4
	2000 - 3000	61,600	57,904	1.83 mm	1.13 mm	
	3000 - 4000	58,800	55,272	1.79 mm	1.10 mm	
	4000 - 5000	56,000	52,640	1.74 mm	1.07 mm	
	5000 - 6000	53,200	50,008	1.70 mm	1.05 mm	
GTH-085	0 - 2000	85,000	80,750	1.95 mm	1.20 mm	5
	2000 - 3000	74,800	71,060	1.83 mm	1.13 mm	
	3000 - 4000	71,400	67,830	1.79 mm	1.10 mm	
	4000 - 5000	68,000	64,600	1.74 mm	1.07 mm	
	5000 - 6000	64,600	61,370	1.70 mm	1.05 mm	
GTH-100	0 - 2000	100,000	95,000	1.95 mm	1.20 mm	6
	2000 - 3000	88,000	83,600	1.83 mm	1.13 mm	
	3000 - 4000	84,000	79,800	1.79 mm	1.10 mm	
	4000 - 5000	80,000	76,000	1.74 mm	1.07 mm	
	5000 - 6000	76,000	72,200	1.70 mm	1.05 mm	

NATURAL TO L.P. GAS

The GTH 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 GTH 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.

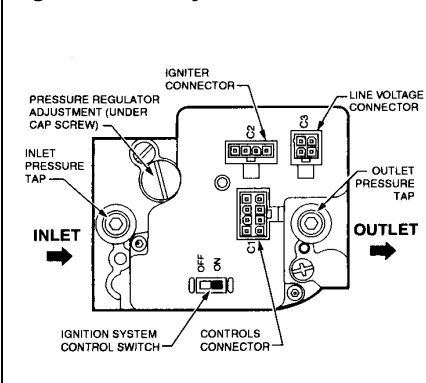
If, in all other respects the furnace is ready to be fired, continue with the following steps. If not, complete the remainder of the installation then return to these steps before starting the *Start-up & Set-up* section.

Figure 30: Inshot Burner Assembly



SETTING THE GAS PRESSURE

Figure 31: 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: 10.5 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.

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-149.1 & 2, 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.

⚠ 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.

Figure 32: White-Rodgers gas valve

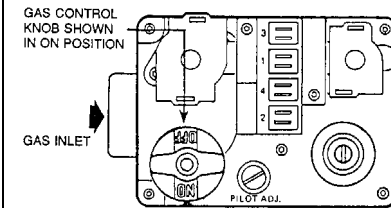
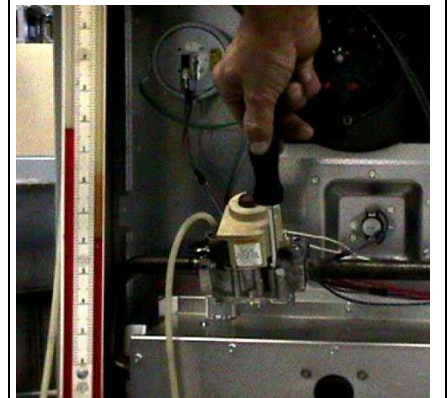


Figure 34: Regulator Adjustment



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 33: 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 GTH 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.

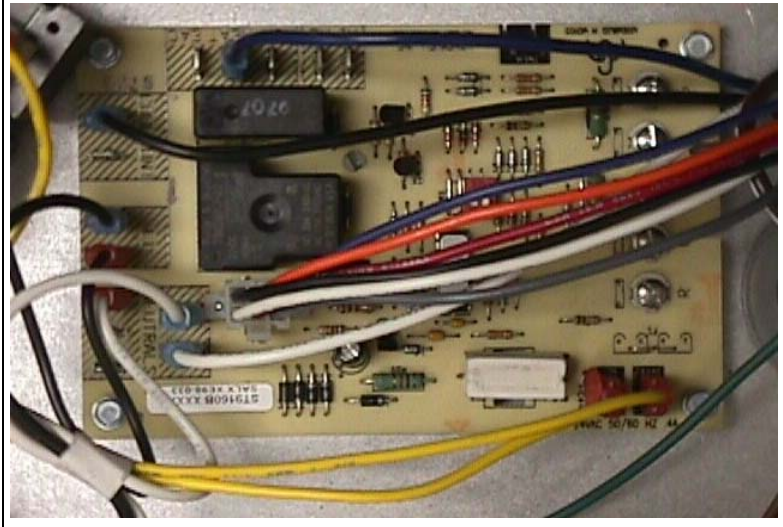
FAILING TO GROUND THE FURNACE PROPERLY CAN RESULT IN ELECTRIC SHOCK RESULTING IN PERSONAL INJURY OR DEATH.

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 35: Electrical Connections / Molex Connector



Figure 36: 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.

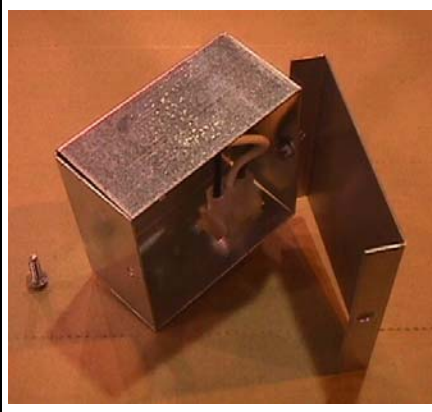
Use good quality wire nuts; e.g. Marrette® connectors, Ideal® wire nuts, etc.

**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 37.
4. Fasten the junction box to the right hand panel.

Figure 37: 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 29.

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.

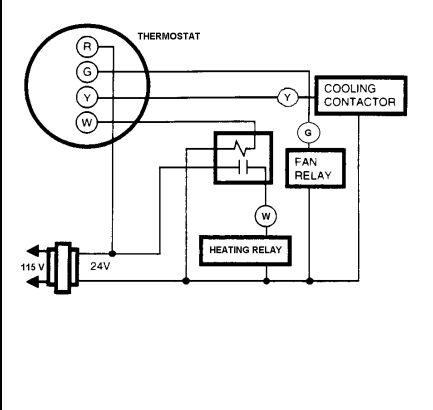
THERMOSTAT

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 38.

Figure 38: 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

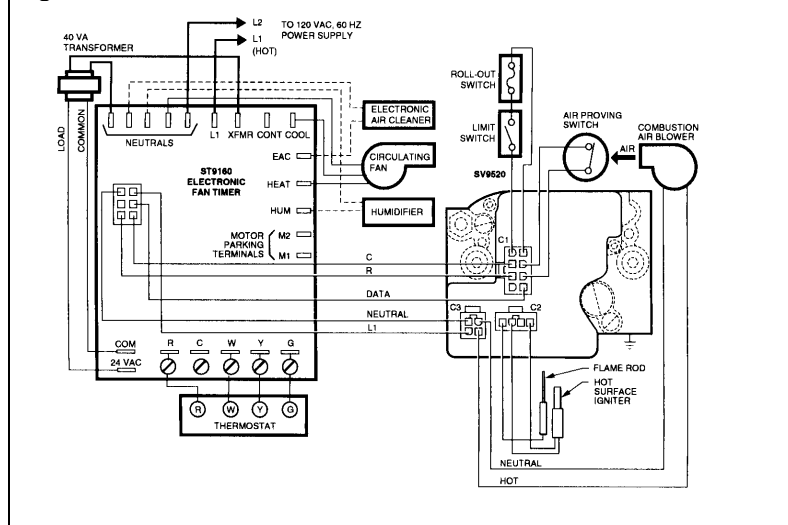
Both the Honeywell and White-Rodgers control modules have provisions to supply power and control a line voltage humidifier or the primary of a 120 / 24 volt humidifier step down transformer, rated at 120vac, 1.0 amp max.

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 39: 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.
5. If equipped with a White-Rodgers 36E36 gas valve, turn the gas control knob to the "ON" position.
6. 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.

NOTE: On initial start-up, the drain trap assembly will be dry. A dry trap will allow flue gases to flow through the recovery coil drain, which will prevent the condensate from draining from the recovery coil. If enough condensate accumulates in the recovery coil, the recovery coil pressure switch will sense this condition and break its electrical contacts, and extinguish combustion. If this takes place, the induced blower will stop after a brief post-purge cycle, the condensate will drain out and fill the trap. If the thermostat is still calling for heat, the ignition sequence will start again after a 5-minute wait.

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 air proving pressure switch and chamber 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 two pressure switch contacts open.
9. The circulating fan continues to run until timed out in 60 to 150 seconds, depending on the ST9160B dipswitch 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 both sets of pressure switch contacts are closed; and have failed to open since the last cycle, all subsequent steps will fail to occur.
4. The air proving pressure switch and chamber pressure switch contacts close. The two pressure

switches must close their contacts within 30 seconds. If they fail to do so, the induced 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 both sets of 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. Both sets of pressure switch contacts open.

11. The circulating fan continues to run until timed out in 60 to 150 seconds, depending on the ST9160B dipswitch 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 air proving pressure switch and chamber 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. Both sets of pressure switch contacts open.
9. The circulating fan continues to run until timed out in 60 to 180 seconds, depending on the 50A65 dipswitch 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 both sets of pressure switch contacts are closed; and have failed to open since the last cycle, all subsequent steps will fail to occur.
4. The air proving pressure switch and chamber pressure switch contacts close. *If either set of 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 air 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 8 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 8 shows the actual input of the furnace based on the heating value of the natural gas in BTU / ft³.

TABLE 9 shows the meter timings when the furnace is running at rated input, with respect to the heating value of the gas.

TABLE 8: INPUT VALUES

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

TABLE 9: GAS METER TIMINGS

METER TEST DIAL TIMINGS FOR FULL RATED INPUT													
MODEL	METER TEST DIAL	HEATING VALUE OF GAS - BTU / FT ³											
		900		950		1000		1050		1100		2520 (L.P.)	
		MIN	SEC	MIN	SEC	MIN	SEC	MIN	SEC	MIN	SEC	MIN	SEC
GTH-050	¼ ft ³	-	15	-	16	-	17	-	18	-	18	-	42
	½ ft ³	-	30	-	32	-	33	-	35	-	37	1	24
	1 ft ³	1	0	1	4	1	7	1	10	1	14	2	49
	2 ft ³	2	1	2	7	2	14	2	21	2	27	5	38
	0.01 m ³	-	21	-	22	-	24	-	25	-	26	-	60
	0.05 m ³	1	46	1	52	1	58	2	4	2	10	4	58
GTH-070	¼ ft ³	-	11	-	11	-	12	-	13	-	13	-	30
	½ ft ³	-	22	-	23	-	24	-	25	-	26	-	60
	1 ft ³	-	43	-	45	-	48	-	50	-	53	2	1
	2 ft ³	1	26	1	31	1	36	1	40	1	45	4	2
	0.01 m ³	-	15	-	16	-	17	-	18	-	19	-	43
	0.05 m ³	1	16	1	20	1	24	1	29	1	33	3	33
GTH-085	¼ ft ³	-	9	-	9	-	10	-	10	-	11	-	25
	½ ft ³	-	18	-	19	-	20	-	21	-	22	-	50
	1 ft ³	-	35	-	37	-	39	-	41	-	43	1	39
	2 ft ³	1	11	1	15	1	19	1	23	1	27	3	19
	0.01 m ³	-	13	-	13	-	14	-	15	-	15	-	35
	0.05 m ³	1	3	1	6	1	10	1	13	1	17	2	55
GTH-100	¼ ft ³	-	8	-	8	-	8	-	9	-	9	-	21
	½ ft ³	-	15	-	16	-	17	-	18	-	18	-	42
	1 ft ³	-	30	-	32	-	33	-	35	-	37	1	24
	2 ft ³	1	0	1	4	1	7	1	10	1	14	2	49
	0.01 m ³	-	11	-	11	-	12	-	12	-	13	-	30
	0.05 m ³	-	53	-	56	-	59	1	2	1	5	2	29

AIR FLOW

For proper furnace operation, air flow 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 ΔT .
5. Compare the measured ΔT 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 ΔT is above the approved temperature range, there is too little air flow. It must be increased by

TABLE 10: AIR FLOW SPECIFICATIONS

MODEL GTH -	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	GT12- 7DD ½	HIGH	1361	1328	1305	1259	1212	1162	1110
		M-HI	1132	1121	1109	1097	1060	1035	996
		M-LO	776	772	772	763	755	723	705
		LOW	530	505	492	478	464	450	427
070	GT12- 7DD ½	HIGH	1361	1328	1305	1259	1212	1162	1110
		M-HI	1132	1121	1109	1097	1060	1035	996
		M-LO	776	772	772	763	755	723	705
		LOW	530	505	492	478	464	450	427
085	GT12- 10DD ¾	HIGH	1843	1792	1723	1651	1575	1516	1434
		M-HI	1758	1688	1633	1576	1496	1434	1369
		M-LO	1688	1633	1576	1517	1455	1391	1324
		LOW	1497	1456	1413	1369	1301	1254	1179
100	GT12- 10DD ¾	HIGH	1843	1792	1723	1651	1575	1516	1434
		M-HI	1758	1688	1633	1576	1496	1434	1369
		M-LO	1688	1633	1576	1517	1455	1391	1324
		LOW	1497	1456	1413	1369	1301	1254	1179

selecting a faster fan speed, removing restrictions in the ductwork, or adding supply or return ductwork.

If the measured ΔT is too low, there is too much air flow. Use a lower speed tap on the multi-speed motor.

CALCULATING AIR FLOW

There are circumstances where it may be desirable to know the air flow delivery through the duct system, such as when estimating the amount of air flow 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

ΔT 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.

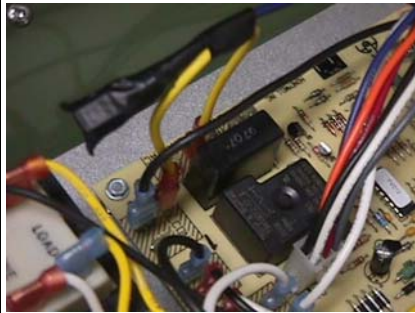
- If the motor is equipped with a power block, remove the blue wire from the existing terminal and re-install it on the desired terminal.

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 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.

Figure 40: 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.



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

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

Figure 41: Honeywell ST9160B Dip Switch Settings

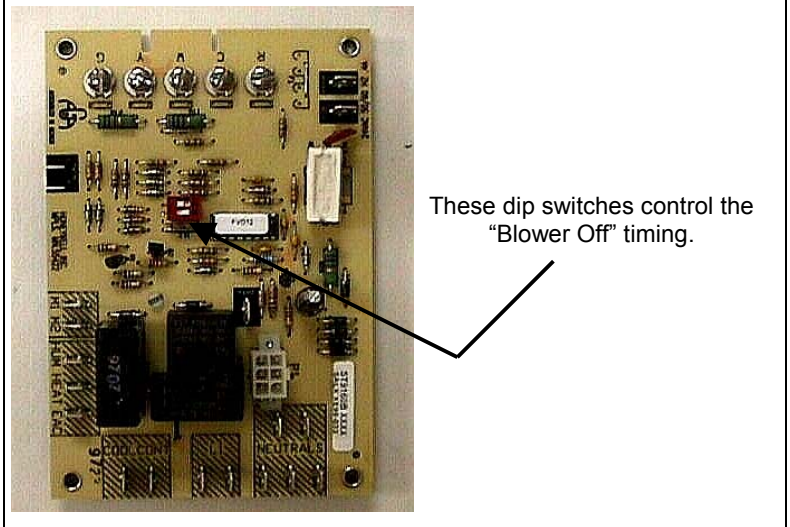
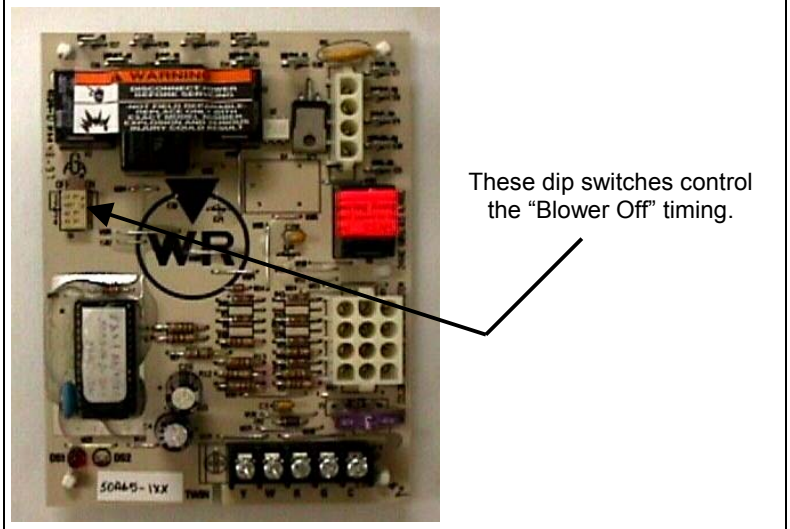


Figure 42: White-Rodgers 50A65 Dip Switch Settings



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

Recommended: Electronic air filters using electrostatic precipitation to remove dust are an excellent filtration device. 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

Figure 43: Air filter Maintenance.



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.

TERMINATIONS

The combustion air and exhaust terminals should be inspected occasionally to ensure that they are free of obstructions and debris. If screens were used in either terminal, ensure that they are free of debris, corrosion, or anything preventing the free flow of air.

INTAKE AIR / EXHAUST PIPING

The combustion air intake piping and exhaust piping should be inspected periodically for sags, evidence of leakage etc. If either condition exists, 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 which 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 combustion air or exhaust piping as a hanger for clothes or anything else.
8. **IMPORTANT:** Never attempt to operate the furnace without the blower door and combustion compartment door in place.

ANNUAL INSPECTION / SERVICE

The furnace must be inspected annually by a qualified installation contractor, service agency or fuel supplier.

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 the combustion air intake and exhaust piping and terminals for blockage. Also check for signs of soot in the condensate drainage. If flame distortion continues after eliminating the blockage in the piping as the cause, it may be necessary to replace the tubular heat exchanger. The recovery coil (secondary heat exchanger) may be cleaned; the tubular (primary 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.

DRAINAGE

The condensate drainage system should be inspected and cleaned if necessary. If the drain trap assembly, or any other component becomes blocked, condensate may backup into the secondary or primary heat exchanger causing nuisance trip-outs of the pressure switches or limit switch. The condensate should be observed for signs of dirt, carbon, debris, etc.

If a condensate neutralizer has been added to the condensate drain, it should be inspected, cleaned, or the condensate neutralizing media should be replaced to ensure clear condensate flow.

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

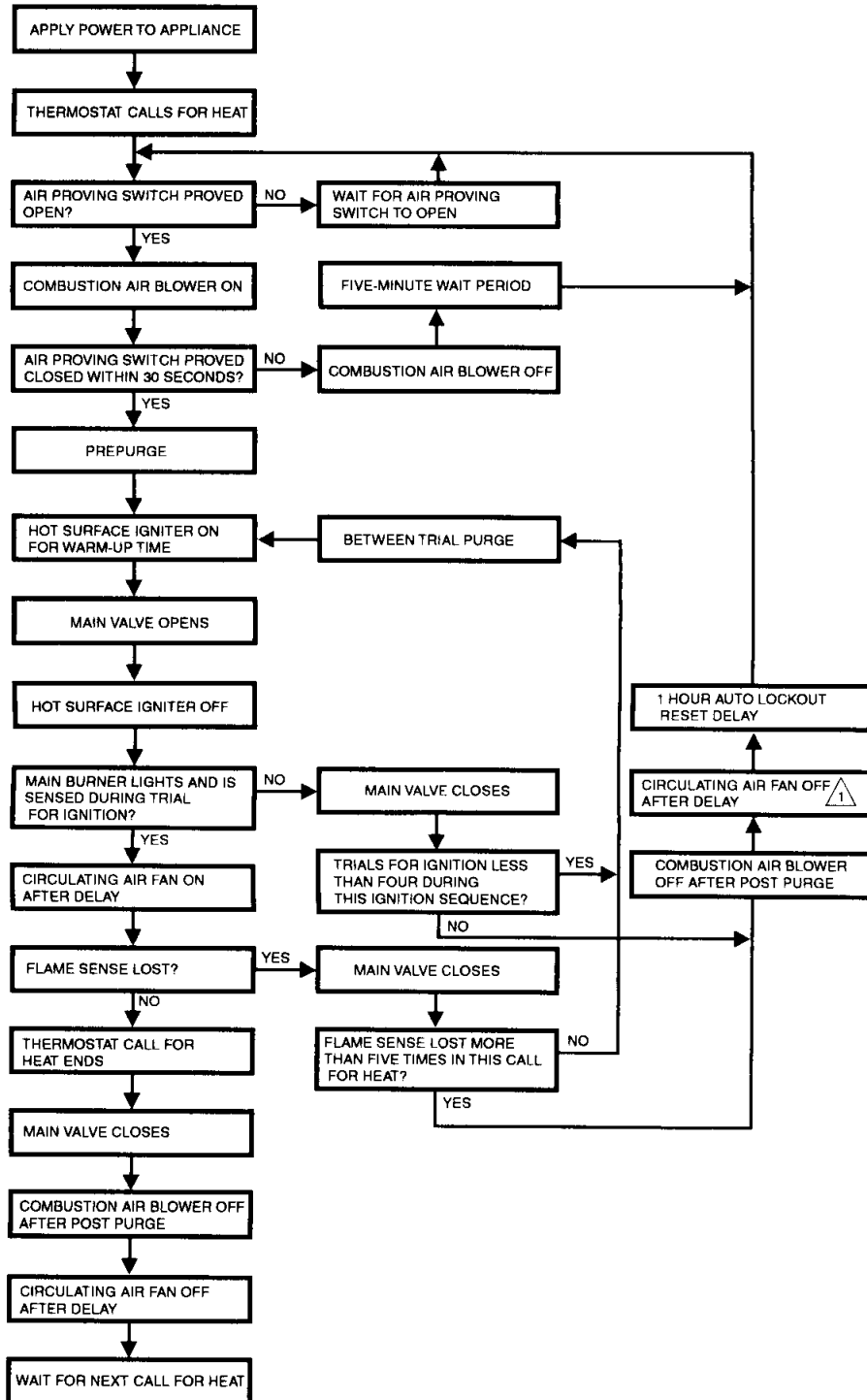


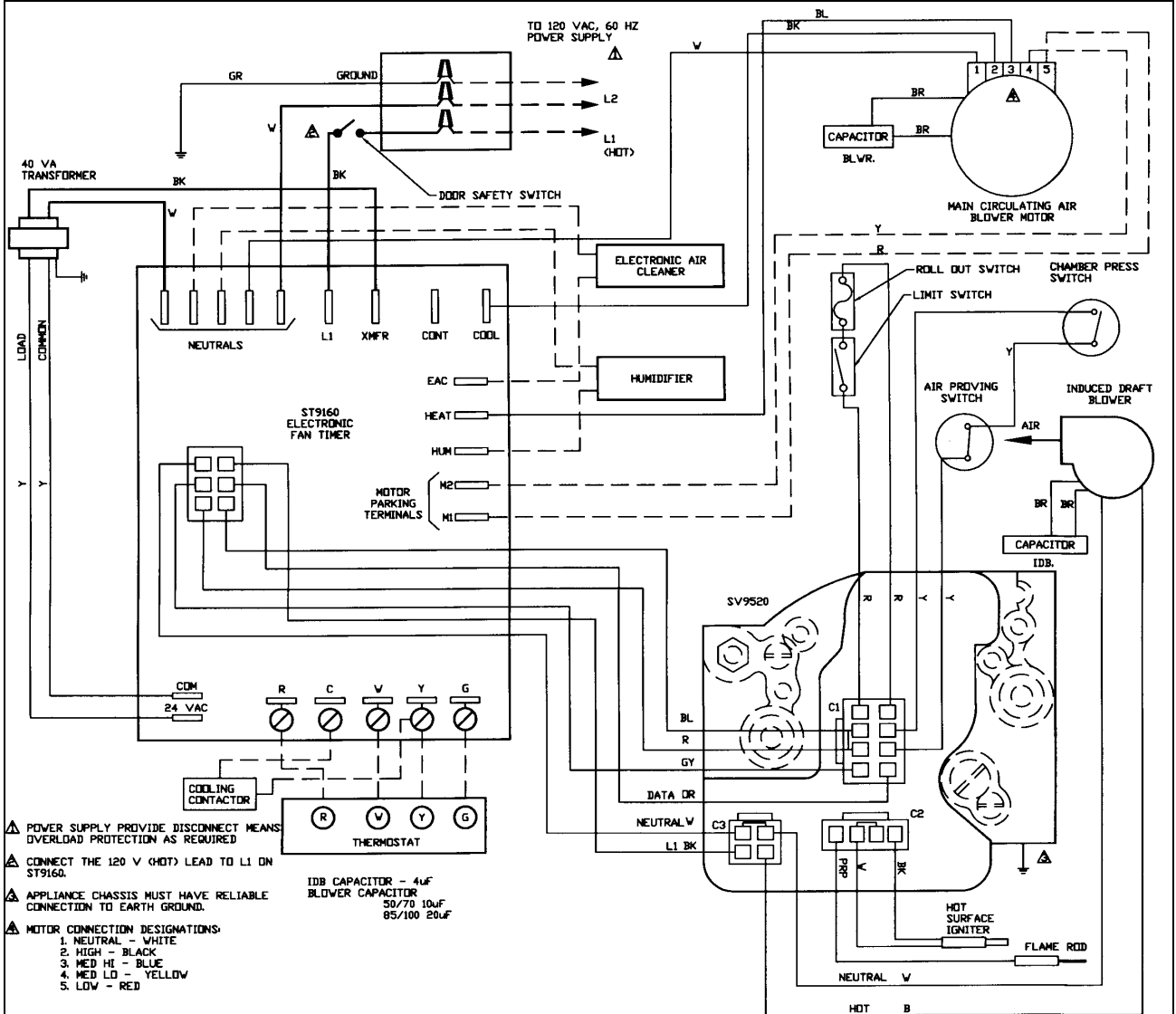
TABLE 11: TROUBLESHOOTING - HONEYWELL ST9160B / SV9520M by LED DIAGNOSTIC LIGHT		
LED STATUS	INDICATES	CHECK or REPAIR
OFF	No power to system control.	<ol style="list-style-type: none"> 1. Line voltage input power at L1 and L2 connectors on ST9160B Electronic Fan Timer (ETF) Terminal Board. 2. Low voltage (24v) power at 24VAC and COM terminals on ST9160B ETF. 3. System wiring harness in good condition and securely connected at both ends.
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>Both pressure switches remain closed longer than 30 seconds after a call for heat begins.</p> <p>Induced blower is not energized until at least one of the pressure switches open.</p>	<ol style="list-style-type: none"> 1. Pressure switches stuck closed. 2. Pressure switches mis-wired or jumpered.
3 Flashes	<p>One or both pressure switches 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"> 1. Ignition system control switch must be in the ON position. 2. Pressure switch operation, tubing and wiring. 3. Obstructions or restrictions in combustion air intake or exhaust piping or terminals preventing proper air flow.
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"> 1. Open flame roll-out switch. 2. Open high temperature switch. 3. Limit and Roll-out switch wiring in good condition and securely connected.
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 lock-out, control will reset and initiate a new ignition sequence, if call for heat is still present.</p>	<ol style="list-style-type: none"> 1. Gas supply OFF, or gas supply pressure too low to operate furnace. 2. Damaged or broken HSI element. 3. Line voltage HOT leadwire not connected to L1 on ST9160B EFT. 4. Furnace not properly earth grounded. 5. Flame sensor rod contaminated or in incorrect position. 6. HSI element located in wrong position. 7. Hot surface element or flame sensor wiring in good condition and properly connected. 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.

TABLE 11: TROUBLESHOOTING - HONEYWELL ST9160B / SV9520M by LED DIAGNOSTICS <i>continued</i>		
LED STATUS	INDICATES	CHECK or REPAIR
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.

TABLE 12: GENERAL TROUBLESHOOTING - HONEYWELL ST9160B / SV9520M

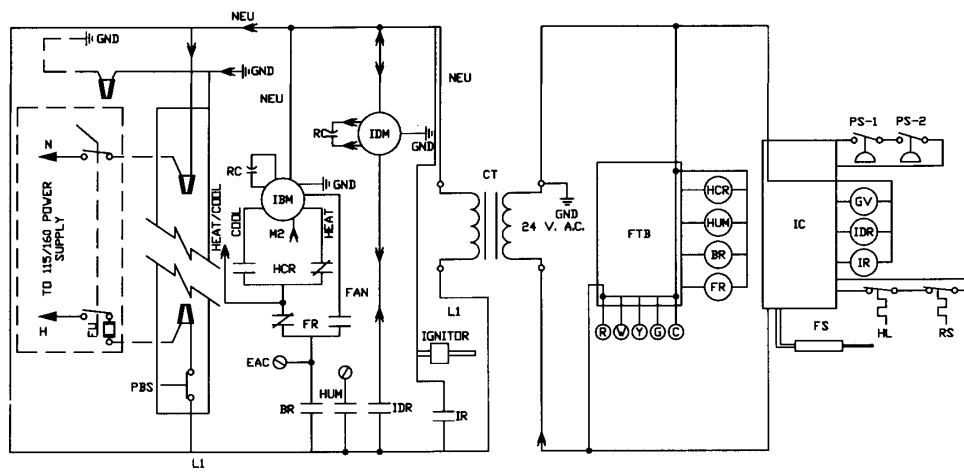
IF	AND	CHECK or REPAIR
Induced blower does not energize.	2 Flash code does not come on 30 seconds after call for heat starts.	<ol style="list-style-type: none"> 1. Induced blower wiring. 2. Induced blower.
Induced blower does not energize.	2 Flash code does come on 30 seconds after call for heat starts.	<ol style="list-style-type: none"> 1. Pressure switches stuck closed. 2. Pressure switches are mis-wired or jumpered.
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"> 1. Ignition system control switch must be in the ON position. 2. One or both pressure switches stuck in the open position. 3. Pressure switch, tubing and wiring. 4. Obstruction in furnace combustion air intake or exhaust piping / terminals that is preventing proper combustion air flow.
Pre-purge time has expired	HSI element does not glow red within 10 seconds.	<ol style="list-style-type: none"> 1. Broken or damaged HSI element. 2. Broken or damaged HSI element lead-wires. 3. SV9520M failure to power HSI element.
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"> 1. Induced blower moving main burner gas away from the HSI element. 2. Inlet gas pressure too low for main burner ignition. 3. Input line voltage too low to heat HSI element. 4. HSI element incorrectly positioned. 5. Clogged or incorrect main burner orifice

TABLE 12: GENERAL TROUBLESHOOTING - HONEYWELL ST9160B / SV9520M <i>continued</i>		
IF	AND	CHECK or REPAIR
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 of HSI element and main gas flow, then go through a between trial 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"> 1. Line voltage to L1 terminal of ST9160B must be 120 volts with reference to furnace chassis. 2. Furnace must be reliably connected to earth ground. 3. induced blower moving main burner flame away from the flame sensor rod. 4. Inlet gas pressure too low for proper flame sensing. 5. Flame sensor rod contaminated or in incorrect position. 6. Wiring between SV9520M and flame sensor rod must be in good condition and properly connected.
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"> 1. Wiring between system control and EFT. 2. 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"> 1. Open burner roll-out switch. 2. Open high limit switch. 3. High limit and burner roll-out switch wiring in good condition and securely connected.
Main burner goes out before thermostat call for heat ends.	4 Flash code does not come on.	<ol style="list-style-type: none"> 1. Intermittent wiring connection between SV9520M and flame sensor rod. 2. Induced blower moving main burner flame away from flame sensor rod. 3. One or both pressure switches has opened. 4. Flame sensor rod ceramic or leadwire overheated. 5. Gas supply / flow reduced or interrupted.
5 Flash code comes on.		Flame at main burner.
<p>6 Flash code comes on.</p> <p>After 1 hour lock-out reset delay, control will reset and initiate a new ignition sequence if the call for heat is still present.</p>		<ol style="list-style-type: none"> 1. Gas supply off or at too low a pressure to operate furnace. 2. Damaged or broken HSI element. 3. Line voltage to L1 terminal of ST9160B EFT must be 120 volts with reference to the furnace chassis. 4. Furnace is not properly connected to earth ground. 5. Flame rod contaminated or in incorrect location. 6. Hot surface element located in incorrect position. 7. Hot surface element or flame sensing rod wiring in good condition and properly connected. 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.



- ⚠ POWER SUPPLY PROVIDE DISCONNECT MEANS OVERLOAD PROTECTION AS REQUIRED
- ⚠ CONNECT THE 120 V (HOT) LEAD TO LI ON ST9160.
- ⚠ APPLIANCE CHASSIS MUST HAVE RELIABLE CONNECTION TO EARTH GROUND.
- ⚠ MOTOR CONNECTION DESIGNATIONS:
 1. NEUTRAL - WHITE
 2. HIGH - BLACK
 3. MED HI - BLUE
 4. MED LO - YELLOW
 5. LOW - RED

IDB CAPACITOR - 4μF
 BLOWER CAPACITOR
 50/70 10μF
 85/100 20μF



- LEGEND**
- FU - FUSE
 - EAC - ELECTRONIC AIR CLEANER
 - HUM - HUMIDIFIER RELAY
 - FR - FAN RELAY
 - HCR - HEAT/COOL RELAY
 - BR - BLOWER RELAY
 - CT - CONTROL TRANSFORMER
 - FS - FLAME SENSOR
 - GND - GROUND
 - GV - GAS VENT
 - IDR - INDUCED DRAFT RELAY
 - FTB - FAN TIMER BOARD
 - IC - IGNITION CONTROL
 - HL - HEAT LIMIT
 - RS - LOWER SWITCH
 - PS-1 - PRESSURE SWITCH #1
 - PS-2 - PRESSURE SWITCH #2
 - IDM - INDUCED DRAFT MOTOR
 - IBM - INDUCED BLOWER MOTOR
 - RC - RUN CAPACITOR
- WIRE NUT**
- WIRE COLOUR CODES**
- | | |
|----------|------------|
| BK BLACK | PRP PURPLE |
| BR BROWN | R RED |
| BL BLUE | W WHITE |
| G GREEN | Y YELLOW |
| D DRANGE | GY GREY |

REPLACEMENT WIRE MUST BE THE SAME SIZE AND TYPE OF INSULATION AS ORIGINALLY SUPPLIED(105° C MIN.)

HONEYWELL SV9520 AND ST9160 CONTROLS

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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