

Thermo Pride



CONDENSING GAS FURNACE 2190 SERIES

INSTALLATION AND INSTRUCTION MANUAL

MODELS GHC60, 80, 100

WARNING: If the information in these instructions is not followed exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.

WHAT TO DO IF YOU SMELL GAS

- Do not try to light any appliance.
- Do not touch any electrical switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier; call the fire department.

Installation and service must be performed by a qualified installer, service agency or the gas supplier.

PLEASE READ THESE INSTRUCTIONS PRIOR TO INSTALLATION, INITIAL FIRING, AND BEFORE PERFORMING ANY SERVICE OR MAINTENANCE. THESE INSTRUCTIONS MUST BE LEFT WITH THE HOMEOWNER AND SHOULD BE RETAINED FOR FUTURE REFERENCE BY QUALIFIED SERVICE PERSONNEL.

MG-301E

4940

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INDEX

<u>SECTION</u>	<u>PAGE</u>
SPECIFICATIONS	II.
HOOK UP AND COMPONENTS FOR GHC SERIES	III.
GHC SERIES COMPONENTS LOCATIONS	IV.
I. GENERAL INSTRUCTIONS	1
II. GENERAL INSTALLATION	1
A. CODES AND CLEARANCES	1
B. FURNACE LOCATION	2
C. REQUIREMENTS FOR COMBUSTION AIR & VENTILATION	2
D. REQUIREMENTS FOR VENTING	3
E1. HORIZONTAL VENTING	6
E2. VERTICAL VENTING	7
F. CONNECTING FURNACE TO OUTSIDE VENT TERMINALS	8
G. ALTERNATE LEFT SIDE VENTING	10
H. CPVC DRAIN LINES	10
I. GAS PIPING GENERAL	11
J. INSTALLATION OF GAS PIPING	12
K. REQUIREMENT AND SIZING OF DUCT WORK	14
L. FILTER RACKS	16
M. WIRING	16
N. REPLACING EXISTING FURNACE FROM COMMON VENT	18
III. OPERATION	19
A. INITIAL START UP	19
B. SEQUENCE OF OPERATION	20
C. FURNACE CHECK OUT PROCEDURE	21
D. SETTING COMBUSTION	24
IV. DEALER MAINTENANCE INSTRUCTIONS	25
A. CLEANING AND INSPECTING RADIANT BURNER	25
B. REMOVING THE BURNER FOR SERVICE	26
C. CLEANING THE PRIMARY HEAT EXCHANGER	27
D. CLEANING THE SECONDARY HEAT EXCHANGER	28
E. REMOVING THE SECONDARY HEAT EXCHANGER	29
V. INSTALLERS INSTRUCTIONS TO USER	30
IV. TROUBLESHOOTING	31
VII. FURNACE PARTS LIST	36

This and the following page contain reproductions of the various warning and instruction labels placed on the Thermo Pride Condensing Gas Furnaces. Please read and comply with the contents of these labels.

OPERATING INSTRUCTIONS ARE LOCATED INSIDE APPLIANCE NEAR BURNER ASSEMBLY.

SPECIAL HOMEOWNERS INSTRUCTIONS

WARNING: IMPROPER INSTALLATION, ADJUSTMENT, ALTERATION, SERVICE OR MAINTENANCE CAN CAUSE INJURY OR PROPERTY DAMAGE. REFER TO THE OWNER'S INFORMATION MANUAL PROVIDED WITH THIS FURNACE. FOR ASSISTANCE OR ADDITIONAL INFORMATION CONSULT A QUALIFIED INSTALLER, SERVICE AGENCY OR THE GAS/OIL SUPPLIER.

⚠ WARNING

The following items should be inspected every year by a qualified heating contractor. Correct any deficiencies at once.

Heat Exchanger: Inspect for corrosion, pitting, warpage, deterioration, carbon build up and loose gaskets.

Burner: Check for correct operation, proper combustion, no fuel leakage, and if provided, clean burner filter.

Chimney/Vent Pipe: Inspect for restriction, loose joints, abnormal carbon build up and condensation.

Controls: Check for correct operation and proper settings, (if manually adjustable).

Periodic visual inspections should also be made by the owner during the heating season. Call a qualified heating contractor to report suspected deficiencies. (Do not attempt to make repairs yourself!)

Further owner and heating contractor responsibilities are detailed in the installation and maintenance instruction manual. (Shut off power before inspecting.)

THIS FURNACE MUST BE INSTALLED IN ACCORDANCE WITH THERMO PRODUCTS INSTRUCTION AND LOCAL CODES. IN ABSENCE OF LOCAL CODES, FOLLOW THE NATIONAL FUEL GAS CODE-ANSI Z223.1

A TYPE B-2 VENT MUST BE INSTALLED WHEN THE LISTED FLUE PIPE CLEARANCE FROM COMBUSTIBLE CONSTRUCTION IS USED. REFER TO INSTALLATION INSTRUCTIONS NO. MG-900 FOR PARTS LIST AND METHOD OF INSTALLATION. IF SIDE WALL VENTING, THIS APPLIANCE REQUIRES A SPECIAL VENTING SYSTEM. REFER TO INSTALLATION INSTRUCTIONS NO. MG-950 FOR PARTS LIST AND METHOD OF INSTALLATION.

WARNING: THIS UNIT MUST BE INSTALLED AND SERVICED BY A QUALIFIED CONTRACTOR ONLY.

FOR YOUR SAFETY

Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.

FOR YOUR SAFETY

If you smell gas:

1. Open window.
2. Don't touch electrical switches.
3. Extinguish any open flame.
4. Immediately call your gas supplier.

FOR INSTALLATION ON COMBUSTIBLE FLOORING

NOTICE

PURE COPPER IS DEPOSITED ON THE SURFACE OF THE HEAT EXCHANGER. IT WILL REMAIN PERMANENTLY ON THE HEAT EXCHANGER, ACTING AS A CORROSION INHIBITOR. THE VEHICLE THAT DEPOSITS THE COPPER ON THE HEAT EXCHANGER WILL BURN OFF ON INITIAL FIRING AND MAY CREATE AN UNPLEASANT ODOR. IT IS SUGGESTED THAT A WINDOW BE OPENED AND THE FURNACE REMAIN OPERATING UNTIL SMOKE IS DISSIPATED.

-REMOVE THIS TAG BEFORE FIRING-

DESIGNED MAXIMUM OUTLET AIR TEMPERATURE °F
THIS FURNACE IS CERTIFIED FOR INSTALLATION WITH MINIMUM CLEARANCES TO COMBUSTIBLE CONSTRUCTION FROM THE TOP FROM THE FRONT FROM THE BACK FROM THE LEFT SIDE FROM THE RIGHT SIDE AND FROM THE FLUE PIPE
MINIMUM GAS SUPPLY PRESSURES ARE FOR PURPOSE OF INPUT ADJUSTMENT.
NORMAL MANIFOLD PRESSURE WC
MAXIMUM GAS SUPPLY LP 14" WC
MINIMUM GAS SUPPLY LP 11" WC
MAXIMUM GAS SUPPLY NAT 14" WC
MINIMUM GAS SUPPLY NAT WC

"FOR INDOOR INSTALLATION" IN BUILDING CONSTRUCTED ON-SITE

SHOULD THIS UNIT BE DISASSEMBLED ALL COMPONENTS, PANELS, BLOCK OFFS, COLLARS, GASKETS, AND FASTENERS MUST BE REASSEMBLED AS ORIGINALLY FACTORY PRODUCED.

OUTSIDE POWER SOURCE
115 V. 60 CYCLE TO BE CONNECTED TO WIRES INSIDE THIS BOX.
CONNECT WIRE L1 TO THE "HOT" LINE.
CONNECT WIRE L2 TO THE "COMMON" LINE.

This page contains various warnings and cautions reproduced from the Condensing Gas Furnace Manual. Please read and comply with the statements below.

CAUTION: The vent elbow must be kept away from bushes, shrubs or any vegetation that may restrict the flow of flue products. It must also be kept clear of any leaves, weeds or other combustible materials. Keep the vent hood clear of snow. Avoid areas where standing water or condensate drippage may be a problem.

CAUTION: Improper drain connection will prevent proper operation of unit. Use only 1/2" CPVC or PVC condensate pipe to house drain.

CAUTION: The furnace and its individual gas valve must be disconnected from the gas supply during pressure testing of the gas supply system at pressures in excess of 1/2 PSIG or 14.0" wc. The furnace must be isolated from the gas supply piping by closing the knob on its individual gas valve during pressure testing of the piping at test pressures equal to or less than 1/2 PSIG or 14" wc.

WARNING: Turn off power to furnace. Before gas piping system is placed into service, it must have been leak tested by a qualified service technician (See Section J of these instructions on the installation of gas piping).

WARNING: After purging gas, ventilate area for at least 15 minutes before attempting to start the furnace. LP gases are heavier than air and may accumulate in dangerous concentrations at floor level.

WARNING: When adjusting primary air slide, never close slide passed lowest point where "click" occurred during cold start.

WARNING: When the burner has to be removed for service, do not touch, brush or bump the surface of the mantle. To reduce chances of damaging the burner mantle, follow the instructions below carefully.

2190 GAS CONDENSING FURNACE SPECIFICATION SHEET

MODEL NO.	GHC-60		GHC-80		GHC-100	
BTU/HR INPUT	60,000		80,000		100,000	
BTU/HR OUTPUT (1)	55,200		72,800		90,000	
HT. OF CASING	52"		52"		52"	
WIDTH OF CASING	19"		20"		20"	
DEPTH OF CASING	27"		27"		27"	
WARM AIR OUTLET	17"X18"		18"X18"		18"X18"	
RETURN AIR INLET	16"X20"		16"X20"		16"X20"	
DIAMETER OF FLUE	2" PVC		2" PVC		3" PVC	
DIA. OF COMBUSTION						
AIR COLLAR	3" PVC		3" PVC		3" PVC	
CFM AND EXTERNAL						
STATIC	.20	.50	.20	.50	.20	.50
HIGH SPEED	1515	1380	1835	1625	2320	2020
MH SPEED	1300	1200	1505	1400	1905	1795
ML SPEED	1100	980	1195	1165	1550	1505
LOW SPEED	755	610	1020	1020	1235	1220
TEMPERATURE RISE	40°F	70°F	40°F	70°F	40°F	70°F
BLOWER HORSE POWER	1/3		1/2		3/4	
NO. OF SPEEDS	4		4		4	
LARGEST RECOMMENDED						
A/C (2)	3.5 TON		4 TON		5 TON	
SIZE OF PERMANENT						
FILTER	20"X20"X1"		20"X20"X1"		20"X20"X1"	
HEATING SURFACE IN						
SQ. INCHES	2140		2332		2598	
APPROX. SHIPPING						
WEIGHT	240 LBS.		245 LBS.		250 LBS.	
SEASONAL EFFICIENCY						
(AFUE) (3)	92.0%		91.0%		90.0%	
SIZE OF CPVC						
CONDENSATE LINE	1/2"		1/2"		1/2"	

1. BTU output based on 92% steady state combustion efficiency rated by manufacturer.

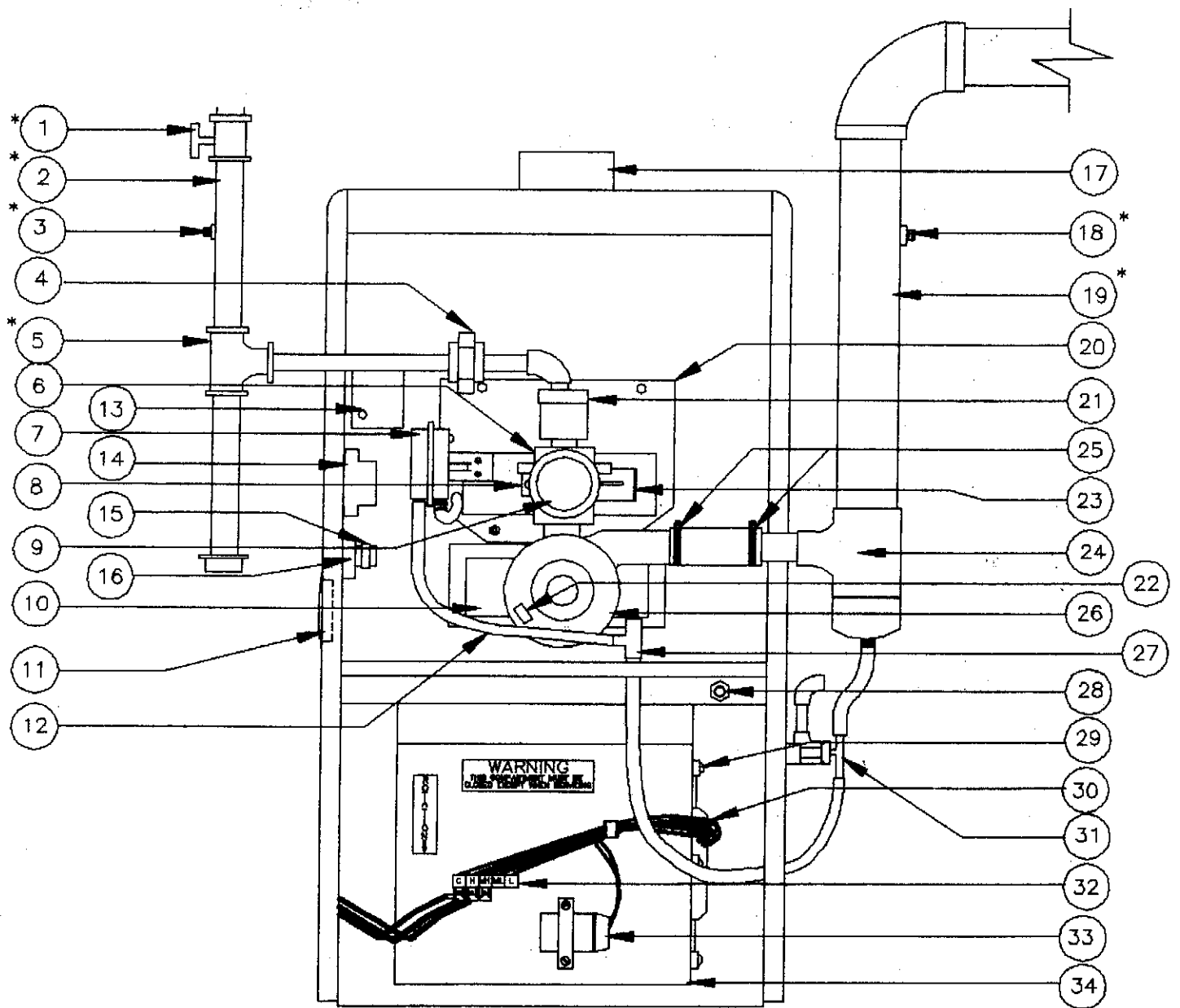
2. High speed tap on motor is required for largest recommended air conditioner.

3. Seasonal efficiency or annual fuel utilization efficiency ratings are based on U.S. Department of Energy test results.

HOOK UP AND COMPONENTS FOR GHC SERIES

- *1. Manual shut off valve.
- *2. Black iron steel pipe.
- *3. 1/8" NPT plugged pipe tapping.
 - 4. Ground joint pipe union.
- *5. Black iron pipe tee.
 - 6. Cast iron filter mounting block.
 - 7. Large pressure switch.
 - 8. Combustion air filter end switch.
 - 9. Corrugated combustion air filter.
- 10. Condenser clean out box.
- 11. Plastic plug.
- 12. 1/2" diameter pressure tube.
- 13. Combination fan and limit control.
- 14. Ignition module.
- 15. Fan control center.
- 16. Junction box.
- 17. 3.0" Diameter Combustion Air Collar
- *18. Flue gas sample plug.
- *19. PVC vent pipe.
 - 20. Burner mounting plate.
 - 21. Gas valve.
 - 22. Inducer motor relay.
 - 23. Combustion air adjustment slide.
 - 24. PVC tee assembly.
 - 25. Hose clamps.
 - 26. Inducer assembly.
 - 27. Plastic tee.
 - 28. Door interrupt switch.
 - 29. Motor mounting bracket.
 - 30. House blower motor.
 - 31. 1/2" CPVC drain trap assembly.
 - 32. Motor speed terminal strip.
 - 33. Motor capacitor.
 - 34. House blower assembly.

* Indicates items not supplied by Thermo Products.



GHC SERIES COMPONENT LOCATIONS.

I. GENERAL INSTRUCTIONS

These instructions must be read in their entirety before installation of the furnace. It is the installer's responsibility to do the following.

1. Inform the customer and/or user that: **ALL INSTALLATION AND SERVICE MUST BE PERFORMED BY A QUALIFIED INSTALLER OR PROFESSIONAL SERVICE PERSONNEL.**
2. Inform and demonstrate to the user the correct operation and maintenance of the appliance as explained in Section V of this manual, Installers Instructions to User.
3. Inform the user of the hazards of using or storing flammable liquids and vapors in the vicinity of the appliance. Have the owner or user remove any such products from the area in your presence.
4. Inform the customer or user that failure to install, maintain and operate this furnace in accordance with these instructions could result in hazardous conditions, bodily injury, property damage and could void the limited warranty of the furnace.
5. Inform the owner or user that these instructions, the User's Information Manual and the instructions for any accessories, such as a thermostat or condensate pump, must be kept in the plastic pouch on the blower door.

II. GENERAL INSTALLATION

NOTICE: This furnace is not to be used as a construction heater.

This furnace is shipped completely assembled, wired, factory tested and adjusted for the gas shown on the furnace label. For parts shortage or damage, follow the instructions in the Freight Policy section of the Thermo Pride Catalog.

A. CODES AND CLEARANCES

The following items must be considered when sizing and locating the furnace.

1. All local codes and/or regulations take precedence over the instructions in this manual and should be followed accordingly. Authorities having jurisdiction should be consulted before installation. In the absence of local codes, installation must conform with these instructions, regulations of the (LATEST EDITIONS) of National Electrical Code ANSI/NFPA70 and the National Fuel Gas Code ANSI Z223.1/NFPA 54.
2. The BTU output capacity of the furnace should be based on heat loss calculations made in accordance with manuals published by the Air Conditioning Contractors of America (ACCA) or ASHRAE.

3. - MINIMUM CLEARANCES TO COMBUSTIBLE MATERIALS -

<u>Model No.</u>	<u>From sides of furnace</u>	<u>Front</u>	<u>Top & Sides of Plenum</u>	<u>From the Vent/Flue</u>	<u>Rear</u>
GHC60-80-100	1"	1"	1"	0"	1"

The above minimum clearances are for fire protection. Clearance for servicing the front of the furnace and to all points on the furnace requiring service must be 24". Both the primary heat exchanger and condenser coil can be cleaned from the front. If for any reason the condenser coil has to be replaced, rear access is required.

This furnace may be installed in an alcove or closet if the listed clearances to combustible construction are maintained. Unless placed on wood or sheet metal covering the width and depth of the furnace, it shall not be placed directly on carpeting, tile or other combustible material other than wood flooring.

4. Definitions of "Combustible Material" and "Non Combustible Material", taken from ANSI Z21-47 standard for gas-fired central furnaces, are as follows:

a. COMBUSTIBLE MATERIAL

As pertaining to materials adjacent to or in contact with heat producing appliances, gas vents, chimneys and warm air ducts, shall mean materials made of or surfaced with wood, compressed paper, plant fibers or other materials capable of being ignited or burned, such material shall be considered combustible even if flame-proof, fire retardant or plastered.

b. NON COMBUSTIBLE MATERIAL

Material which is not capable of being ignited and burned such as materials consisting of or a combination of steel, iron, brick, tile, concrete, slate, glass and plaster.

B. FURNACE LOCATION

NOTE: Authorities having jurisdiction over local codes and ordinances should be consulted before installation.

These high efficiency condensing furnaces are not certified for and shall not be vented into a standard or any type of chimney. The following shall be considered for locating the furnace:

1. For best performance, locate the furnace so that it is centralized with respect to the duct system and as near as possible to a floor drain since condensate drainage must be provided.

2. Place the unit so that proper venting can be achieved, with a minimum number of elbows, in accord with the instructions in this manual. (Section D).

NOTE: If at all possible, the furnace should be located so the flue can be vented from the right side of the furnace to the outside flue termination. Left side venting will increase installation, assembly, and labor time resulting in a more costly installation.

3. The furnace must be located on a level, dry surface. If the area becomes wet or damp at times, the furnace should be raised above the floor using a concrete base, bricks, patio blocks, etc. Check furnace level after installation to ensure proper drainage and trouble-free performance.

4. This furnace must be connected to a drain in accordance with these instructions (Item II H). **If it is not practical to connect the unit to a drain, a condensate pump must be used and can be ordered as an accessory, part number 350225.** If a condensate neutralizer kit is required by local codes or the customer, it is available under part number 320095.

5. A gas fired furnace installed in a residential garage must be installed so that the burner and ignition source are at least 18 inches above floor level and it must be protected from vehicular damage.

6. Provisions for adequate air for combustion and ventilation must be provided in accord with the air for combustion and ventilation section of the National Fuel Gas Code, ANSI Z223.1 (LATEST EDITION), applicable codes and this manual.

C. REQUIREMENTS FOR COMBUSTION AIR AND VENTILATION

The area in which the furnace is located must have an adequate supply of air for combustion and ventilation. Open, non-partitioned basements, below grade utility rooms without storm windows or rooms with loose access doors will generally permit adequate air infiltration.

NOTE: Air requirements for operation of exhaust fans, kitchen vent systems, clothes dryers, fireplaces, etc. must be considered in determining combustion air requirements.

1. If the furnace (and/or other gas-fired appliances) is located in a confined space, but there is adequate air infiltration into the rest of the building, provide two permanent openings into the confined space. The total input of all gas appliances in the confined space determines the sizing of the openings. Each opening shall have a minimum free area of one square inch per 1000 BTU of the input rate of all gas appliances in the space, but not less than 100 square inches. One opening shall be within 6 inches of the top of the wall or door and the other within 6 inches of the bottom.

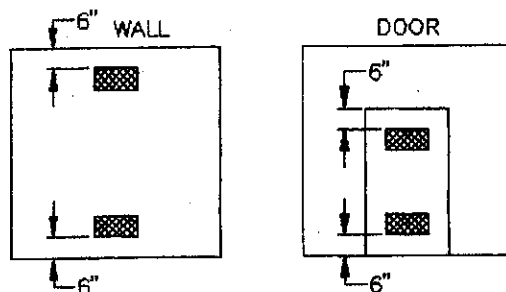


Fig. A

EXAMPLE: A 70,000 BTU input furnace, 40,000 BTU input water heater and 35,000 BTU input gas dryer would require two openings each with a free area of 145 square inches. If only the 70,000 BTU furnace were installed in the confined space each opening would require the minimum 100 square inch free area.

2. If the building is tightly constructed and/or has an exhaust fan(s) which creates a negative pressure, air for combustion must be supplied from the outdoors or from spaces freely communicating with the outdoors. When communicating directly with the outdoors or with vertical ducts to the outdoors, two openings each having a minimum free area of one square inch per 4,000 BTU of the input rating of all gas equipment in the area are required. When horizontal ducts are used, the free area must be based on 2,000 BTU per square inch of the input rating of all equipment in the area. Minimum dimension of air duct shall be at least three inches.

EXAMPLE: A 80,000 BTU input furnace, 40,000 BTU input water heater and 30,000 BTU gas dryer would require two openings of 37.5 square inches each if ducted vertically to the outdoors. If horizontal ducts were used each opening would require 18.75 square inches.

NOTICE: Outside combustion air must not come from an area that is directly adjacent to a pool, hot tub or spa.

D. REQUIREMENTS FOR VENTING

The furnace venting system must be installed by a qualified service person in accord with local codes, the National Fuel Gas Code ANSI Z223.1 (LATEST EDITION) and these instructions. The Thermo Pride High Efficiency Condensing Furnace may be vented vertically through the roof or horizontally through a sidewall. **NOTE:** This furnace shall not be vented through an existing or new chimney.

The following items and local code requirements must be followed:

1. The vent termination supplied by Thermo Products must be used.
2. The "entire" vent system must be made of PVC schedule 40 pipe.
3. Flue vent pipe must be at least as large as the outlet of the tee assembly supplied with the furnace. No size reduction is permissible. The GHC-60 and GHC-80 require 2" diameter schedule 40 PVC pipe, the GHC-100 requires 3" diameter schedule 40 PVC pipe. All three furnaces can use 3" diameter PVC or soil pipe for outside combustion air.

4. This appliance shall not be common vented with any other appliance including those burning solid fuels.

5. Horizontal runs of vent pipe shall slope upward $1/4"$ per foot from the tee outlet at the furnace to the vent termination in the outside wall. This will permit proper drainage of the condensate.

6. The vent pipe must be supported every four feet to prevent pipe blockage caused by condensate trapped in a sag in the vent pipe.

7. An elbow is equivalent to a five foot length of pipe. The maximum length of vent pipe is 45 feet with one elbow or a total of 50 foot. The maximum number of inside elbows allowed is $6 \times 5' = 30$ feet. If six elbows were used, only 20 foot of straight pipe would be allowed, (total length 50-30 feet for the six elbows = 20 foot of pipe). The minimum vent length is six foot or one elbow and one foot of straight pipe. Any combination of straight pipe and elbows $\times 5$ that equals 6 foot or more, but not over 50 is acceptable as long as not more than six elbows are used.

NUMBER OF ELBOWS	MAX. LENGTH VENT PIPE	TOTAL LENGTH	NUMBER OF ELBOW(S)	MAX. LENGTH OF VENT PIPE	TOTAL LENGTH
6	20	50	3	35	50
5	25	50	2	40	50
4	30	50	1	45	50

8. A hack saw may be used to cut the PVC pipe. It must be cut smoothly at 90° angles with all burrs removed. All joints must be sealed air tight using PVC or all-purpose pipe cement. All joints must use standard PVC schedule 40 fittings. Joints are not to be made by gluing together the cut or raw edges of the vent pipe.

9. All vent connections shall be checked for leakage with the induced draft blower running and with the vent termination blocked. Cigarette smoke or a soap and water solution may be used to check for leaks.

10. Vent pipe passing through an unheated space must be insulated with 1.0" thick foil faced fiber glass or its equivalent to prevent freezing of any condensate within the pipe.

11. Minimum clearance from the PVC pipe to combustible material is zero inches. **NOTE: If exterior sidewall building materials are subject to degradation from flue gases or moisture a minimum 12" diameter shield made from stainless steel or high density plastic shall be used for protection.**

12. The maximum wall thickness through which the pipe or vent termination may pass is 18" and the minimum is 2". The maximum distance from the outer wall to the center of the elbow is 12" and the minimum is 4". The screen in the elbow must point down. (See Fig. B).

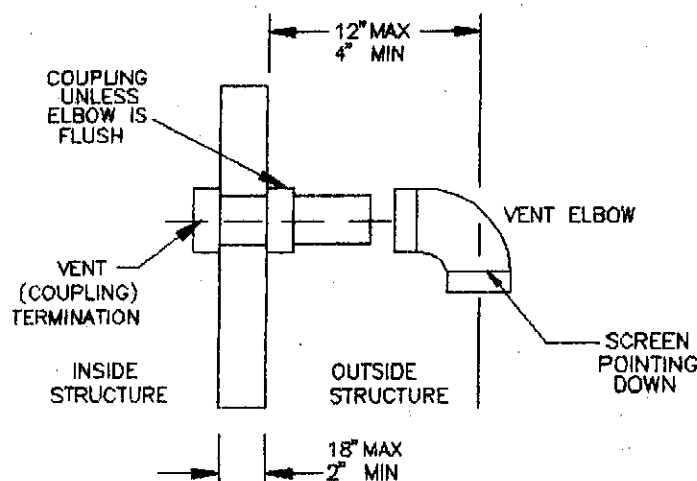


Fig. B

13. The PVC vent termination or outside vent elbow must be installed in accord with local codes and these instructions. The outside edge of the vent elbow cannot be installed closer than 18" to the outside edge of the combustion air intake elbow and must be installed in the same atmospheric pressure zone (IE. on the same wall). We recommend that the elbows should not be installed more than 12 feet apart and the vent and intake utilize the same number of elbows and approximately the same length of straight pipe to reach the outside elbows. (Fig. D of this section).

The vent discharge must be installed a minimum of 18" above grade 14" from any obstruction and three feet from an inside corner of an L-shaped structure. **NOTE: In areas of snow build up, the vent shall be installed high enough to clear and/or be protected from drifting snow.**

14. The exit terminals or vent elbows of mechanical draft systems shall not be less than seven feet above grade when located adjacent to public walkways. The vent system shall terminate at least three feet above any forced air inlet, within ten feet of the vent hood. If the location near a door, window or gravity feed inlet cannot be avoided, the vent shall terminate at least four feet horizontally from or 18 inches above any door, window or gravity air inlet into any building. (See Fig. C).

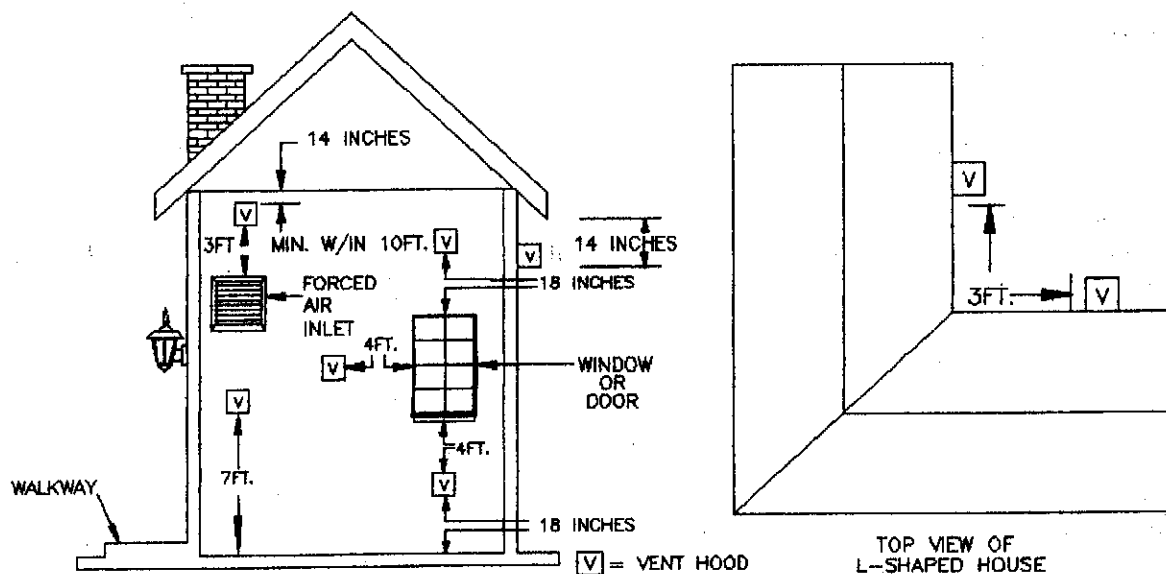


Fig. C

CAUTION: THE VENT ELBOW MUST BE KEPT AWAY FROM BUSHES, SHRUBS OR ANY VEGETATION THAT MAY RESTRICT THE FLOW OF FLUE PRODUCTS. IT MUST ALSO BE KEPT CLEAR OF ANY LEAVES, WEEDS OR OTHER COMBUSTIBLE MATERIALS. KEEP THE VENT HOOD CLEAR OF SNOW. AVOID AREAS WHERE STANDING WATER OR CONDENSATE DRIPPAGE MAY BE A PROBLEM.

NOTE: The exhaust vent elbow shall be checked periodically, at least at the start of each heating season for restriction or blockage from foreign material in the vent pipe or on the screen and cleaned when necessary.

NOTE: If this furnace replaces an appliance with a vent that was originally installed in a common vent system serving other appliances, the vent system is likely now too large to properly vent the remaining appliances only and must be modified accordingly.

If this is the case, refer to Section N of this manual and the National Fuel Gas Code ANSI Z223.1 (LATEST EDITION). If the common vent system has to be resized for proper operation, refer to the appropriate tables in the National Fuel Gas Code.

NOTE: This furnace is designed for and we strongly recommend using only outside air for combustion. If very clean indoor air is available with no possibility of any contamination from chlorides or other cleaning vapors, the outside air line is not needed. If inside combustion air is used, the 3" diameter combustion air intake collar on top of the furnace must be left open.

NOTE: Heat exchanger failure caused from contaminated air will void its limited lifetime warranty.

This furnace is assembled at the factory for right side venting of its flue products and a simple assembly operation is all that is required for connection to the outside vent termination.

NOTE: Alternate left side venting increases assembly and labor time resulting in a more costly installation.

E1. HORIZONTAL VENTING

NOTE: Installation of the outside combustion air (if used) and outside exhaust vents must be performed by a qualified installer or service person in accord with local codes, the National Fuel Gas Code ANSI Z223.1 (LATEST EDITION) and Sections C, D, and E of these instructions.

1. Observing all clearances from Figure C and those outlined in Sections C, D, and E of these instructions, cut two 3-1/2" diameter holes in the outside wall. **NOTE:** The center lines of the holes must be at least 21-1/2" apart to ensure the 18" minimum space between vent elbows (Fig. D). One of the holes should be selected for the combustion air vent and the other for the flue or exhaust vent. We recommend that the vents should not be installed more than 12 feet apart. The combustion air intake shall be upwind of the vent when exposed to prevailing winds.

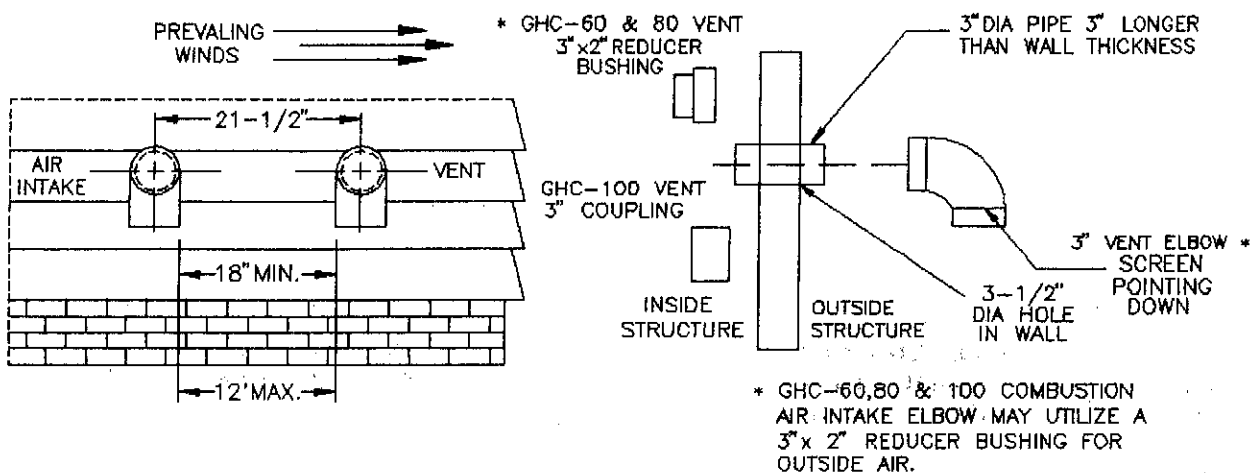


Fig. D

E2. VERTICAL VENTING

The furnace may be vented vertically through the roof. The bottom line of the vent and combustion air intake elbows shall be a minimum of two feet above any roof surface within ten feet horizontally. If the vent and air intake elbows must be installed at different heights, the vent tee must always be higher than the air intake elbow. **The combustion air intake shall be installed upwind of the vent elbows when exposed to prevailing winds.** Also, the vent and air intake elbows should be mounted perpendicular to any prevailing winds. (See Fig. D-2). The vent and air intakes should be mounted no closer than 18" apart and no further than 12 feet apart. The vent and combustion air intake elbows shall be positioned so that the vent does not blow directly into the air intake. **NOTE: For vertical venting, a second elbow (not supplied) must be used so that the two elbows supplied with the bird screen will point down toward the roof on both the vent and combustion air intake.**

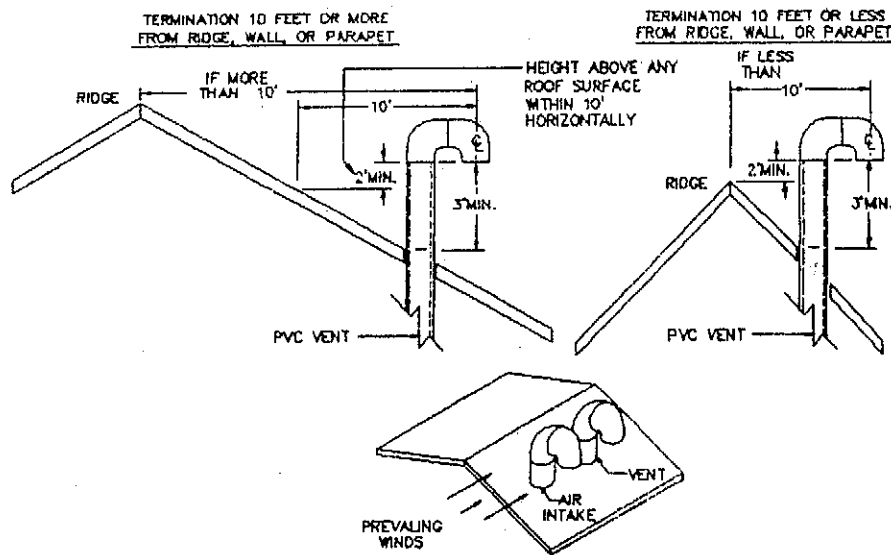


Fig. D-2

When the PVC vent and air intake pipes must pass through a floor or ceiling, the following instructions must be followed.

CEILING: Frame out area around where PVC pipe is to penetrate ceiling. Cut a 2-3/8" hole for 2" PVC and a 3-1/2" hole for 3" PVC in the ceiling and a corresponding hole in a firestop to be made of a minimum of 18 ga. metal large enough to cover the entire framed area. Cut PVC pipe so that it extends up past the firestop far enough to engage a PVC coupling that will rest on the firestop and act as a support. Seal between the pipe coupling and firestop with high temperature RTV sealant. (See Fig. D-3). Continue running PVC pipe to vent and air intake elbows as described previously.

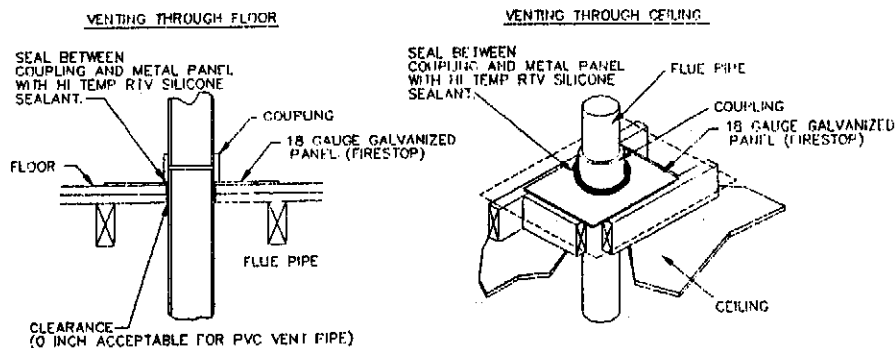


Fig. D-3

FLOOR: Follow same instructions as ceiling penetration, except the area around where the pipe passes through the floor does not have to be framed in. (See Fig. D-3).

2. Cut the 3" diameter PVC pipes 1-1/2" longer than the depth of the wall. This allows for a 1-1/2" connection on the outside end of the pipe. Using PVC pipe cement, cement one of the PVC elbows provided to the end of each 3" pipe. With the elbow pointing down, mark the top of the other end of the pipe. Insert the pipes through the holes in the wall with the elbow pointed down and the open end of the pipe inside the building. (See Fig. D). **NOTE: For the GHC60 and GHC80, a piece of 3" PVC cut 3" longer than the depth of the wall to allow a 1-1/2" connection on both ends of the pipe, outside end for termination elbow, inside end for 2"-3" increaser.**

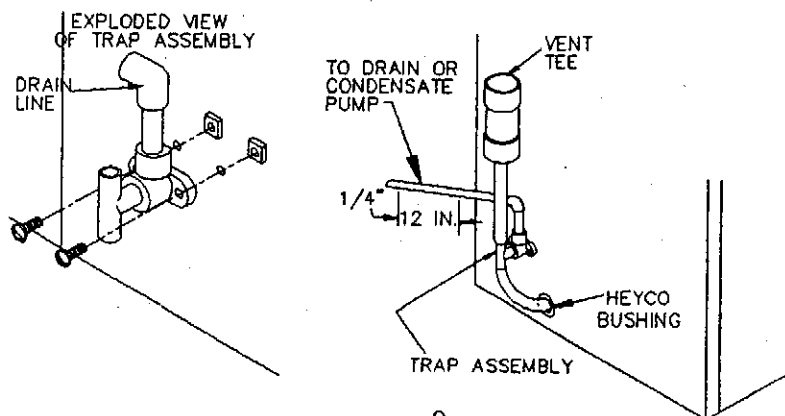
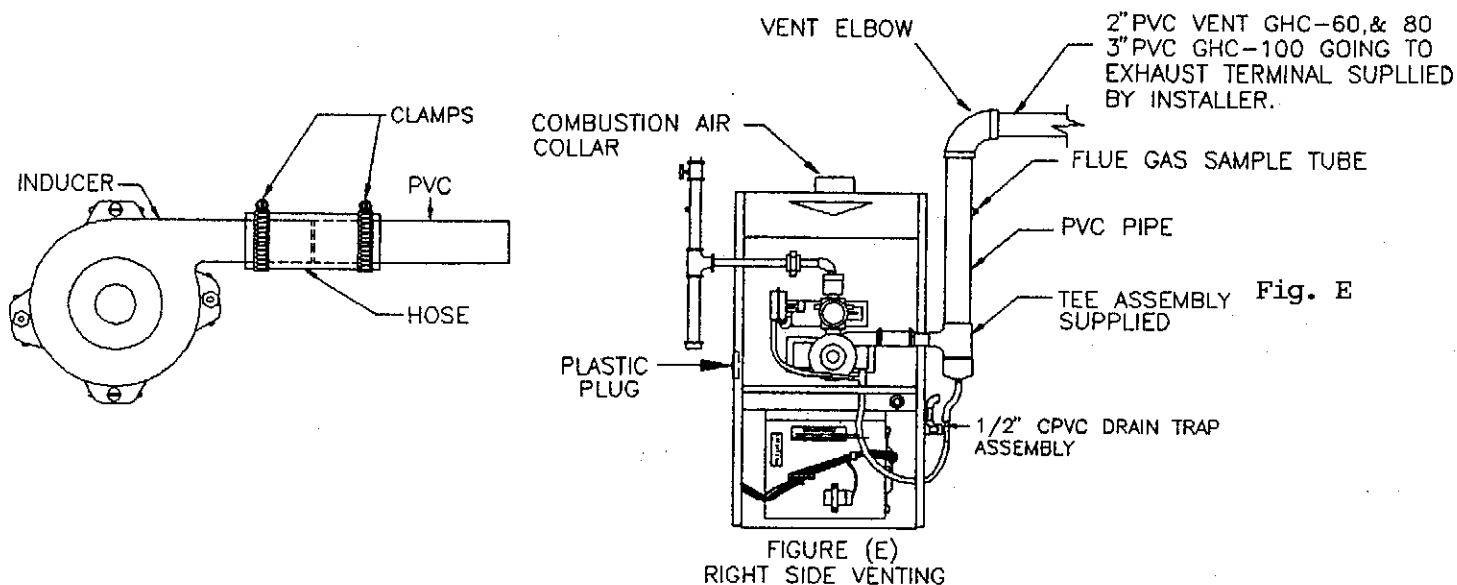
3. To install the inside exhaust vent termination (in the hole selected in step 1 above) proceed as follows: For the GHC-60 and GHC-80 furnaces, using PVC cement, glue (marked to indicate top) to the inside end of the 3" PVC pipe, make sure the mark on the bushing and 3" pipe line up. Follow the same procedure for the GHC-100 using a 3" PVC coupling. This will prevent the vent from sliding in and out through the wall. Make sure that the outside elbow and screen point toward the ground. (See Fig. D).

4. To install the outside combustion air termination inside the building, glue reducing bushing to the inside end of the 3" PVC pipe making sure the marks on the reducer and pipe coincide so that the outside elbow is pointing down.

5. Finish the installation by caulking around the intake and vent pipes where they pass through the wall.

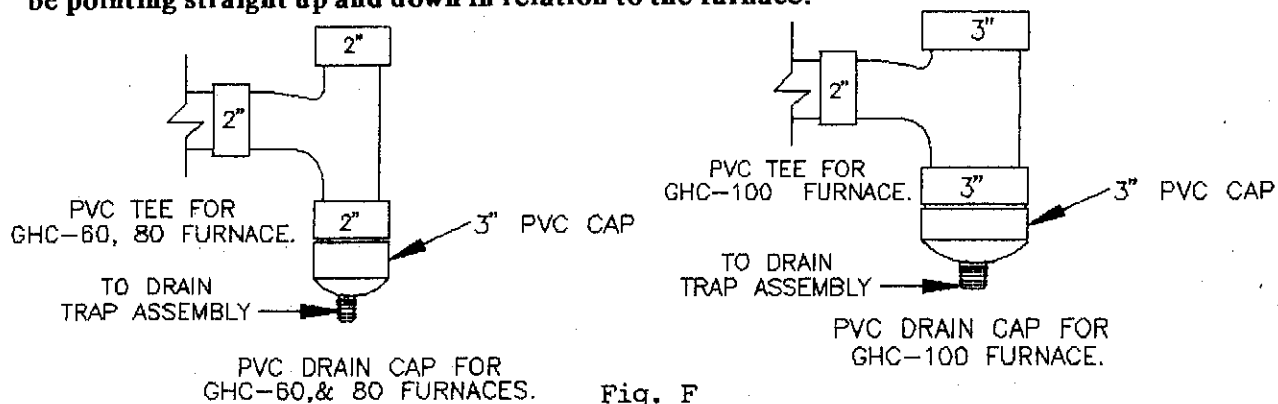
F. CONNECTING FURNACE TO OUTSIDE VENT TERMINALS

If inside combustion air is used, be sure the 3" diameter combustion air collar at the top center of the furnace is left open and is free from any obstruction. (Fig. E).



If the flue products have to be vented from the left side of the furnace, follow the procedure for converting the furnace for left side venting in Section G of this manual. Then follow the procedure for connecting the outlet of the furnace tee assembly to the vent termination in Section G of this manual.

1. If right side venting is used, insert the 2" leg of the tee assembly provided (Figure F) through the 2-3/4" diameter hole in the right side of the furnace casing. Using the rubber hose and two clamps provided, fasten the tee assembly to the inducer outlet, Figure E. **NOTE: The hose must overlap the inducer outlet and the pipe. Be sure the pipe is pushed far enough into the hose to contact the inducer outlet, tighten clamps snugly, do not over tighten to avoid deforming PVC pipe. The tee should be pointing straight up and down in relation to the furnace.**



2. Glue the drain cap assembly (Figure F) to the bottom opening of the tee outlet with PVC cement. Using as few elbows as possible, run a 2" diameter PVC pipe for the GHC-60 and GHC-80 or a 3" diameter PVC pipe for the GHC-100 from the female connection at the top of the furnace tee to the female connection at the flue vent termination. **NOTE: The vent piping must slope upward 1/4" per foot from the furnace to the vent terminal and must be supported every four feet. After making sure the slope and length of the piping are correct, glue the furnace tee and vent terminal connections in place.**

3. When using outside combustion air 3" diameter PVC or soil pipe should be run from the 3" diameter collar at the top of the furnace to the exhaust termination installed in the outside wall. The 3" pvc or soil pipe may be reduced to 2" pipe at a distance of one foot from the 3" diameter collar at the top of the furnace. (Figure D Section E). The maximum number of inside elbows is six and the minimum is one. See the table and instructions in Section D on requirements for venting the same restrictions apply.

If the combustion air piping is installed in a warm humid place, such as a laundry room or above a suspended ceiling it must be insulated with 1.0" foil faced insulation or its equivalent.

4. If the furnace is installed on an upper floor with a hipped roof, the exhaust vent shall drop vertically downward to a point below the roof line. Two ninety degree DWV or PVC elbows may be used to make the two turns. **NOTE: Horizontal vent piping must slope upward 1/4" per foot (away from the furnace) and be supported every four foot.**

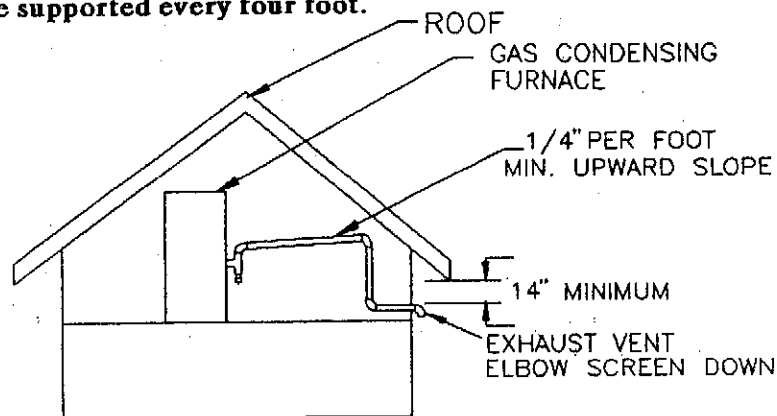


Fig. G

G. ALTERNATE LEFT SIDE VENTING

If the unit has to be converted to left side venting, we recommended that the gas piping be brought in from the right side. To change furnace to left side venting, proceed as follows:

- a. Remove the 2-3/4" diameter plastic plug from the left side of furnace casing placing it in the 2-3/4" diameter hole on the right side.
- b. Loosen and remove the two #10 screws located at the top and bottom of the inducer housing. Make sure you retain the washers from under the screw heads.
- c. Remove the two 3/8" nuts and washers from the studs protruding through embossments on the sides of the inducer housing. Pull the housing forward to clear the studs and rotate the inducer 180° so that the discharge opening in the inducer is aligned with 2-3/4" diameter hole in the left side casing. Replace the inducer over the studs and fasten in place with the nuts and washers.
- d. Once the inducer has been centered with the 2-3/4" diameter hole, replace the two #10 screws and washers from step b. **NOTE: Tighten inducer nuts and screws to prevent leakage behind the inducer.**

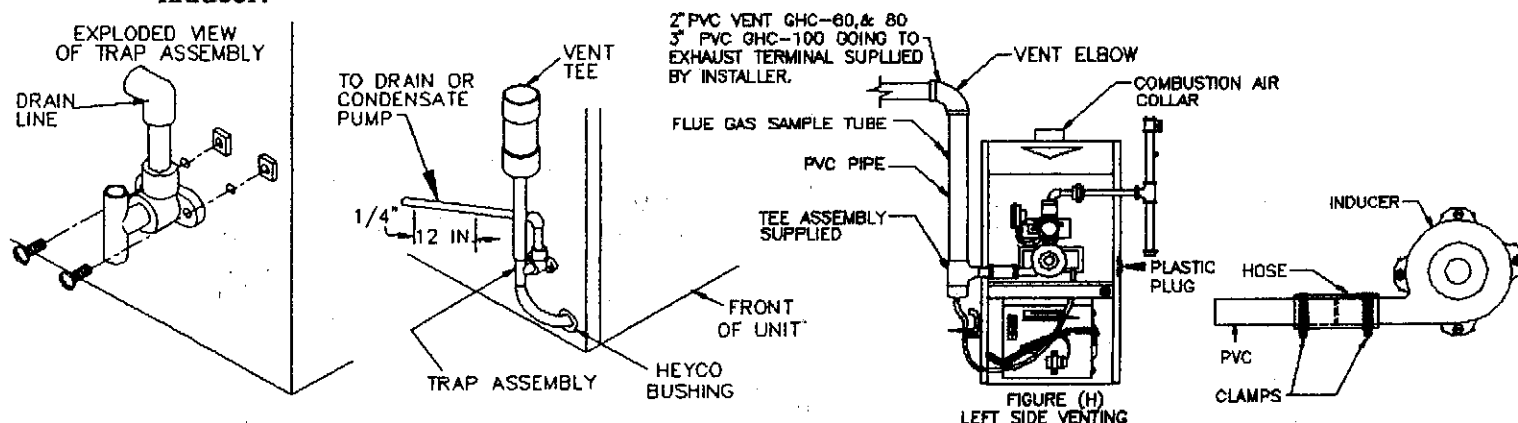


Fig. H

- e. One cutting operation is required on the tee assembly (supplied with furnace) for left side venting. Cut along the red line on the 2" horizontal leg of the tee assembly that goes to the inducer. The cut must be 90° and all burrs should be removed. A hack saw may be used. This will shorten the leg by 4.50" on the GHC-60 furnace and 4.25" on the GHC-80 and GHC-100 models.

- f. Insert the 2" leg of the tee assembly (provided Figure H in this Section), in the 2-3/4" diameter hole in the left side of the casing. Using the rubber hose and two clamps provided fasten the tee assembly to the inducer outlet (Figure I). **THE HOSE MUST OVERLAP THE INDUCER OUTLET AND THE PIPE. BE SURE THE PIPE IS PUSHED FAR ENOUGH INTO THE HOSE TO CONTACT THE INDUCER OUTLET. PLACE THE CLAMPS AT THE ENDS OF THE HOSE CONNECTOR. DO NOT OVER TIGHTEN TO AVOID DEFORMING PVC PIPE. THE TEE SHOULD POINT STRAIGHT UP AND DOWN ALONG SIDE THE FURNACE.**

H. CONDENSATE DRAIN LINE AND TRAP ASSEMBLY

This furnace must be connected to a drain system by a qualified installer or service person. The installation must be in accord with local codes and the instructions in this manual.

CAUTION: Improper drain connection will prevent proper operation of unit. Use only 1/2" CPVC or PVC condensate pipe to house drain.

IMPORTANT: IF AN AIR CONDITIONING CONDENSATE DRAIN LINE IS COMBINED WITH THE FURNACE CONDENSATE DRAIN LINE, IT MUST HAVE A SEPARATE TRAP AHEAD OF THE JOINT CONNECTION.

1. Determine on which side of the furnace the PVC vent piping and condensate disposal line is to be run. Attach the condensate trap assembly provided using the locating holes in the front side of the furnace cabinet with the nuts and screws provided. Note the trap drain line must be installed in the up position on the same side as the PVC vent piping. (See Figure E, Section F).
2. The 1/2" o.d. clear plastic tube running through the blower compartment should be connected to the bottom leg of the drain tee installed in step 1 above. The separate length of clear plastic tube should be connected from the top leg of the drain tee to the barb located on the bottom of the PVC vent tee provided (Figure E).
3. Turn the 90° 1/2" PVC elbow toward the floor drain and install the 1/2" CPVC or PVC condensate pipe maintaining a 1/4" per foot downward slope the full length from the trap elbow to the drain. The drain line must be water tight, supported and secured so that it can't be moved.
4. If a drain is not readily available or is above the trap outlet level on the furnace or it can't be sloped downward its full length to the drain inlet, a condensate pump must be installed. The pump part number 320095 can be ordered from the factory. Follow the pump manufacturer's installation instructions and keep them in the plastic pouch located on the furnace.
5. The furnace condensate is slightly acidic with a ph of 3.5. Cola drinks with a ph of 3.1 are actually more acidic. If local codes require or the customer requests it, order our limestone neutralizing kit (accessory part number 320095). Instructions included with the kit must be followed and kept in the plastic pouch with the furnace instructions.

I. GENERAL GAS PIPING

All gas piping and testing must be performed by a qualified installer or service person. The installation must comply with local codes, these instructions and The National Fuel Gas Code ANSI Z223.1 (LATEST EDITION).

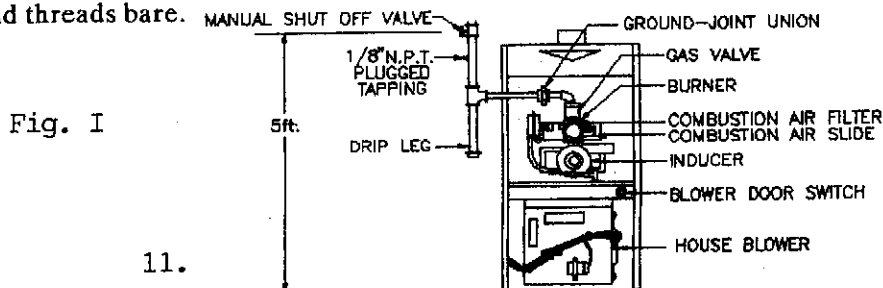
NOTE: If the vent elbow above the furnace tee assembly on the side of the vent (Figure E, Section F) is installed 17" or more above the tee outlet, the gas piping should be installed on the opposite side of the furnace.

CAUTION: The furnace and its individual gas valve must be disconnected from the gas supply during pressure testing of the gas supply system at pressures in excess of 1/2 PSIG or 14.0" wc. The furnace must be isolated from the gas supply piping by closing the knob on its individual gas valve during pressure testing of the piping at test pressures equal to or less than 1/2 PSIG or 14" wc.

NOTE: All gas piping must be leak tested using a soap and water solution (if the gas is turned on) following the procedure outlined in this section. A final test for gas leakage must be made after purging the gas line in Section III on operation. This test must be conducted with the unit operating and should include the furnace piping and gas valve. Never use an open flame to check for a gas leak.

IMPORTANT: Care must be taken not to wet electronic components during leak test. Wetting the primary ignition module may damage its circuitry and cause a hazardous situation. If wetting occurs, dry moisture from all leads and terminals. Wait at least 24 hours for the circuit to fully dry before energizing the burner circuit.

1. A readily accessible, certified manual shut off valve with a non-displaceable rotor member shall be installed within six feet of the gas equipment it serves. A union or flanged connection shall be provided downstream from the manual valve to permit removal of controls. A 1/8" N.P.T. plugged tapping, that is accessible for connecting a test gauge, must be installed immediately upstream of the gas connection to the furnace (Figure I). Unions must be of a ground joint type or flanged-jointed using a gasket resistant to LPG. Pipe dope or tape certified to be resistant to the action of liquified petroleum gases shall be used on all threaded joints leaving two end threads bare.



2. A drip leg must be used on both LP and natural gas installations prior to the furnace to trap oil, condensate and other impurities which might otherwise lodge in the gas valve or plug the burner orifice. When there is excessive condensation between the gas meter and the furnace, a drop leg shall be provided at the outlet of the gas meter. Failure to install a drip leg may void the limited warranty on the furnace.

J. INSTALLATION OF NATURAL GAS PIPING

The installation of the gas piping and the following test procedures must be performed by a qualified installer or service person.

Piping from the natural gas meter to the furnace shall be in accord with requirements of the local utility.

1. The following chart is to be used as a guide in sizing natural gas supply piping. The input loading of all gas appliances installed on any main or trunk line must be totaled to determine its needed carrying capacity.

EXAMPLE: A line must supply a furnace of 110,000 BTU/hr input, a hot water heater of 40,000 BTU/hr input and gas range with a 30,000 BTU/hr input capacity. The total BTU/hr input loading on the line is 180,000 BTU/hr. The 200,000 BTU/hr column on the chart must be used in sizing the pipe.

- STEEL PIPE SIZE FOR NATURAL GAS -

BURNER FIRING RATING, BTU/HR	FEET OF PIPE FROM METER TO BURNER				
	10'	20'	30'	40'	50'
50,000	1/2	1/2	3/4	3/4	3/4
100,000	3/4	3/4	3/4	3/4	1
150,000	3/4	1	1	1	1-1/4
200,000	1	1	1-1/4	1-1/4	1-1/4
250,000	1	1	1-1/4	1-1/4	1-1/4
300,000	1	1	1-1/4	1-1/4	1-1/4

Use nominal black iron pipe and malleable iron fittings for natural gas service lines. provide rigid supports for the pipe. If the pipe size must be reduced, use reducing couplings only. Avoid the use of reducing bushings. Remove all burrs and inspect the pipe for dirt or other foreign material prior to connecting.

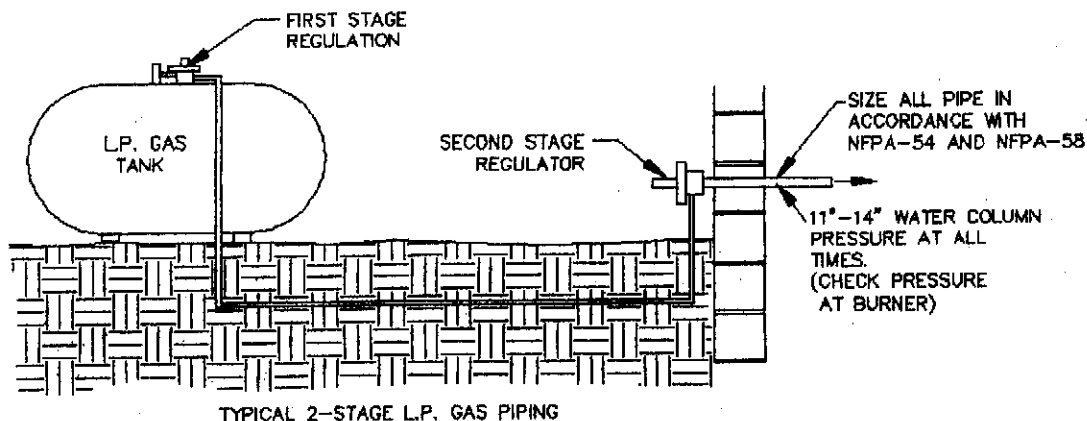
Maximum supply pressure for natural gas is 14" wc and minimum supply for purpose of input adjustment is 5-1/2" wc.

INSTALLATION OF LP GAS PIPING

1. Experience has proved that the pressure drop in the gas line running from the outside propane gas tank to the gas appliances in a home is the most frequent cause of equipment malfunctions. A single pressure regulator located at the tank, will not reliably regulate the high tank pressure (up to 200 lbs.) down to 11" wc. Varying pressures will occur at the appliances as outside temperatures and usage demands vary. Two stage regulation is the only effective method of controlling these variables.

Maximum supply pressure for liquified petroleum gases is 14" wc and minimum supply pressure. For purpose of input adjustment is 11" wc.

TYPICAL PIPING FOR TWO STAGE REGULATION



NOTE: Two stage regulation must be installed for liquified petroleum gas when used with any Thermo Pride LP furnace. See illustration of a typical two stage piping system.

2. The following chart is to be used as a guide in sizing LP gas supply piping. The input loading of all gas appliances installed on any main or trunk line must be totaled to determine its needed carrying capacity.

EXAMPLE: A line must supply a furnace of 110,000 BTU/hr input, a hot water heater of 40,000 BTU/hr input and gas range with a 30,000 BTU/hr input capacity. The total BTU/hr input loading on the line is 180,000 BTU/hr. The 200,000 BTU/hr column on the chart must be used in sizing the pipe.

- COPPER TUBING SIZE FOR LIQUIFIED PETROLEUM GASES -

TABLE I					TABLE II					
IF THE LENGTH OF LINE BETWEEN REGULATORS (TANK TO BUILDING) IS THIS LONG ---					IF LENGTH OF LINE BETWEEN SECOND STAGE REGULATOR AND FURNACE IS THIS LONG ---					
USE THIS SIZE TUBING TO KEEP PRESSURE DROP BELOW 2 LBS. FOR MAXIMUM FLOW SHOWN.	TOTAL INPUT LOAD(BTU) ON LINE	25'	50'	75'	100'	USE THIS TUBING OR PIPE TO KEEP PRESSURE DROP BELOW 1 1/2" WATER COLUMN FOR MAXIMUM FLOW SHOWN.	TOTAL INPUT LOAD(BTU) ON LINE	10' 20'	30' 40' 50'	
	125,000	3/8" O.D. COPPER					75,000	5/8" O.D. COPPER		
	250,000	3/8" O.D. COPPER			1 1/2" O.D. COPPER		125,000	5/8" O.D. COPPER	3/4" BLACK PIPE	
	375,000	1/2" O.D. COPPER					187,500	3/4" BLACK PIPE		
	500,000	1/2" O.D. COPPER					250,000	3/4" BLACK PIPE		
							375,000	3/4" BLACK PIPE	1" BLACK PIPE	
						500,000	1" BLACK PIPE			

Seamless copper tubing may only be used with gases that are not corrosive to it. See note below and check with your LP gas supplier before using. Seamless copper tubing must comply with standard type K or L for seamless copper water tube, ASTM B 88; or seamless copper tube for air conditioning field service, ASTM B 280.

NOTE: Copper and brass tubing and fittings (except tin lined) shall not be used if the gas contains more than a trace (0.3 grains per 100 cubic ft) of hydrogen sulfide gas.

K. REQUIREMENTS AND SIZING OF DUCT WORK

The duct system must be sized and installed by a qualified installer or service person, following the design standards of the Air Conditioning Contractors of America (ACCA) or ASHRAE.

1. When a return air register is located in the same room as the furnace, it must be installed a minimum of 20 feet away from the furnace.
2. If supply ducts carry circulated air to areas outside the space containing the furnace, the return air duct shall also be sealed to the furnace and terminate outside of the furnace space.
3. The return air duct system must equal the supply air duct system in its CFM capabilities. Use a suppliers catalog for proper sizing of outlet and return air registers and grills to ensure that they meet the CFM requirements of the run to which they are connected. (See Fig. J).
4. If the furnace is used in connection with an air conditioning evaporator coil, the furnace must be installed parallel with or on the upstream side of the coil to prevent condensation in the heat exchanger. If the evaporator coil is installed with a parallel flow arrangement, dampers or other means to control flow of air must be used to prevent chilled air from entering the furnace. If such a device is manually operated, it must be equipped with a means to prevent operation of either the furnace or air conditioner unless it is in the full heat or cool position.

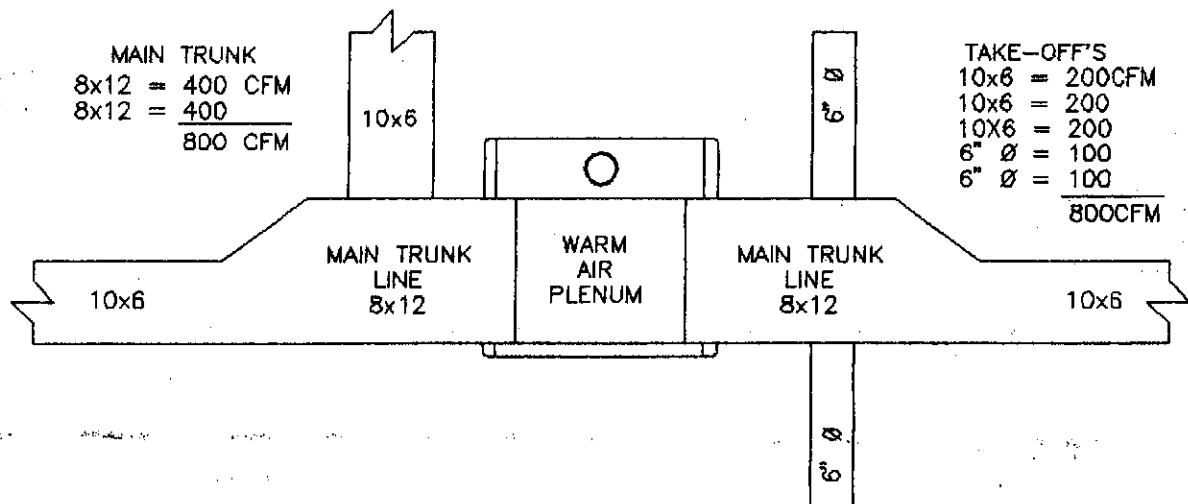


Fig. J

5. The duct system shall be sized for the maximum CFM requirement of the installation, whether it is for heating or cooling. Two common rules for heating and cooling follow:

A. 400 CFM (12,000 BTU'S) per ton of cooling is required.

B. 1.4 CFM of heating per 100 BTU'S of furnace output based on its steady state efficiency and a 40° to 70° temperature rise.

EXAMPLE: Heating output of furnace is $100,000 \times 1.4 - 100 = 1400$ CFM. Air conditioning installed is 4 tons $\times 400$ CFM = 1600 CFM or 48,000 BTU'S. **NOTE:** The duct system must be sized for the larger CFM requirement for cooling. If only 3 tons (36,000 BTU'S) of cooling $\times 400$ CFM = 1200 CFM was installed, the duct would have to be sized for the 1400 CFM heating requirement. If future add on air conditioning is planned, size for the larger load.

To achieve proper air movement, the main trunk lines, take offs, registers and grills of the supply and return air duct system must have an adequate square inch area to move the desired CFM. The following chart shows the CFM air handling capability based on a 0.1" SP loss, in the supply duct system.

**DUCT SIZES FOR HOMES, QUIET OFFICES OR SIMILAR INSTALLATIONS
CHART SIZED FOR VELOCITY OF APPROXIMATELY 800 FEET PER MINUTE**

CFM	DIA.	SQ."	RECTANGULAR DUCT DIMENSIONS ... INCHES							
45	4	12.5								
65	5	19.6								
100	6	28						6x6	9x4	
150	7	38						8x6	12x4	
200	8	50						10x6	14x4	
250	9	63					8x8	12x6	18x4	
300	9	63					9x8	14x6	20x4	
400	10	78					12x8	16x6	25x4	
500	12	113				10x10	14x8	19x6	30x4	
600	12	113				12x10	16x8	22x6	38x4	
700	12	113				14x10	18x8	26x6		
800	14	154			12x12	15x10	20x8	28x6		
900	14	154			14x12	17x10	22x8	32x6		
1000	16	201			15x12	18x10	24x8	34x6		
1100	16	201		14x14	16x12	20x10	26x8	40x6		
1200	16	201		15x14	17x12	22x10	28x8	42x6		
1300	16	201		16x14	18x12	22x10	30x8	46x6		
1400	18	255		16x14	19x12	24x10	32x8	48x6		
1500	18	255		17x14	20x12	26x10	34x8	50x6		
1600	18	255		16x16	18x14	22x12	26x10	36x8	54x6	
1700	18	255		17x16	20x14	22x12	28x10	38x8	58x6	
1800	18	255		18x16	20x14	24x12	30x10	40x8	62x6	
1900	20	314		18x16	22x14	26x12	32x10	44x8	64x6	
2000	20	314		20x16	22x14	26x12	34x10	46x8		
2200	20	314	18x18	20x16	24x16	28x12	36x10	48x8		

To insure obtaining the necessary air handling capacity of a duct system, each of the system components (trunk lines, take offs, runs and register and grill-free areas) must be properly sized and matched together. A 12"x8" duct with a 400 CFM capacity for example will not flow 400 CFM if the register(s) to which it connects can only flow a total of 200 CFM.

To obtain the proper 45°F to 70°F temperature rise for heating when an air conditioning coil is installed, the speed of the blower motor may have to be changed. This depends on the static resistance of an individual duct system and the size of the air conditioner.

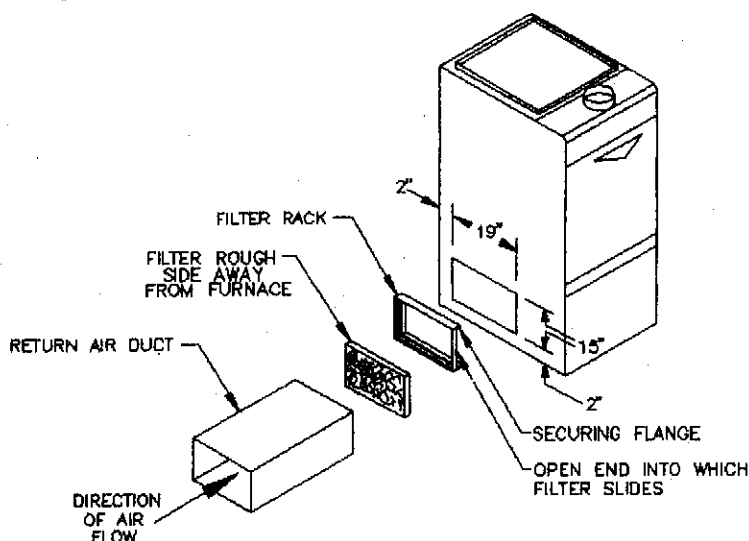
L. FILTER RACKS

Following the instructions in this manual, it is necessary to cut a return air opening in the bottom right or left side of the furnace casing. This work must be performed by a qualified installer or service person.

NOTE: If the furnace supply duct carries circulated air from the space containing the furnace, a return air duct must be installed and sealed to the return air opening of the furnace. The return air duct must terminate outside the space containing the furnace.

1. Select the side of the unit that has the easiest access to the return air duct work. Cut a 15" high by 19" long hole in the side of the casing. The hole should be located 2" in from the back of the furnace and 2.0" above the bottom of the casing. The 15" dimension is vertical toward the top of the unit and the 19" dimension horizontal toward the front. The open end of the rack should be placed so that the filter can be easily removed for cleaning, usually at the front or service access end of the furnace.

NOTE: This unit is designed to have the filter rack located on the opposite side of the unit from the condensate drain and flue. If this is not possible, the filter rack dimensions will need to be reduced appropriately to allow for clearance of the condensate drain and flue.



2. Permanently attach the filter rack to the furnace using screws or pop rivets along the securing flange. Making sure the open end is not obstructed, connect the return air duct to the filter rack. Slide the filter into place with the coarse uneven side away from the furnace and the fine mesh side pointing toward the furnace. (See Fig. K).

M. WIRING

All wiring shall be performed by a qualified electrician or service person. The wiring must comply with local codes, the instructions in this manual and in the absence of codes with the latest edition of the National Electrical Code ANSI/NFPA-70 LATEST EDITION.

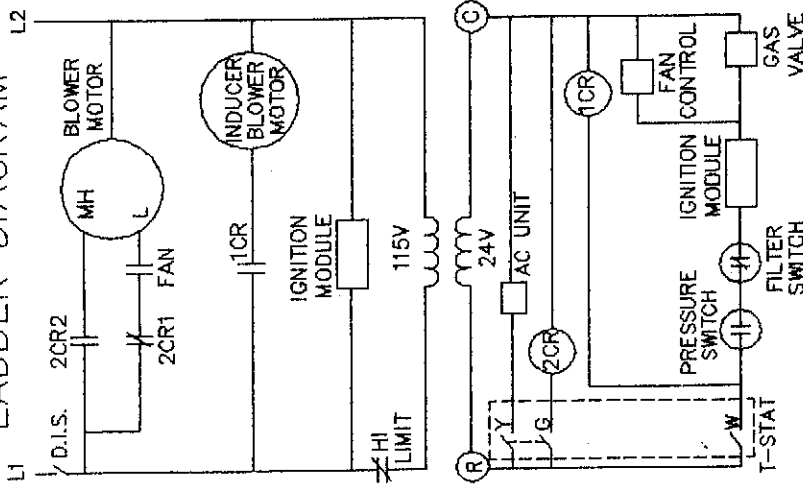
NOTE: An electrical device not covered in this manual shall not be added to this unit without consulting Thermo Products Engineering.

The following items are required to complete the wiring of the installation:

1. A separate power supply with 20 amp over current protection and a disconnect switch must be provided. The disconnect switch must be located reasonably close to and within sight of the furnace.

P/N WD-415D
ECN 2940

LADDER DIAGRAM



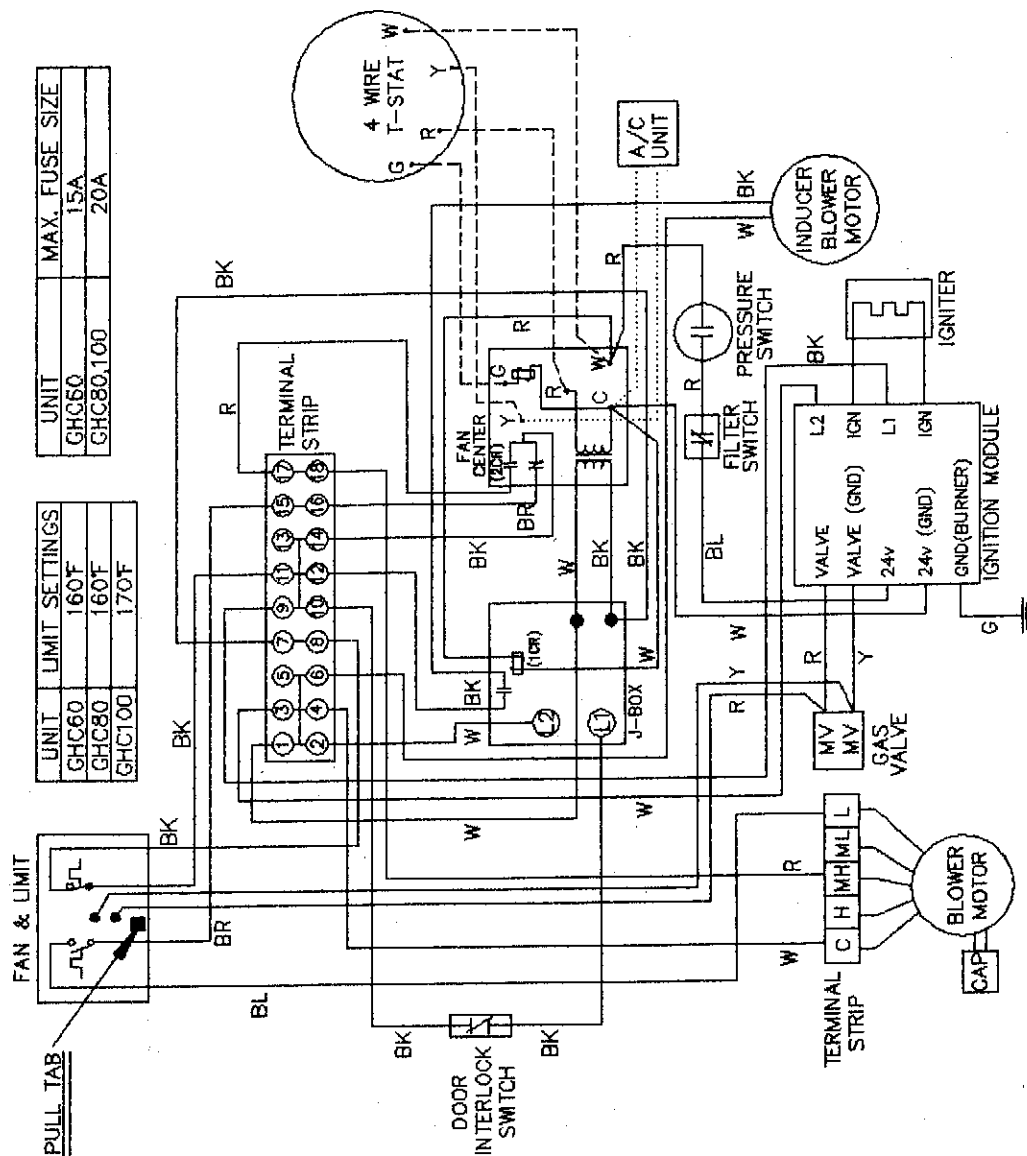
- NOTES:
1. CONNECT HOT TO L1 AND COMMON TO L2.
 2. REPLACE IGNITER WIRE WITH TYPE 150' C UL STYLE.
 3. IF ANY OF THE ORIGINAL WIRE AS SUPPLIED WITH THE FURNACE MUST BE REPLACED, IT MUST BE REPLACED WITH WIRING MATERIAL HAVING A TEMPERATURE RATING OF AT LEAST 105°C.
 4. SET ANTICIPATOR AT .8 AMPS

LEGEND

- - - FIELD WIRING
- FACTORY WIRING
- AIR CONDITIONING WIRING

- D.I.S. - DOOR INTERLOCK SWITCH
- 1CR - #1 CONTROL RELAY (POST PURGE)
- 2CR - #2 CONTROL RELAY
- CAP. - CAPACITOR

WIRING DIAGRAM GHC60, 80, & 100 (HONEYWELL IGNITION MODULE) 120V POWER SUPPLY 20 AMP. OVERCURRENT PROTECTION ELECTRICAL SCHEMATIC



2. The hot surface igniter and operation of this furnace depends on correct polarity. The hot leg of the supply circuit must be connected to the number 1 red wire in the junction box of the furnace and the common leg to the number 2 white wire. Reference the wiring diagram located in the furnace vestibule or in this manual.

3. When the furnace is installed, it must be carefully grounded in accordance with local codes, the instructions in this manual and in the absence of codes with the provisions of the latest edition of the National Electrical Code ANSI/NFPA-70. This standard may be purchased from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269-9904.

4. It is important that the unit be properly grounded or the signal from the hot surface igniter will not be sensed by the ignition module and the gas valve contacts will not stay closed after ignition. With the house blower running and a voltmeter (set on the 10 volt scale) check the furnace casing to ground for zero volts. Any sign of voltage indicates a poor ground connection. Make sure your connections are tight and you have a good source for ground. A good source for ground would be a water pipe or the ground terminal on the main electrical disconnect for the building.

5. Field wiring between the furnace and devices not attached to the furnace shall conform with the temperature limitation for Type T 35°C wire. If any of the original furnace wire is replaced or a separate device other than the thermostat is wired internal to the unit 105°C thermoplastic or equivalent wire must be used.

6. Install the room thermostat using instructions supplied with it. Set the heat anticipator at 0.8 amps to compensate for the time delay on start up. An amp reading can be taken across terminals R & W on the sub base of the thermostat. (with the furnace operating) and multiply that reading by 2. The higher the setting, the longer the burner cycle.

Example: .45 amps across R and W times 2 equals a heat anticipator setting of .90 amps.

N. REPLACING AN EXISTING FURNACE FROM A COMMON VENT

When an existing furnace is removed from a common vent serving other appliances, the vent system is likely too large to safely vent the remaining appliances.

Each appliance still connects to the vent system must be individually inspected and must be operated while other gas appliances connected to the same vent system are off. The following steps must be conducted on each of the remaining appliances to assure proper venting of their flue products to the outdoor atmosphere.

a. Seal off any unused opening(s) in the common vent system.

b. Visually inspect the venting system for proper size and upward horizontal pitch. Determine that there is no blockage, corrosion or other signs of deterioration or deficiencies that could cause unsafe operation of any of the remaining appliances. See item F below for proper sizing.

c. Turn on clothes dryer and any other air exhausting appliances that may operate during the heating season but which are connected to the common vent. Turn on (at maximum speed) all exhaust fans, such as range hoods and kitchen or bathroom exhausts. Do not operate summer exhaust or window air conditioning units.

d. Follow the lighting instructions for each unit still connected to the original vent system. Set the thermostat on the appliance being tested for continuous operation. After at least five minutes of continuous operation, check for spillage at the relief opening of the draft hood, using a match, candle, or cigarette smoke.

e. If improper venting is observed on any of the appliances during the above testing, the common vent system must be corrected. Follow the steps outlined in the National Fuel Gas Code, ANSI Z223.1 (LATEST EDITION) to resize the vent system to approach the minimum size using the appropriate tables in Appendix G of that code. The National Fuel Gas Code may be obtained by writing the American Gas Association Laboratories, 8501 East Pleasant Valley Road, Cleveland, OH 44131 or the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

f. After determining that each appliance remaining connected to the common venting system is vented properly, when tested as outlined above and that the vent system is properly sized, return doors, windows, exhaust fans, fireplace dampers and the remaining appliances to their previous conditions of use.

III. OPERATION

WARNING: Turn off power to furnace. Before gas piping system is placed into service, it must have been leak tested by a qualified service technician (See Section J of these instructions on the installation of gas piping).

Before initial start up, it is recommended that air be purged from the gas piping by loosening the ground-joint union (Fig. I, Sec. J) until the odor of gas is detected. When odor is detected, **immediately** tighten the union and check it for leakage with soap and water solution.

WARNING: After purging gas, ventilate area for at least 15 minutes before attempting to start the furnace. LP gases are heavier than air and may accumulate in dangerous concentrations at floor level.

NOTE: Protective coating on heat exchanger will vaporize on initial firing and may create an unpleasant odor. To minimize the effect and prevent its occurring again, open window(s) communicating with heated area. We recommend that initial firing should last for at least 1/2 hour or until the odor is dissipated.

A. INITIAL START UP

When starting the condensing furnace for the first time, put water into the drain system. This will prevent flue gases from escaping into the residence. Pull the 1/2" diameter hose from the pressure switch. Pour 1 cup of water into the hose and replace it by pushing it firmly onto the pressure tap.

With the power still off, put a toggle switch (in the off position) across the R and W terminals of the fan center (see unit wiring diagram). If a jumper wire is used, hook one end to the "W"

terminal, let the other end hang loose (in open air) until you are ready to start up the unit by closing the circuit at terminal R. The switch or jumper wire will act in place of the thermostat.

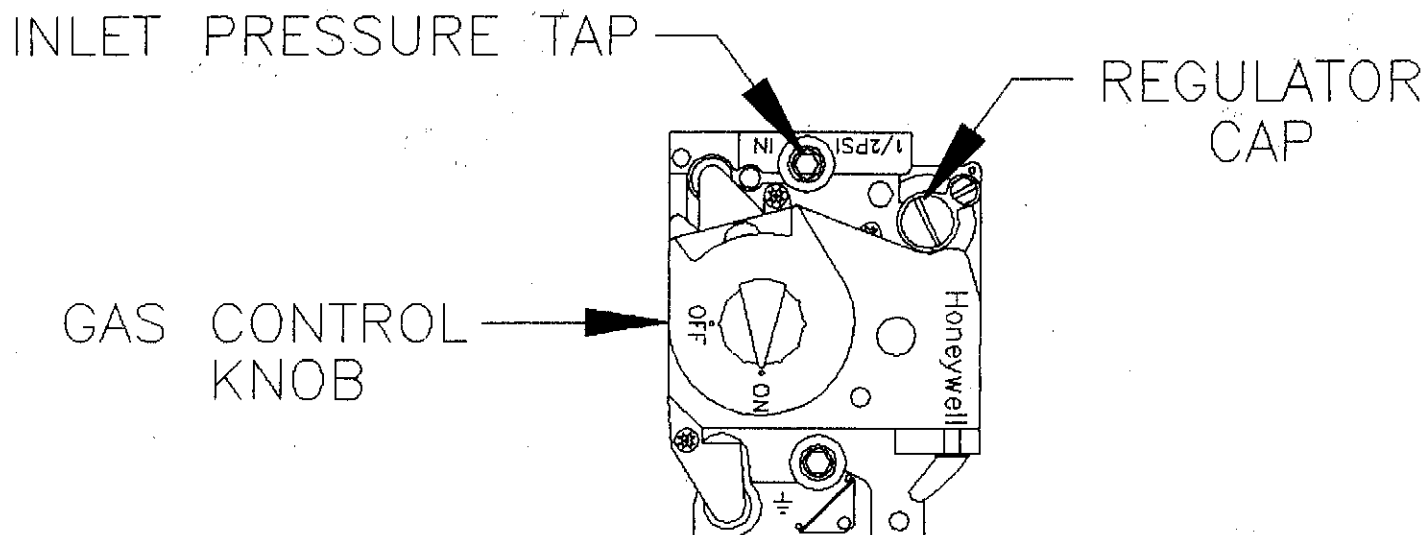
The items listed below should be checked before attempting to put the furnace into operation.

1. With the electrical power off, check wiring for loose connections and correct hook up referencing the furnace wiring diagram.
2. Make sure tubing is securely pushed onto pressure switch taps.
3. Make sure PVC vent pipe connections are tight and pipes are open.
4. Make sure combustion air filter is firmly in place and is clean and dry. Return air filter must be clean and placed in the filter rack with mesh side facing unit.
5. Make sure outside vent elbow points down, that screen is clean and there are no obstructions.
6. If outside air intake elbow is used, inspect as in item 5 and make sure piping is connected to air intake collar at top of furnace. If inside combustion air is used, make sure collar is open and free from obstructions.
7. The drain trap at the bottom of the PVC tee assembly must be connected to the buildings drain system (Fig. E, Sec. F).
8. Make sure that the blower compartment door is firmly in place.

We are now ready to follow the sequence of operation by actually firing the unit. We suggest that you familiarize yourself with the sequence before you start up the unit.

This furnace is equipped with a hot surface ignition system that lights the burner directly, after an approximate 40 second delay. **DO NOT ATTEMPT TO MANUALLY LIGHT THE BURNER.**

Turn on the gas supply to the furnace at the main manual shut off valve (Fig. I, Sec. I). Turn the knob on the furnace gas valve clockwise to the "OFF" position.



B. SEQUENCE OF OPERATION

All controls must be checked with the furnace operating prior to the qualified installer or service person leaving the job site.

1. Turn on the power supply to the furnace at the disconnect switch.
2. Turn on the toggle switch or connect the other side of the jumper wire from the "W" to the "R" terminal on the fan control center. This simulates the closing of the thermostat contacts.
3. The 24 volt side of the time delay relay is now energized and the inducer motor should start.

NOTE: This proves the continuity of the 120 volt side of the limit, the door interlock switch and the 120 volt functioning of the inducer relay.

4. When the inducer motor reaches speed, the 24 volt large pressure switch closes. This proves that: the burner is getting proper flow of combustion air, the PVC vent system is open, the condensate line is clear of restriction and assures a clean supply of combustion air protecting the burner orifice and mantle.

5. The ignition module is energized and sends 120 volts to the igniter.

6. The igniter starts to glow red and during a nominal 40 second warm up reaches ignition temperature. The ignition module then sends 24 volts to the solenoid of the gas valve.

7. The gas valve opens for a trial of ignition period of four seconds in which gas flow is proven and ignition is sensed.

8. During the four second trial for ignition sequence, the ignition module will energize the igniter for the first two seconds then the ignition module stops the 120 volts to the igniter and the igniter begins to sense the presence of the flame. The igniter continues to monitor the burner flame throughout the cycle.

9. The fan control contacts close on time delay relay bringing on the house blower operation approximately 1 minute after the start of burner operation. The unit will stay in this mode of operation for as long as the thermostat continues to call for heat.

At this point, we temporarily leave the sequence of operation, keep the toggle switch on or the jumper wire in place and begin the furnace Check Out Procedure. We will finish the sequence of operation with the burner shut down portion of the sequence at the end of the Check Out Procedure.

START SEQUENCE OF OPERATIONS

Thermostat set above room temperature is calling for heat, contacts close.

Time delay relay is energized and the inducer motor starts.

Pressure switch proves combustion air, condensate flow, and an open vent system, contacts close.

STAGE 1 TRIAL FOR IGNITION

Ignition module energized, start of 40 seconds pre-purge and warm up.

Igniter glows red and reaches ignition temperature.

Gas valvesolenoidenergized valve opens for two seconds.

Main burner lights, igniter senses flame, sends signal to module within two seconds.

STAGE 2 BURNER OPERATION

Igniter stops glowing, monitors burner operation.

Timed fan control closes contacts.

House blower motor starts.

High limit control stays closed.

STAGE 3

Thermostat is satisfied or set below room temperature, contacts open.

BURNER SHUT DOWN

Module turns off power to the inducer relay. Radiant burner shuts off.

Fan control opens on temperature drop.

END OF CYCLE

House blower motor stops.

A normal sequence of operation will prove a clean unobstructed flow of combustion air, an open flue system, and unrestricted flow of condensate. The ignition module assures trouble free ignition and burner operation. Burner operation is sensed by a small current generated in the module through the igniter wire, the burner flame, the burner mount and back through burner to ground.

C. FURNACE CHECK OUT PROCEDURE

1. CHECKING FURNACE INPUT

The orifice for this furnace was sized: (1) for natural gas having a heating value of 1025 BTU per cubic foot and a specific gravity of .60 or (2) for liquified propane gas with a heating value of 2500 BTU per cubic foot and a specific gravity of 1.53. The information plate inside the furnace vestibule will specify which gas your furnace is orificed for. If the furnace is installed at an altitude that is more than 2,000 feet above sea level, it is mandatory that the input to the burner be reduced 4.0% for every 1,000 feet that it is above sea level. If the furnace is installed at an elevation of 5,000 feet, its input must be reduced 20.0%. Example: a furnace rated at 100,000 BTU at sea level must be reduced to a firing rate of 80,000 ($100,000 \times .80 = 80,000$) at an elevation of 5,000 feet. If the furnace is installed at an elevation of 2,000 feet or less, no reduction in input is required. Your gas supplier will supply you with the correct orifice sizing information.

To check the input of your natural gas furnace, allow the unit to operate for 10 to 15 minutes and proceed as follows:

a. Call your gas supplier and ask for the BTU content (heating value) of one cubic foot of the gas, supplied to the installation area. An alternate approach is to assume a value of 1025 BTU/Cu. Ft. which is the national average.

b. With all other gas appliances turned off and using a stop watch, clock the time required for the (small) dial on the gas meter to make one full revolution. The meter will state how many cubic feet is flowing for one revolution usually one, two or five. The unit must have been in operation at least 10 minutes before clicking.

FORMULA: BTU/CuFt x Number of Cu Ft x 3600 Seconds = Input BTU/Hr
Seconds for one revolution

EXAMPLE: 1025 BTU/CuFt x 2 Cu Ft x 3600 = 79,015 BTU Input
93.4 Seconds

Check for the model number of this furnace, its input, the type of gas and the manifold pressure on the information plate located on the vestibule panel behind the upper front door. If using the above example, the furnace was a GHC-80 model the 79,015 BTU input would be acceptable because it was within 2% of the listed input of 80,000.

c. Make sure that the gas supply pressure to the furnace falls within the certified range of 5-1/2" to 14" wc pressure on natural gas and 11.0" to 14.0" wc on LP gases. The pressure to the furnace must be checked while the furnace burner and any other gas appliances on the same supply system are operating, using the test procedure outlined in Section J of this manual.

d. This gas furnace is equipped with a fixed orifice sized for a manifold pressure of 3.5" wc on all of the GHC units for both NAT & LP gas. The input can only be increased or decreased by adjusting the manifold pressure. Remove the 1/8" threaded pipe plug located on the bottom right side of the gas valve. use a U tube manometer or pressure gauge to measure the pressure. To adjust the pressure, remove the cap from the regulator on the top of the gas valve and using the adjustment screw, decrease the pressure by turning the screw counterclockwise or increase it by turning the screw clockwise. **ADJUSTMENTS TO THE LISTED PRESSURE MUST NOT EXCEED 0.3" WC.** A 0.3" wc adjustment will increase or decrease the input approximately 4.0%.

If a gas meter is not available for natural gas or the unit is installed on liquified petroleum gases which are not metered, the correct input can be assumed if the furnace manifold pressure is the same as that shown on the information label and the proper size orifices are utilized.

Shut off the gas supply to the furnace. Remove the pressure gauge and reinstall the pipe plug using a thread compound resistant to the action of LP gases.

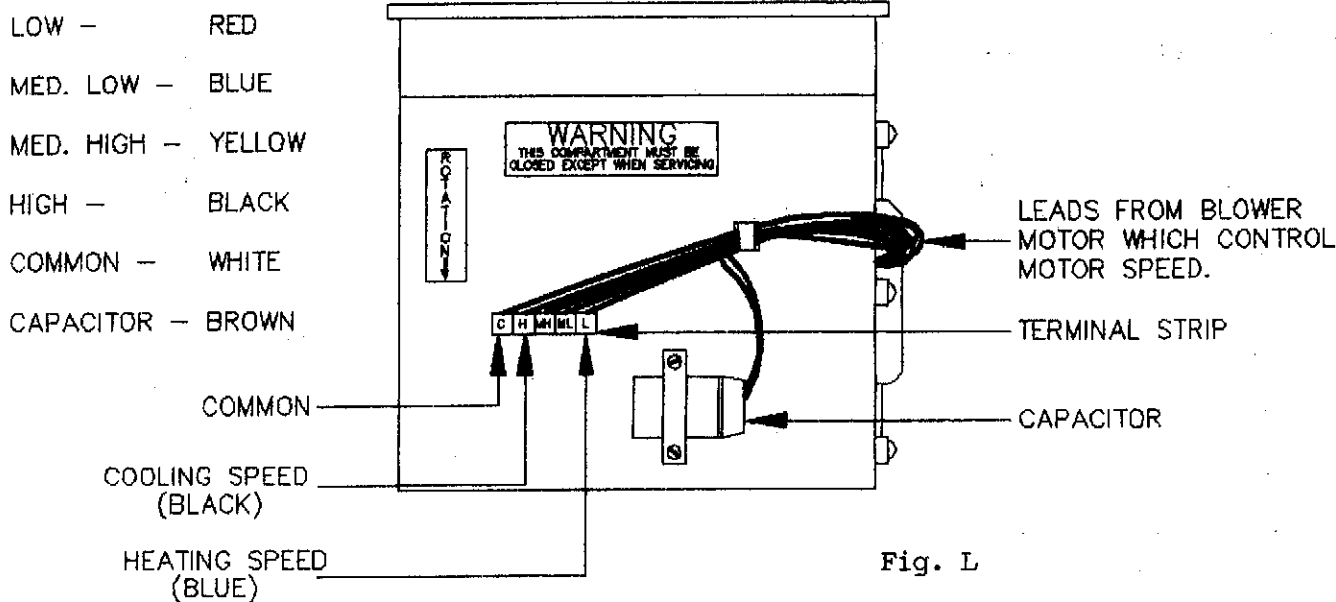
If the rated input cannot be obtained with the present orifice at the correct pressure, your local gas supplier will assist in sizing the proper orifice. Our Engineering Department will gladly assist in sizing the orifice if you provide them with the heating value in BTU per cubic foot and the specific gravity of the gas.

2. SETTING DUCT RISE FOR HEATING

These furnaces are wired at the factory for a blower speed that should result in an approximate temperature rise of 70°F through the furnace. All three models are wired on low speed for heating. All three furnaces are wired for high speed on cooling. The temperature rise through the furnace may vary depending on the duct system, elevation, heating value, etc. of each installation. A lower duct rise will result in a higher efficiency.

After 20 to 30 minutes of continuous operation, the temperature rise through the furnace must fall within a range of 40°F to 70°F. If the outlet or supply duct temperature is too high, you should check to make sure that your return air filter is clean, your return air registers are free from obstruction, your outlet registers are properly adjusted and clear and your supply and return air ducts are open.

If the supply temperature is still too high, it means the house blower is not moving enough air and the speed of the blower must be increased by changing the speed tap on the motor. Turn off the power supply to the furnace and remove the bottom (blower) door. Move the blue wire located on the bottom of the terminal strip on the blower housing to the next position to the left. If the blue wire is at the (MH) medium high speed terminal, it will have to be spliced onto the (H) high speed (black) air conditioning wire at the bottom of the strip.



If the temperature rise is too low, the change is made by moving the blue wire to the right towards the low speed tap. If the blue wire is on the low speed tap and supply temperature is still low, individual room registers must be closed until the rise is above 55° F.

Replace the blower door and turn on the power supply.

NOTE: Any time the unit is turned off or a safety control functions, the unit will have to go through the entire ignition sequence before it resumes operation.

3. CHECKING SAFETY LIMIT FUNCTION (NORMALLY CLOSED SWITCH)

a. Block off the return air supply at the furnace filter with cardboard or another suitable material while the burner is operating.

b. The limit is wired into the 120 volt circuit. It is a normally closed switch and its contacts open on temperature rise. When the temperature around the limits bi-metal reaches its fixed setting, the burner must shut off. The limit must function before the plenum temperature goes over 170° F.

c. Remove blockage from filter and when the limit bi-metal cools, the contacts will close and the burner operation cycle will repeat.

4. CHECK COMBUSTION AIR FILTER SWITCH (NORMALLY CLOSED END SWITCH)

Remove upper front door and with burner running, pull combustion air filter (Figure I, Section I) toward you. When filter loses contact with switch, burner will shut down. Replace filter against switch and ignition cycle will repeat.

5. DOOR INTERRUPT SWITCH (NORMALLY CLOSED END SWITCH)

Remove lower blower door with burner running. This switch is in the 120 volt circuit and will shut down the entire system. Replace blower door and cycle will repeat.

6. PRESSURE SWITCH (NORMALLY OPEN)

A. This switch closes when the inducer reaches speed. It also protects against a blocked flue or clogged condensate line. Block off the outside vent elbow and the switch will open and break the 24 volt circuit. Remove blockage and sequence will repeat.

7. CHECK IGNITION MODULE LOCKOUT

Turn off power to unit and remove top door. Push knob on gas valve up to OFF position. Restore power to unit and the ignition module will attempt to light the burner three times and then lock out. The three trials will take approximately three minutes. Push gas valve down to ON position, wait one minute, igniter should not glow. Turn power OFF, wait at least 45 seconds and then restore power. The igniter should start to glow and the unit will resume normal operation.

8. CHECK OPERATION OF FAN CONTROL

From a cold start, the main blower should come on within 45 seconds to one minute after the burner lights. Turn off the toggle switch or remove one leg of the jumper wire from R or W. Wait approximately three to five minutes. Contacts on fan control should open and house blower should turn off.

9. CHECK OPERATION OF THERMOSTAT

Remove the toggle switch or the remaining leg of the jumper wire from R and W terminals of the fan center. Connect the house thermostat leads across R and W and set it above room temperature. Make sure that the thermostat functions to start the furnace when it calls for heat and shuts it off when it is satisfied.

D. SETTING COMBUSTION

The furnace was adjusted at the factory for the gas shown on the information plate located in the vestibule. The heating value and specific gravity of the gas varies in different geographical regions and can alter burner performance. The furnace must be adjusted on the job site for the actual gas being used.

We recommend using the "click" method for starting the unit and setting combustion. With the unit cold, push the primary air slide (Figure M) closed. Then with the gas valve turned off, power onto the unit, and the thermostat calling for heat or a jumper across R and W at the fan center; move the slide out until you hear the contacts on the pressure switch "click" closed. Mark the position of the slider plate at this time. Then open the slide another 1/8" for the GHC-60 and GHC-80 and 3/16" for the GHC-100.

Push the gas valve lever down to the ON position. After three minutes, the radiant burner mantle should be burning with a uniform glow over its entire surface (see Users Information Manual).

It is recommended at this point that calibrated instrumentation be used to measure CO (carbon monoxide) and either CO₂ (carbon dioxide) or O₂ (oxygen) in the flue gas. The readings should be taken in the PVC piping above the outlet of the furnace tee assembly (Fig. E, Sec. F). The radiant burner cannot be adjusted to its optimum visually. Improper adjustment will result in lower efficiencies or in poor operation.

The furnace must have been run for a total firing time of 1/2 hour and the area ventilated be for taking the combustion readings. We suggest that the readings be taken after completing the furnace check out procedure (Item III, C). 15 minutes after the burner lights, the combustion results shall fall within the values shown on the next page.

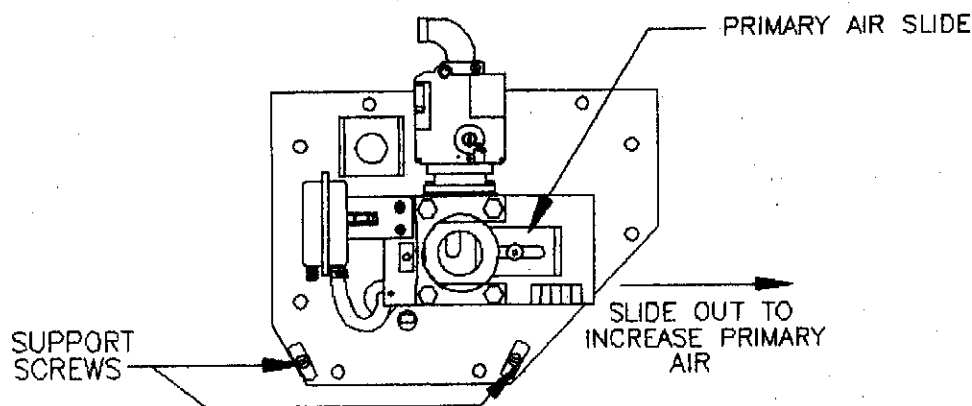


Fig. M

<u>GAS</u>	<u>CARBON DIOXIDE (CO₂)</u>		<u>OXYGEN (O₂)</u>		<u>CARBON MONOXIDE (CO)</u>
	<u>MAX.</u>	<u>MIN.</u>	<u>MAX.</u>	<u>MIN.</u>	
NATURAL	10.0%	8.1%	7.0%	3.8%	LESS THAN 50 PPM
LP GASES	11.5%	9.3%	7.0%	3.7%	LESS THAN 50 PPM

Decreasing the primary air will raise the CO₂ reading and lower the O₂ reading. After setting the burner, fill out the installation tag attached to the combustion air adjustment assembly. **NOTE:** With the above combustion settings and a rise through the furnace between 40°F to 70°F flue temps may range between 100°F to 120°F.

WARNING: When adjusting primary air slide, never close slide passed lowest point where "click" occurred during cold start.

CAUTION: After the CO₂ and or O₂ readings are set, the CO reading must be safe at or below 50 ppm.

IV. DEALER MAINTENANCE INSTRUCTIONS

General and preventive maintenance procedures outlined in this section must be performed by a qualified service technician. Each of these procedures must be followed by repeating the start up and test procedures outlined in Section III of this manual.

A. CLEANING AND INSPECTING RADIANT BURNER

1. At the start of each heating season, a qualified technician should inspect and if necessary, clean the combustion air filter located on the perforated metal holder in front of the radiant burner assembly. The holder should be inspected and if any of the perforated holes are plugged, clean with a stiff wire brush and then pick up any residue left with a vacuum cleaner.

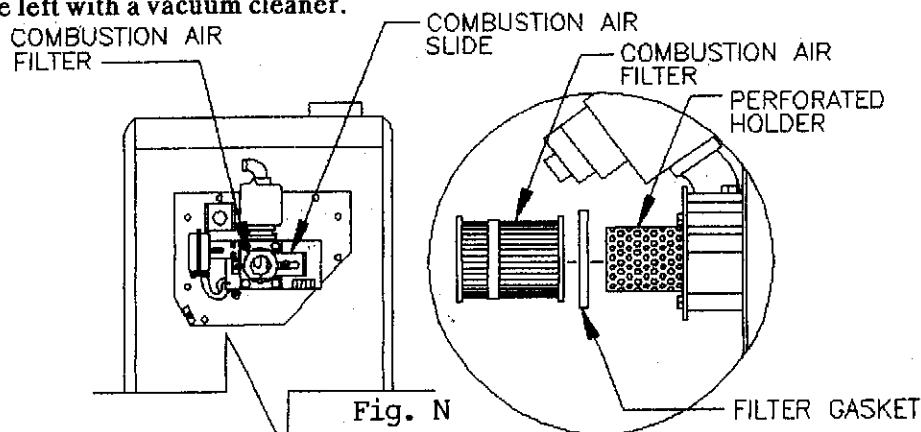


Fig. N

2. With the combustion air filter removed, shine a light into the opening behind the filter. If lint and or dirt have accumulated in and around the opening, caution the user of the need for more frequent cleaning. We recommend that the user should have a second combustion filter on hand (see item 3). Clean around the opening using a small brush and vacuum cleaner. If the combustion air slide has to be moved, for better access, first mark its location so that it can be returned to its original position after cleaning.

3. The combustion air filter can be cleaned in a warm soap and water solution, then rinsed with tap water and air dried. A hair dryer can be used to speed up the process, but still may not get the filter dry enough to allow the furnace to operate. It is for this reason that we strongly recommend that the user have a second filter that can be rotated with the original after each cleaning.

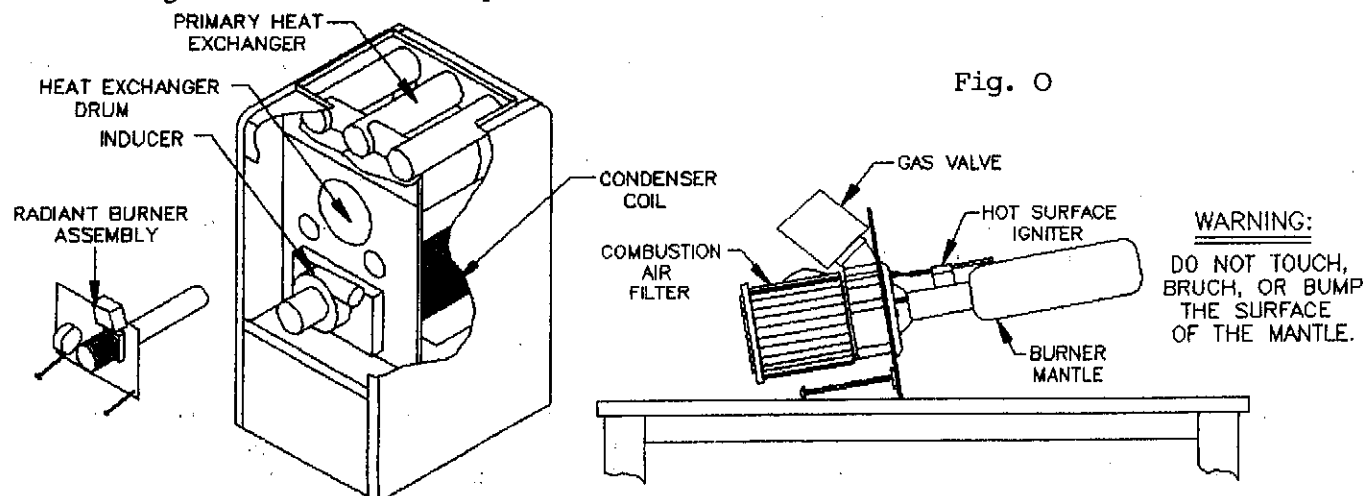
4. If the burner adjustment slide has been moved, return it to its original position. Replace the filter by firmly pushing it forward onto the perforated holder. If the filter is not all the way forward, the filter contact switch will not close and the furnace will not operate.

5. The burner mantle should never require cleaning provided the combustion air filter is properly cleaned and maintained. If proper burner performance and combustion cannot be achieved and it is felt that a dirty mantle is the cause, it should probably be replaced. Call the factory for assistance.

B. REMOVING THE BURNER FOR SERVICE

WARNING: When the burner has to be removed for service, do not touch, brush or bump the surface of the mantle. To reduce chances of damaging the burner mantle, follow the instructions below carefully.

1. Shut off the gas supply to the furnace using the manual shut off valve (Figure I). Set the thermostat to its low setting and turn off the electric power at the furnace disconnect switch.



2. Disconnect the ground joint union from the gas valve (Item 2, Figure I) remove the 1/2" diameter plastic hose from the pressure switch. Remove the red and yellow wires from the gas valve, the red wire from the filter switch and the green ground wire from the slide assembly.

3. Remove the six upper bolts from the burner mounting plate. Holding the burner assembly in place, remove the two bottom nuts. Carefully grasp the burner assembly by the gas valve and the cast iron bracket below the valve. Keeping the burner mantle level, pull the entire assembly forward. Do not bump the burner mantle against the edges of the burner opening or the sides of the furnace casing.

4. Carefully clamp the burner mounting plate in a vise or lay it back toward you so that it rests on a flat surface supported by the two 4" support bolts.

5. Any time the burner is removed from the furnace, it should be examined for possible damage. The fiber coating on the burner has an approximate depth of 1/2". If there is an area that has been scraped or damaged, the coating in that area must be at least 1/8" thick. Do not measure with a measuring device, but visually estimate the coating depth. If there is any doubt, the mantle must be replaced.

6. After the burner has been removed, inspect the primary heat exchanger drum for signs of corrosion or dirt buildup. If there are such signs, the entire heat exchanger should be inspected and cleaned where necessary. (Item IV, Section C).

7. Reverse the above procedures to reinstall the burner. The furnace must be returned to its factory produced state and any gaskets that show deterioration or damage must be replaced by ordering from the factory. Reset the combustion. (Item III, Section D).

C. CLEANING THE PRIMARY HEAT EXCHANGER

Inspection and cleaning of the heat exchanger must be done by a qualified service technician. The heat exchanger should only be inspected and cleaned if indicated by poor burner performance. Yellow or floating burner flames may indicate a plugged heat exchanger. Before attempting to inspect or clean the heat exchanger, make sure the combustion air filter is clean, the burner is properly set (according to these instructions) and the PVC vent piping and outside vent elbow are open and free from obstructions.

1. Turn off the gas supply to the furnace using the main manual shut off valve. Turn the furnace thermostat to its lowest setting and turn off the power at the furnace disconnect switch.

2. There are four inspection covers on the GHC-60 and GHC-80 and five inspection covers (Figure P) on the GHC-100. The two lower covers are below burner level and are easily reached. Remove the bottom covers being careful not to damage the gaskets. Shine a light into the tube openings. If there are signs of corrosion or a build-up of scale and dirty, the entire heat exchanger should be examined and cleaned where needed. If there is no evidence of scale or corrosion, replace the inspection covers and gaskets and return the furnace to operation by reversing the procedure in Step 1. above.

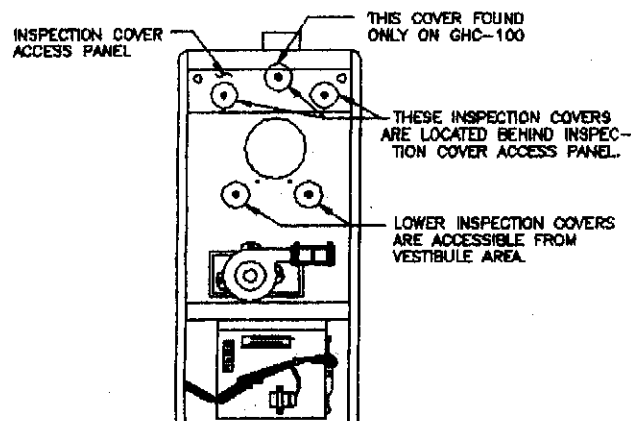


Fig. P

3. To thoroughly clean and inspect the primary heat exchanger, remove the burner assembly (Item IV, Section B), the inspection cover access panel and the remaining inspection covers. Any build up of dirt or scale can be removed using a wire brush and an industrial type vacuum cleaner.

4. Replace all components removed in the reverse order. Any gaskets that show signs of damage or deterioration must be replaced with new gaskets. **NOTE: When replacing the inspection access panel, its lower edge must be placed under the burner plate gasket.**

5. Follow the start up procedure (III, Section A) and reset the combustion (III, Section D) before putting the furnace back into operation.

D. INSPECTING AND CLEANING THE SECONDARY HEAT EXCHANGER

Only a qualified service person may inspect and or clean the secondary heat exchanger.

1. Turn off the gas supply to the furnace using the main shut off valve (Item II, Figure I). Turn the thermostat to its lowest setting and shut off the electric power at the furnace disconnect switch.
2. To inspect the condenser tubes, disconnect the inducer assembly from the 2" leg of the PVC vent assembly (Item II, Figure I). Remove the inducer from the front header box (see left side venting, Item II, Section G). The inducer motor wires are long enough that they don't have to be disconnected. Several tubes are accessible through the opening in the front of the header box. Using a pair of needle nose pliers, remove one of the turbulators straight out of the tube through the front opening. A clip at the rear of the condenser will flex allowing the turbulators to come out. Examine the turbulator closely for signs of soot or dirt accumulation. Any build up likely to plug the tubes will appear on the turbulators. The tubes can be inspected by shining a light along their inner surfaces. Any sign of a dirt build up indicates that the entire coil should be cleaned.
3. The secondary coil can be cleaned without removing it. Remove all the bolts holding the header box to the coil header plate. Carefully using several flat headed screwdrivers progressively, pry up along the flanges holding the header box in place so as not to damage the flanges.
4. Remove the turbulators from the condenser tubes and clean each tube by pushing a 1/8" diameter cleaning rod (with a soft cloth firmly attached at the end) through from the front. The small amount of dirt that is pushed through can safely remain at the bottom of the rear header. Dry and clean each turbulator with a clean soft cloth.
5. When replacing each turbulator, re-bend the rear tab at the original break line. Push the turbulator back into the tubes, you will hear a click when it reaches the back and snaps over the end.

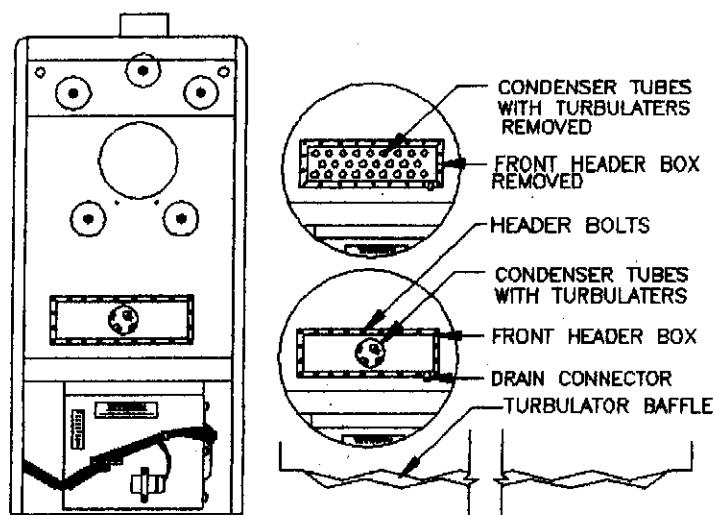


Fig. Q

6. Once the coil is cleaned, all components must be replaced in the reverse order and the furnace must be restored to its original factory produced state. Any gaskets showing signs of deterioration must be replaced. Any flanges that show even the slightest damage or distortion on the header box must be repaired. If there is any doubt, order a new header box. Turn on the gas supply, restore power and set the thermostat for the desired temperature.

E. REMOVING THE SECONDARY HEAT EXCHANGER

If the secondary heat exchanger ever has to be removed, it requires access to the rear of the furnace. Only a qualified service person should remove or replace the condenser coil.

1. Turn off the gas supply to the furnace using the manual shut off (Item II, Figure I). Set the room thermostat to its lowest setting and turn off the power supply at the furnace disconnect switch.
2. Remove the inducer assembly from the front of the furnace (see left side venting (Item II, Section G). The inducer motor wires are long enough that they don't have to be disconnected. Then remove the 1/2" hose from the drain nipple on the bottom right of the header box.
3. Remove the four 1/4" nuts and washers from the header studs (2 above and 2 below the header box). The condenser coil is now loose, except for the front studs and the hose connection from the primary heat exchanger to the rear header. Next, remove the rear panel from the furnace.
4. Loosen both clamps on the 3" diameter hose coming from the rear header. Use a screwdriver to pry the hose loose and slide it upward on the heat exchanger connector so that it clears the header pipe. Be carefully not to damage the hose. If the hose is torn or damaged, it must be replaced by the same high temperature hose (order by part #410025).
5. At this point, the coil is only supported by the four front studs and shelf off of the rear heat exchanger leg. Carefully slide the condenser toward the front, supporting the rear to avoid damaging the fins. The condenser must be tilted upward and to the right at the front end to allow the rear header to fit through the rectangular opening in the front panel.
6. To reinstall the coil, reverse the above procedure. Any gaskets that have been damaged must be replaced and the furnace returned to its original factory produced state.

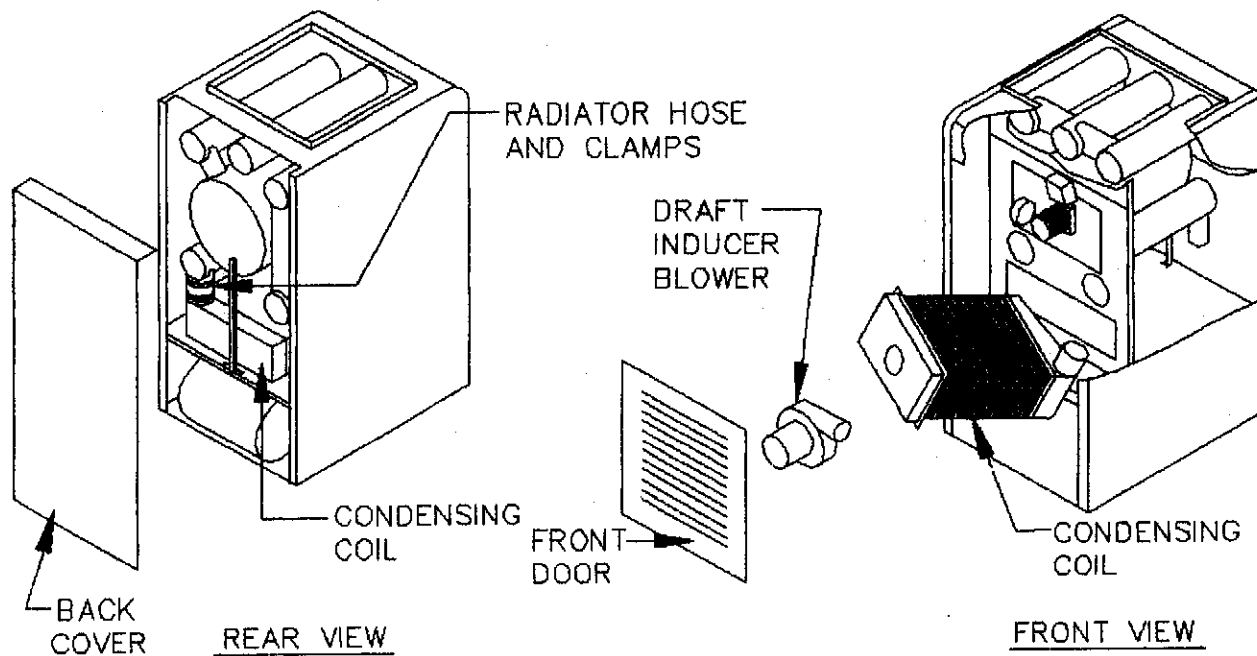


Fig. R

V. INSTALLERS INSTRUCTIONS TO USER

It is the installers responsibility to inform the user of the following before leaving the installation site:

A. These instructions and the users information manual must be kept along with instructions for any accessories in the plastic pouch on the side of the furnace.

B. Inform user of the location of the manual gas shut off valve and furnace electrical disconnect switch.

C. Inform the user that failure to maintain and operate this furnace in accordance with these instructions could result in hazardous conditions, bodily injury, property damage and may void the limited warranty on the furnace.

D. Inform and demonstrate to the user the correct operation and maintenance of the appliance as explained in this manual.

E. Review with and encourage the user to read all warnings and instructions on the front cover and in Sections I, II and III of the Users Manual.

F. Recommend that the user have a qualified service person inspect the furnace at the start of each heating season. Inform the user of the frequency of inspection required for each item in Section II of the Users Manual.

CLICK METHOD FOR START UP

IMPORTANT: The above procedure must be followed when setting up a new furnace or on any service call dealing with the pressure switch. It is important in setting up a new furnace that the pressure switch or combustion air adjustment be made with a cold unit using the click method outlined below. This establishes the minimum air slide adjustment at which the pressure switch will allow the unit to operate.

Make sure that there is water in the trap assembly along the side of the furnace. If in doubt, pour 1/2 cup of water into the end of the clear plastic hose running from the large pressure switch to the plastic tee at the bottom of the vestibule. Shut off the furnace gas valve and push the combustion air adjustment slide in until it is fully closed. Restore power to the furnace and either set the thermostat to its highest setting or jumper across R and W at the transformer.

Move the slide out slowly until you hear the large pressure switch "click". Mark the slide position and then open it another 1/8" on the GHC-60 and 80 and 3/16" on the GHC-100. Turn the gas valve to the ON position. The mantle should now light and after two minutes should be burning with an even glow over its entire surface. There should be no signs of lifting blue flames or black spots. If there are, the slide can be moved back toward the closed position, but never beyond the mark made when the pressure switch closed using the click method outlined above.

IMPORTANT: The above procedure must be followed when setting up a new furnace or on any service call.

GHC60, 80 AND 100 TROUBLE SHOOTING CHART

TROUBLE	SOURCE	PROCEDURE	CAUSES	CORRECTION
BURNER INDUCER FAILS TO START	NO WATER IN TRAP ASSY.	ON FIRST START OR BEGINNING OF FALL PULL CLEAR HOSE OFF LARGE PRESSURE SWITCH & POUR IN 1/2 CUP WATER	ON START UP OR BECAUSE OF EVAPORATION DURING OFF SEASON	ADD WATER, SEE PROCEDURE
	120 VOLT POWER	CHECK MAIN DISCONNECT & FURNACE DISCONNECT SWITCHES	BLOWN FUSE TRIPPED BREAKER OR SWITCH OFF	REPLACE FUSE/RESET BREAKER TURN ON SWITCH
	DOOR INTERRUPT SWITCH	CHECK DOOR INTERRUPT SWITCH IN BLOWER COMPARTMENT FOR 120 VOLTS INPUT AND 120 VOLTS OUTPUT WITH SWITCH ENGAGED	FAULTY OR INCORRECT WIRING FAULTY INTERRUPT SWITCH BUTTON NOT FULLY ENGAGED	CORRECT REPLACE SWITCH READJUST DOOR HANDLE TO CLOSE DOOR SECURELY
	THERMOSTAT	JUMPER ACROSS R & W CONTACTS ON FAN CENTER IF INDUCER STARTS FAULT IS IN THERMOSTAT OR IN THE THERMOSTAT CIRCUIT	THERMOSTAT IN "OFF" OR "COOL" THERMOSTAT SET TOO LOW VIBRATION AT THERMOSTAT THERMOSTAT NEAR HEAT SOURCE FAULTY THERMOSTAT OR WIRING THERMOSTAT NOT LEVEL	SWITCH TO HTG. MODE SET TO ABOVE ROOM TEMP. CORRECT SOURCE OF VIBRATION MOVE HEAT SOURCE OR THERMO. REPAIR OR REPLACE THERMO. LEVEL THERMOSTAT

TROUBLE	SOURCE	PROCEDURE	CAUSES	CORRECTION
BURNER INDUCER FAILS TO START (CONT.)	TRANSFORMER	CHECK FOR 24 VOLT FROM R OR W CONTACT TO GROUND ON CASING OR FROM R OR W TO C	FAULTY TRANSFORMER INCORRECT OR FAULTY WIRING	REPLACE TRANSFORMER CORRECT OR REPLACE WIRING
	POST PURGE OR RELAY	CHECK FOR 120 VOLTS AT N.O. RELAY CONTACTS (1&3) CHECK FOR 24 VOLTS AT N.C. RELAY CONTACTS (H&H)	FAULTY RELAY FAULTY OR INCORRECT WIRING	REPLACE RELAY REPLACE OR CORRECT WIRING
	INDUCER & MOTOR ASSY.	CHECK FOR 120 VOLTS AT BLK. & WHT. MOTOR LEADS CHECK MTR. CAPACITOR FOR CONT. DOES INDUCER WHEEL APPEAR TO BE TOO LOOSE? IS INDUCER WHEEL HARD TO TURN? CHECK CONTINUITY ON WINDINGS	FAULTY OR INCORRECT WIRING FAULTY MTR. CAPACITOR FAULTY MTR. SHAFT OR BEARINGS OR LOOSE ON SHAFT FROZEN MTR. SHAFT BURNED OUT MTR. WINDINGS	REPLACE OR CORRECT REPLACE CAPACITOR REPLACE INDUCER ASSY. REPLACE INDUCER ASSY. REPLACE INDUCER ASSY. REPLACE INDUCER ASSY.
BURNER FAILS TO START, INDUCER RUNNING	LARGE N.O. PRESSURE SWITCH	TEMPORARILY BYPASS LARGE PRESSURE SWITCH WITH INDUCER RUNNING OR CHECK CONTINUITY ACROSS N.O. LEADS	DIRTY COMBUSTION AIR FILTER FAULTY SWITCH NOT ENOUGH COMBUSTION AIR IS INDUCER BLOWER TIGHT AGAINST MTG. PLATE? ARE PVC PIPES & OUTSIDE VENTS OPEN & FREE FROM OBSTRUCTION	CLEAN OR REPLACE FILTER REPLACE PRESSURE SWITCH OPEN AIR SLIDE ADJUST. 1/16 TIGHTEN SCREWS & NUTS UNBLOCK & REMOVE OR CUT AWAY ANY OBSTRUCTION
BURNER FAILS TO START, INDUCER RUNNING	FILTER END SWITCH N.O.	CHECK TO MAKE SURE FILTER IS FIRMLY AGAINST END SWITCH CHECK SWITCH FOR CONTINUITY	FILTER TOO FAR AWAY FROM SWITCH FAULTY SWITCH	PUSH FILTER TIGHT AGAINST SWITCH REPLACE SWITCH
	IGNITION MODULE	CHECK FOR 24 VOLTS ACROSS 25 V CONTACTS AT MODULE CHECK FOR 120 VOLTS AT IGN. TERMINALS ON MODULE	FAULTY WIRING UNDER 21 VOLTS FAULTY MODULE	REPAIR OR REPLACE REPLACE TRANSFORMER REPLACE IGNITION MODULE
	HOT SURFACE IGNITER	CHECK TO SEE IF HOT SURFACE IGNITER GLOWS RED	DAMAGED OR BROKEN HOT SURFACE IGNITER	REPLACE IGNITER
NOISY BURNER RUMBLES ON LIGHT OFF	INDUCER	CHECK FOR SOURCE OF AIR LEAKAGE	AIR LEAKAGE AROUND INDUCER PLATE	TIGHTEN NUTS & SCREWS HOLDING INDUCER REPLACE GASKET
	INDUCER GASKET	FOLLOW THE CLICK METHOD WHEN STARTING UP UNIT UNIT SHOULD BE COLD	DAMAGED GASKET	TIGHTEN ALL MOUNTING BOLTS AND NUTS
	BURNER MOUNTING PLATE	IF BURNER IS REMOVED FOR ANY REASON, USE HAMMER TO PREN METAL FLAT AROUND BOLT HOLES IN FRONT PANEL	AIR LEAKAGE	TIGHTEN ALL MOUNTING BOLTS AND NUTS

TROUBLE	SOURCE	PROCEDURE	CAUSES	CORRECTION
NOISY BURNER RUMBLES ON LIGHT OFF	BURNER MFG. PLATE GASKET	FOLLOW THE CLICK METHOD WHEN STARTING THE UNIT UNIT SHOULD BE COLD	1/16" THICK OR ANY DAMAGED MOUNTING PLATE GASKET	REPLACE WITH HIGH TEMP. GASKET ORDERED FROM THERMO PRODUCTS
	SIGHT GLASS		CRACKED OR BROKEN	REPLACE
	SIGHT GLASS GASKET	IF BURNER IS REMOVED FOR ANY REASON, USE HAMMER TO PEEN METAL FLAT AROUND	DAMAGED	REPLACE
	CAST IRON SUPPORT BLOCK	BOLT HOLES IN FRONT PANEL	LEAKAGE AROUND CAST IRON BLOCK	REMOVE 4 BOLTS HOLDING SLIDE ASSY. TIGHTEN TWO PHILIPS HEAD SCREWS REPLACE SLIDE ASSY.
	SUPPORT BLOCK GASKETS		DAMAGED	REPLACE BOTH GASKETS
	SHRUNKEN OLD WHITE FILTER GASKET		COMBUSTION AIR BYPASSES FILTER	REPLACE WITH HIGH TEMPERATURE RED SILICONE GASKET
	INSPECTION PLATE GASKETS		DAMAGED OR OLD 1/16" THICK GASKETS	REPLACE FOUR ON GHC60 & 80, FIVE ON GHC100
	BURNER MANTLE	IF ALL OF THE ABOVE CORRECTIONS DO NOT RESULT IN AN IMPROVED BURNER FLAME, REPLACE BURNER MANTLE	TOO DENSE OR SLIGHTLY DIRTY MANTLE	ELIMINATE ADDED RESISTANCE CAUSED BY STAINLESS TUBE
BURNER NOISY WHISTLES OR RESONATES	BURNER ORIFICE	REMOVE STAINLESS TUBE & SHORT ORIFICE	DEFECTIVE BURNER TUBE OR ORIFICE	REPLACE WITH 1/2" LONG BRASS ORIFICE KIT OR CALL IN
BURNER LIGHTS, BUT WON'T STAY LIT	HOT SURFACE REPLACEMENT IGNITER	CHECK FOR CONTINUITY OR FOR 50 TO 400 OHM READING ACROSS IGNITER LEADS BEFORE REPLACEMENT	SHIPPING OR HANDLING DAMAGE FAULTY IGNITER OR LEADS	REPLACE IGNITER REPLACE IGNITER
	GAS VALVE	CHECK FOR 24 VOLTS AT GAS VALVE TERMINALS (ONLY 2 SECOND TRIAL)	INCORRECT OR FAULTY WIRING FAULTY GAS VALVE	CORRECT OR REPLACE WIRING REPLACE GAS VALVE

TROUBLE	SOURCE	PROCEDURE	CAUSES	CORRECTION
BURNER LIGHTS, BUT WON'T STAY LIT	WEAK SIGNAL TO MODULE	BURNER LIGHTS, BUT GOES OUT IMMEDIATELY (WITHIN 4 SECS.)	INCORRECT LINE VOLTAGE POLARITY FAULTY GAS VALVE FAULTY MODULE FAULTY IGNITER IMPROPER GROUND	INTERCHANGE L1 AND L2 LEADS IN JUNCTION BOX REPLACE GAS VALVE REPLACE MODULE REPLACE IGNITER CHECK CONTINUITY
	WEAK SIGNAL TO MODULE	BURNER LIGHTS, BUT GOES OUT BETWEEN 1 & 15 MINUTES WITH THERMOSTAT CALLING FOR HEAT	LOOK FOR BLACK SPOTS ON MANTLE LOOK FOR LIFTING BLUE FLAME MANTLE LOOKS GOOD EVEN GOLD IN COLOR	REPLACE MANTLE ADJUST AIR SLIDE IN REFER TO CLICK METHOD PG. 1 ALLOW UNIT TO CYCLE SEVERAL TIMES SIGNAL SHOULD IMPROVE
	LIMIT SIDE OF FAN & LIMIT	BURNER LIGHTS, BUT GOES OUT BETWEEN 10 & 20 MINS. WITH THERMOSTAT CALLING FOR HEAT	TIGHT DUCT SYSTEM DIRTY HOUSE FILTER REGISTERS CLOSED UNIT OVERFIRED T-STAT CONTACTS FUSED CLOSED HOUSE BLOWER MTR. FAULTY INCORRECT OR FAULTY WIRING	ADD OPENINGS TO SYSTEM WASH OR REPLACE OPEN REGISTERS LOWER MANIFOLD PRESSURE & CHECK RATE REPLACE THERMOSTAT REPLACE MOTOR CORRECT OR REPLACE
HOUSE BLOWER WON'T START	HOUSE BLOWER	REMOVE FOAM SHIPPING BLOCK FROM BLOWER INLET INSIDE BLOWER COMPARTMENT	SHIPPING BLOCK LEFT INSIDE BLOWER INLET	REMOVE & DISCARD
	FAN SIDE FAN LIMIT FAN RELAY	CHECK FAN ON & FAN OFF SETTINGS WAIT 3 MINS. CHECK FOR CONT. ON BLUE FAN WIRES	SETTINGS TOO HIGH FAULTY FAN CONTROL OR FAN RELAY	SET FAN OFF AT 80 DEG. F FAN ON 110 DEG. F REPLACE FAN & LIMIT REPLACE FAN CENTER
	BLOWER MOTOR	PUT 120 VOLTS ACROSS BLUE WIRE & WHITE WIRE ON TERMINAL BLOCK IN BLOWER COMPARTMENT	FAULTY BLOWER MOTOR	
HOUSE BLOWER STAYS ON	FAN SIDE FAN & LIMIT FAN RELAY	WAIT 12 MINS. AFTER THERMOSTAT SATISFIED, BLOWER SHOULD SHUT OFF. LONGER UNIT RUNS LONGER BLOWER RUNS	FAULTY FAN CONTROL FAN OFF SET TOO LOW FAULTY RELAY	REPLACE FAN & LIMIT MOVE FAN OFF TO 100 DEG. F REPLACE FAN CENTER
END				

2190 GAS CONDENSING FURNACE PARTS LIST

PART DESCRIPTION	GHC-60	GHC-80	GHC-100
*1. Manual shut off valve.	-	-	-
*2. Black iron steel pipe.	-	-	-
*3. 1/8" NPT plugged pipe tapping.	-	-	-
4. Ground-joint union.	320418	320418	320418
*5. Black iron pipe tee.	-	-	-
6. Cast iron mounting block.	320035	320035	320035
7. Large pressure switch.	350370	350371	350372
8. Combustion air filter end switch.	350684	350684	350684
9. 4-5/8" long corrugated combustion air filter.	AOPS7633	AOPS7633	AOPS7633
10. Condenser clean out box***	-	-	-
11. 2-3/4" diameter plastic plug.	350030	350030	350030
12. 1/2" diameter vinyl pressure tubing.	410016	410016	410016
13. Combination of fan and limit control.	350123	350123	350123
14. Ignition control module.	380071	380071	380071
15. Fan control center.	350387	350387	350387
16. Lower junction box.	350012	350012	350012
17. 4.0" diameter combustion air collar. (Part of top front).	-	-	-
*18. Flue gas sample plug.	-	-	-
*19. PVC vent pipe.	-	-	-
20. Burner mounting plate.	**	**	**
21. Gas valve.	380050	380050	380050
22. Room thermostat	350510	350510	350510
23. Combustion air adjustment assembly.	380545	380545	380545
24. PVC tee assembly.	320077	320077	320076
25. 3" diameter hose clamps (2)	300276	300276	300276
26. Inducer assembly.	340043	340043	340043
27. Plastic hose tee.	320399	320399	320399
28. Door interrupt switch.	350139	350139	350139
29. Motor mounting bracket.	350627	350627	350627
30. House blower motor.	350347	350337	350343
31. 1/2" CPVC drain trap assy.	320075	320075	320075
32. Motor speed terminal strip	350679	350679	350679
33. Motor capacitor.	350073	350073	350076
34. House blower assembly.	**	**	**
35. Capacitor bracket.	**	**	**
36. House blower.	340082	340082	340082
37. Radiant burner assembly.	**	**	**
38. Radiant burner mantle.	380191	380191	380191

* Descriptive item, not part of furnace.

** Manufactured item, order by description for specific model.

*** Part of secondary heat exchanger coil.

2190 GAS CONDENSING FURNACE PARTS LIST

PARTS DESCRIPTION	GHC-60	GHC-80	GHC-100
39. Floor flange gasket (high temperature.	330096	330096	330096
40. Floor flange.	15793	15793	15793
41. Mounting plate gasket.	330021	330021	330021
42. Heat shield.	330085	330085	330085
43. Mounting block gasket.	330097	330097	330097
44. Filter gasket.	330063	330063	330063
45. Post Purge Relay	350384	350384	350384
46. Terminal Block.	350500	350500	350500
47. 5/16" Red silicone tubing.	410005	410005	410005
48. 9/16" Spring clamp.	300271	300271	300271
49. O-Ring	330080	330080	330080
50. Orifice support.	320034	320034	320034
51. 1/2"x7/8" long pipe nipple.	320213	320213	320213
52. Knurled thumb nut.	300112	300112	300112
53. Hot surface igniter assembly.	380089	380089	380089
54. Heyco bushing.	350022	350022	350022
55. 3.0 Capacitor (inducer motor).	350038	350038	350038
56. 2-1/4" Radiator hose.	410018	410018	410018
57. Inspection access plate.	**	**	**
58. 3" PVC outdoor elbow assembly.	**	**	**
59. 3" PVC outdoor elbow.	320099	320099	320099
60. Stainless steel screen.	320226	320226	320226
61. Door handle.	320152	320152	320152
62. Sight glass.	330081	330081	330081
63. Sight glass gasket.	330098	330098	330098
64. Inducer gasket.	330022	330022	330022
65. Inducer mounting plate.	**	**	**
66. Plenum strip.	**	**	**
67. Brown felt strip.	333042	330042	330042
68. Inspection plate gasket.	330015	330015	330015
69. Permanent air filter.	370022	370022	370022
70. Secondary heat exchanger coil.	360363	360364	360364
71. Coil header plate gasket.	330017	330017	330017
72. Front condenser coil gasket.	330016	330016	330016
73. Heat shield.	330019	330020	330020
74. Coil support.	**	**	**
75. 2-3/4"x2 Silicone heater hose.	410019	410019	410019
76. 3-1/4" diameter hose clamp.	300278	300278	300278
77. Chrome knob.	320145	320145	320145
78. Spacer grommets (3).	300031	300031	300031
79. Furnace base panel.	**	**	**
80. Blower panel.	**	**	**

* Descriptive item not part of furnace.

** Manufactured item order by part description for specific model.

2190 GAS CONDENSING FURNACE PARTS LIST

PARTS DESCRIPTION	GHC-70	GHC-90	GHC-110
81. Right side panel.	**	**	**
82. Left side panel.	**	**	**
83. Casing back.	**	**	**
84. Top front section.	**	**	**
85. Front door.	**	**	**
86. Front center panel.	**	**	**
87. Blower access door.	**	**	**
88. Heat exchanger assembly.	**	**	**

* Descriptive item not part of furnace.

** Manufactured item order part description for specific model.

