

Amana AIR COMMAND 90

Model GUD-C (Upflow)

HIGH EFFICIENCY GAS FIRED DIRECT VENT WARM AIR FURNACE INSTALLATION and OPERATION INSTRUCTIONS

IMPORTANT TO THE INSTALLER

Before installing this unit please read this manual to familiarize yourself on the specific items which must be adhered to such as maximum external static pressure to unit, air temperature rise, min. or max. cfm and motor speed connections. Affix these Installation Instructions adjacent to the furnace.

TO THE OWNER

It is important that you fill out the owner's registration card and mail it today. This will assist Amana in contacting you if any service or warranty information should change in the future. When filling in the registration card, be sure to include the Model, Manufacturing and Serial Numbers, plus the installation date.

Your warranty certificate is also supplied with the unit. Read the warranty carefully and note what is covered. Keep the warranty certificate in a safe place, so you can find it, if necessary.

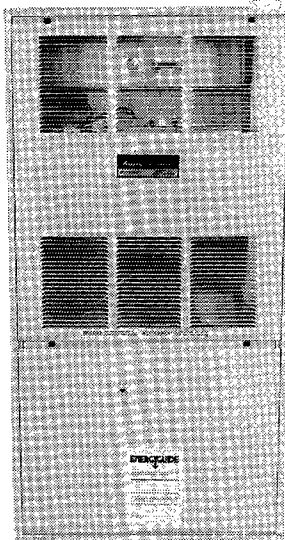
If additional operating instructions are required, call the dealer through whom the purchase was made.

Keep this literature in a safe place for future reference.



WARNING

Should overheating occur or the gas supply fail to shut off, turn off the manual gas control valve to the furnace before shutting off the electrical supply.



**RECOGNIZE THIS SYMBOL
AS A SAFETY PRECAUTION**



WARNING: If the information in this manual 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**
 - Extinguish any open flame.
 - 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.

INDEX

I — SAFETY AND UNIT LOCATION	3
II — SPECIFICATIONS	4
III — GENERAL INFORMATION	6
IV — COMBUSTION AIR AND FLUE PIPING	7
V — CONDENSATE PIPING	13
VI — GAS PIPING	13
VII — ELECTRICAL WIRING	16
VIII — CIRCULATING AIR AND FILTERS	19
IX — SEQUENCE OF OPERATION	19
X — START-UP AND ADJUSTMENT	21
XI — MAINTENANCE	23
XII — FUNCTIONAL PARTS LIST	25
XIII — WIRING DIAGRAM	26

Amana Refrigeration, Inc.
Amana, Iowa, U.S.A.

I. SAFETY AND UNIT LOCATION



RECOGNIZE THIS SYMBOL AS A SAFETY PRECAUTION



WARNING

Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage or death. Refer to this manual. For assistance or additional information consult a qualified installer, service agency or the gas supplier.



WARNING

This product contains or produces a chemical or chemicals which may cause serious illness or death and which are known to the State of California to cause cancer, birth defects or other reproductive harm.



CAUTION

This unit should not be used as a "construction heater" during the finishing phases of construction on a new structure. This type of use may result in premature failure of the unit due to extremely low return air temperatures and exposure to very dirty atmospheres.

LOCATING THE FURNACE



WARNING

To avoid possible equipment damage, fire, personal injury or death, the following points must be observed when installing the unit.



The furnace must be set on a level floor to enable the condensate produced to drain properly. If the floor may become wet or damp at times, the furnace should be supported above the floor on a concrete base sized approximately 1½" larger than the base of the furnace.



The furnace must be installed in a location where all electrical components are protected from water and condensation.



This furnace is not to be installed in a mobile home, trailer, or recreational vehicle.



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



Do not terminate the combustion air intake where the air is often heavily contaminated with compounds containing chlorine or fluorine. Common residential sources of such compounds include:

- Swimming pools and swimming pool pumps/filters
- Clothes dryer vents
- Remote air conditioning or heat pump units (A refrigerant leak would contaminate the combustion air.)
- Plumbing vent stacks
- Bathroom or swimming pool exhaust fans
- Undried paint strippers, adhesives, paints, varnishes, sealers, waxes, and solvents. These are often used during new construction or remodeling.

Various commercial and industrial processes may also be sources of chlorine/fluorine compounds.

In addition, the combustion air intake should not be terminated in areas that are frequently very dusty or dirty.

For further information on locating the termination of the combustion air intake, see "Combustion Air and Flue Piping", Section IV.



Provisions must be made for intake of combustion air and venting combustion products outdoors through an approved venting system as outlined in this manual. The length of combustion air pipe and flue pipe could be a limiting factor in locating the furnace. (See COMBUSTION AIR AND FLUE PIPING, Section IV.)



Allow clearances from the enclosure as shown in TABLE 1 (page 5) for fire protection, proper operation, and service access. These clearances must be permanently maintained. The ventilating air openings in the front and top panels of the furnace must never be obstructed.



When installed in a residential garage the furnace must be positioned so the burners and ignition source are located not less than 18 inches above the floor and protected from physical damage by vehicles.



This furnace produces condensate as it operates. Do not locate the furnace or its condensate drainage system in an area which will be subject to below freezing temperatures.



Do not install the furnace directly on carpeting, tile or combustible material other than wood flooring. In addition, the furnace should be located as centrally as is practical with respect to the air distribution system.



When the furnace is used in conjunction with a cooling unit, the furnace must be upstream of or in parallel with the cooling unit. For details, see Section VIII.

II. SPECIFICATIONS

Direct Vent Gas Furnace

Uplow Model	BTUH		Temp. Rise Range, °F	Number of Burners	(4) F.L.A.	Blower D x W	Blower HP	Blower Speeds	Max. CFM @ .5 ESP	Filters			Pressure Switch Setting(5)	Net Weight	Approx. Ship Weight
	Input	Output								Size	Type	Qty.			
GUD045C30A	(1) 45,000	(1) 43,000	25-55	2	15.1	10x8	1/8	3	1295	16x25x1	Semi-Permanent	1	-1.20 ±0.10	145	158
	(2) 45,000	(2) 43,700													
	(3) 40,500	(3) 39,300													
GUD070C30A	(1) 70,000	(1) 65,000	35-65	3	14.3	10x8	1/8	4	1270	16x25x1	Semi-Permanent	1	-0.90 ±0.09	159	194
	(2) 70,000	(2) 66,400													
	(3) 63,000	(3) 59,800													
GUD070C40A	(1) 70,000	(1) 65,000	35-65	3	17.3	10x10	3/4	4	1650	16x25x1	Semi-Permanent	1	-0.90 ±0.09	168	194
	(2) 70,000	(2) 66,400													
	(3) 63,000	(3) 59,800													
GUD090C35A	(1) 90,000	(1) 84,000	45-75	4	13.2	10x8	1/2	4	1400	16x25x1	Semi-Permanent	1	-1.20 ±0.10	181	216
	(2) 90,000	(2) 85,500													
	(3) 81,000	(3) 77,000													
GUD090C50A	(1) 90,000	(1) 84,000	35-65	4	17.4	10x10	3/4	4	2000	16x25x1	Semi-Permanent	2	-1.20 ±0.10	190	216
	(2) 90,000	(2) 85,500													
	(3) 81,000	(3) 77,000													
GUD115C50A	(1) 115,000	(1) 107,000	35-65	5	17.4	10x10	3/4	4	2000	16x25x1	Semi-Permanent	2	-0.80 ±0.08	215	231
	(2) 115,000	(2) 109,700													
	(3) 103,500	(3) 98,700													

(1) For United States installations.

(2) For Canadian installation at 0-2000 ft.

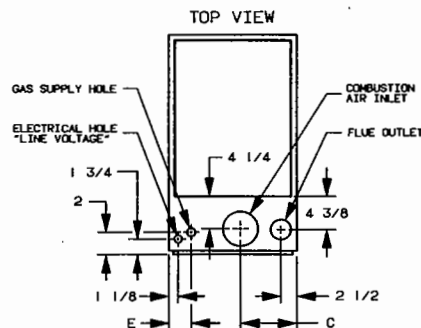
(3) For Canadian installation at 0-4500 ft.

(4) Includes 5 amps drawn by ignitor during 21-second start up cycle.

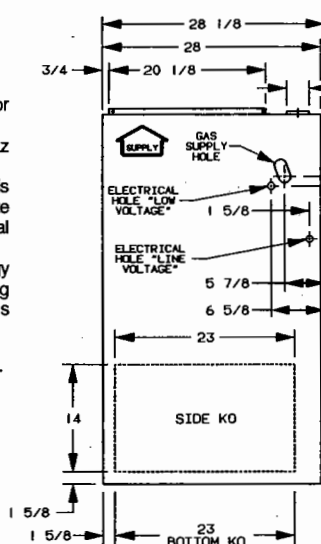
(5) (Vent Blower — Burner Box, inches w.c.), as shipped for installations below 4000 feet.

Flame sensor output is 1 to 4 microamps at 115 volts.

	A	B	C	D	E
GUD045	16 1/2	15	7	10 1/2	2 5/8
GUD070	20 1/2	19	11	14 1/2	2 5/8
GUD090	24 1/2	23	10 1/2	18 1/2	4 5/8
GUD115	24 1/2	23	12 1/2	18 1/2	2 5/8



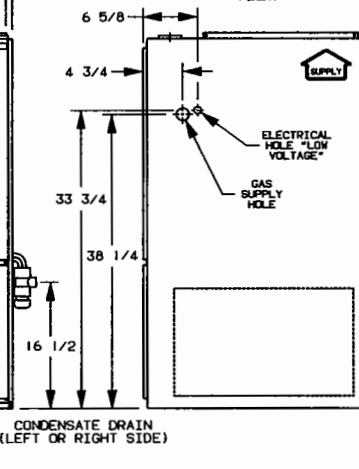
LEFT SIDE VIEW



FRONT VIEW



RIGHT SIDE VIEW



Amara GUD Series Forced Air Central Furnace Design Complies With Requirements Embodied in The American National Standard Shown Below.

ANSI Z21.64 Direct Vent Furnace

NOTES:

- All furnaces have a redundant gas valve and blower door inter-lock switch.
- All furnaces are manufactured for use on 120V, 60 Hertz and single phase electrical power supply.
- Important:** While the data is presented as a guide, it is very important to electrically connect the unit properly, size fuses and wires, in accordance with the National Electrical Code and/or all Existing Local Codes.
- Performance figures are based on Department of Energy information and requirements under continuous operating conditions. Performance will vary with weather conditions and use.
- Drain connections must conform to local codes.
- Installer must supply following gas line fittings, according to which entrance is used:
Top — Two 90° Elbows
One Close Nipple
Left — One 90° Elbow
Right — One 90° Elbow
One 45° Elbow
One Close Nipple

CFM & Temperature Rise vs. External Static Pressure

Model	Motor Speed	External Static Pressure, Inches Water Column													
		0.2		0.3		0.4		0.5		0.6		0.7		0.8	
		CFM	Rise	CFM	Rise	CFM	Rise	CFM	Rise	CFM	Rise	CFM	Rise	CFM	Rise
GUD045C30A	LO	980	40	970	40	940	42	900	44	865	44	810	47	730	52
	MED	1275	—	1200	—	1175	—	1125	—	1055	36	975	39	870	43
	HI	1500	—	1440	—	1375	—	1295	—	1210	—	1120	—	1010	37
GUD070C30A	LO	820	—	800	—	785	—	755	—	730	—	680	—	635	—
	MED-LO	1000	61	985	62	960	63	920	—	880	—	815	—	725	—
	MED	1245	45	1205	51	1165	52	1115	55	1050	56	980	60	880	—
	HI	1460	42	1400	44	1325	46	1270	48	1180	49	1095	53	985	59
GUD070C40A	LO	1350	45	1325	46	1275	48	1200	51	1145	51	1045	56	890	—
	MED-LO	1525	40	1480	41	1425	43	1350	45	1280	46	1200	49	1100	53
	MED	1680	36	1615	38	1560	39	1480	41	1400	42	1310	45	1200	49
	HI	1855	—	1785	—	1735	—	1650	37	1575	37	1485	39	1375	42
GUD090C35A	LO	900	—	895	—	890	—	875	—	840	—	805	—	750	—
	MED-LO	1165	67	1150	68	1135	69	1090	72	1055	72	1000	—	920	—
	MED	1440	54	1400	56	1340	58	1280	61	1200	63	1125	67	1020	74
	HI	1610	49	1560	50	1470	53	1400	56	1295	58	1200	63	1080	70
GUD090C50A	LO	1465	53	1450	54	1400	56	1350	58	1280	59	1195	64	1050	—
	MED-LO	1700	46	1670	47	1625	48	1565	50	1500	51	1400	54	1255	60
	MED	1900	41	1865	42	1805	43	1735	45	1635	46	1590	48	1465	52
	HI	2250	—	2175	36	2085	38	2000	39	1890	40	1780	43	1640	46
GUD115C50A	LO	1455	—	1440	—	1390	—	1350	—	1290	—	1220	—	1115	—
	MED-LO	1690	59	1665	60	1610	62	1555	64	1485	—	1390	—	1245	—
	MED	1920	52	1865	54	1805	55	1730	58	1650	59	1535	63	1355	—
	HI	2280	44	2190	46	2100	48	2000	50	1880	51	1755	55	1600	60

NOTE:

1. CFM information in the above chart is with filter(s) as shipped with furnace. If furnace is shipped with two side return filters, this chart assumes both filters are used.
2. INSTALLATION IS TO BE ADJUSTED TO OBTAIN TEMPERATURE RISE WITHIN THE RANGE SPECIFIED ON THE RATING PLATE.
3. The above chart is for information only. For satisfactory operation, external static pressure should not exceed value shown on rating plate. The shaded area indicates ranges in excess of maximum external static pressure allowable when heating.
4. The above chart is for U.S. furnaces installed at 0-2000 feet. At higher altitudes, a properly derated unit will have approximately the same temperature rise at a particular CFM, while the ESP at that CFM will be lower.

CLEARANCES TO COMBUSTIBLE SURFACES (inches)

TABLE 1

Front	6
Left side	1
Right side	1
Rear	0
Top	1
Flue	0
Floor	C

C = Combustible Floor (Wood Only)

ACCESSIBILITY CLEARANCES (MINIMUM)

36" at front is required for servicing or cleaning.

NOTE: In all cases accessibility clearance shall take precedence over clearances from the enclosure where accessibility clearances are greater.

III. GENERAL INFORMATION



WARNING

Property damage, bodily injury, or death from hazards such as fire, explosion, smoke, soot condensation, electrical shock, or carbon monoxide may result from improper installation, repair, operation, or maintenance on this product.



WARNING

To avoid fire, property damage, and personal injury, do not install this unit in a mobile home, trailer, or recreational vehicle.

This is a direct vent upflow type furnace. To assure that your unit operates safely and efficiently, it must be installed, operated, and maintained in accordance with these installation and operating instructions, all local building codes and ordinances, or, in their absence, with the latest edition of the National Fuel Gas Code, ANSI Z223.1*, in Canada with the CAN/CGA-B149 Installation Codes, local plumbing or waste water codes, and other applicable local codes.

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

*Obtain from:
American National Standards Institute
1430 Broadway
New York, NY 10018

TRANSPORTATION DAMAGE

All furnaces are securely packed in shipping containers approved by the National Safe Transit Committee. The carton should be checked upon arrival for external damage. If damage is found, a request for inspection by carrier's agent should be made in writing immediately.

The furnace should be carefully inspected upon arrival for damage and bolts or screws which may have loosened in transit. In the event of damage, the consignee should:

1. Make notation on delivery receipt of any visible damage to shipment or container.
2. Notify carrier promptly and request an inspection.
3. In case of concealed damage, carrier should be notified as soon as possible — preferably within 5 days.
4. File the claim with the following supporting documents within the 9-month statute of limitations:
 - a. Original Bill of Lading, certified copy, or indemnity bond.
 - b. Original paid freight bill or indemnity in lieu thereof.
 - c. Original invoice or certified copy thereof, showing trade and other discounts or reductions.
 - d. Copy of the inspection report issued by carrier's representative at the time damage is reported to the carrier.

The carrier is responsible for making prompt inspection of damage and for a thorough investigation of each claim. The distributor or manufacturer will not accept claims from dealers for transportation damage.

LOCATING THE THERMOSTAT

Thermostat should be mounted 4 to 5 feet above the floor, on an inside wall of the living room, dining room, or a hallway that has good air circulation from the other rooms being controlled by the thermostat.

Movement of air should not be obstructed by furniture, doors, draperies, etc. The thermostat should not be mounted where it will be affected by drafts, hot or cold water pipes or air ducts in walls, radiant heat from fireplace, lamps, the sun, T.V., etc. or on an outside wall. Consult the Instruction Sheet packed with thermostat for mounting instructions.

IV. COMBUSTION AIR AND FLUE PIPING

This section is outlined as follows:

- A. GENERAL INFORMATION AND SAFETY PRECAUTIONS
- B. MATERIALS TO BE USED
- C. LOCATION OF EXHAUST AND INTAKE TERMINATIONS
- D. SIZING OF EXHAUST VENT AND COMBUSTION AIR INTAKE PIPES
- E. VENT PIPE INSTALLATION
- F. ADDITIONAL CANADIAN VENTING REQUIREMENTS

A. GENERAL INFORMATION AND SAFETY PRECAUTIONS



WARNING

Failure to follow these instructions can result in bodily injury or death from asphyxiation. Therefore, carefully read and follow all instructions given in this section.

THIS APPLIANCE HAS BEEN APPROVED FOR DIRECT VENT INSTALLATION ONLY. COMMON VENTING OF THIS FURNACE WITH ANOTHER APPLIANCE (WATER HEATER, ETC.) IS NOT ALLOWED.

Combustion air must be taken from outside the structure for proper furnace operation.



CAUTION

Terminate the combustion air intake as far as is practical from the air conditioning unit or heat pump, swimming pools, swimming pool pumping units, and dryer vents.

All combustion air and exhaust piping must be installed in accordance with local codes and these instructions.

When the GUD furnace is installed in a confined space where the minimum clearances to combustible surfaces (see p. 5) are applied, such as in a closet or a utility room, two ventilation openings are required with a total minimum free area of 0.25 square inches per 1,000 BTUH of the furnace input rating. One opening must be within 12 inches of the top and one must be within 12 inches of the bottom of the confined space. In typical construction, the clearance between the door and door frame will usually be adequate to satisfy this ventilation requirement.

When the GUD furnace is installed in the same space with other gas appliances, such as a water heater, make sure there is an adequate supply of combustion and ventilation air for the other appliances. See the latest edition of the National Fuel Gas Code (ANSI Z223.1) for determining the combustion air requirements for the appliances.

When an existing furnace is removed from a venting system serving other appliances, the venting system may be too large to properly vent the remaining attached appliances.

The following steps shall be followed with each appliance remaining connected to the common venting system placed in operation, while the other appliances remaining connected to the common venting system are not in operation.

- (a) Seal any unused openings in the common venting system.
- (b) Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion and other deficiencies which could cause an unsafe condition.
- (c) Insofar as is practical, close all building doors and windows and all doors between the space in which the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any appliance not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.
- (d) Follow the lighting instructions. Place the appliance being inspected in operation. Adjust thermostat so appliance will operate continuously.
- (e) Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle, or smoke from a cigarette, cigar, or pipe.
- (f) After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas-burning appliance to their previous conditions of use.
- (g) If improper venting is observed during any of the above tests, the common venting system must be corrected in accordance with the latest edition of the National Fuel Gas Code, ANSI Z223.1.

If resizing any portion of the common venting system, use the appropriate table in Appendix G in the latest edition of the National Fuel Gas Code, ANSI Z223.1.

B. MATERIALS TO BE USED

This Category IV Direct Vent Furnace is designed to be vented to the outside of the structure for the intake of combustion air. Consequently, the venting must be done in a different manner and with different materials than with a conventional system. Two or three inch PVC Schedule 40 pipe meeting ASTM 1785, PVC primer and PVC solvent cement meeting ASTM D2564 specifications must be used. Only DWV type fittings meeting ASTM D2655 for socket dimensions and ASTM D3311 for exterior dimensions can be used. Carefully follow the manufacturer's instructions in cutting, cleaning and solvent cementing PVC or ABS pipe.

As an alternate to PVC pipe, primer, solvent cement, and fittings; ABS materials which are in compliance with the following specifications may be used: two or three inch ABS Schedule 40 pipe must meet ASTM D1527 and must be CSA listed. Solvent cement for ABS to ABS joints must meet ASTM D2235 and must be CSA listed. The solvent cement used for the PVC to ABS joint must meet ASTM D3138. Fittings must be DWV type fittings which meet ASTM D2661 and ASTM D3311 (exterior dimensions) and are CSA listed. Carefully follow the manufacturer's instructions in cutting, cleaning and solvent cementing PVC or ABS pipe.



WARNING

Solvent cements are combustible liquids and should be kept away from all ignition sources (ie: sparks, open flames and excessive heat). Avoid breathing cement vapors or contact with skin and eyes.

All 90 degree elbows must be either medium radius ($\frac{1}{4}$ bend DWV) or long radius (long sweep $\frac{1}{4}$ bend DWV) types conforming to ASTM D3311. A medium radius ($\frac{1}{4}$ bend) elbow is $3\frac{1}{16}$ inch minimum from the plane of one opening to the centerline of the other opening for 2" pipe ($4\frac{9}{16}$ " for 3" pipe). These dimensions are shown in Figure 5.

This furnace must not be connected to any type B, BW, or L vent or vent connector and must not be vented into any portion of a factory built or masonry chimney, except when used as a pathway for PVC pipe as described below.

Flexible couplings for joining PVC pipe (sometimes called "no hub connectors") have been used by some installers to connect the field supplied portion of the flue gas vent system to the furnace. Amana Refrigeration, Inc. does not encourage nor recommend using these connectors. However, if you do choose to use "no-hub connectors," the connectors must be gas tight, water tight, and able to withstand continuous exposure to the warm, moist, acidic flue products of the furnace.

It is the responsibility of the installer to follow the manufacturer's recommendations and to verify that all flue pipe connectors used are compatible with the furnace flue products. In addition, the connectors must possess adequate structural integrity to prevent flue pipe separations during furnace operation.

This furnace is supplied with 2" and 3" air intake terminal screens. These screens were shipped in the same plastic sack which held this manual. For both vertical and horizontal installations, insert the appropriately sized screen into the air intake terminal until it is firmly secured at the hub of the terminal elbow. Discard the unused screen.

If the vent (flue) pipe is exposed to extremely cold temperatures and/or long runs through unheated spaces or outdoors, insulation may be required on the outside of the vent pipe to prevent condensate from freezing. Canadian installers must take note of the "Additional Canadian Venting Requirements" on page 12. Where required, use $\frac{1}{2}$ " thick closed cell foam insulation such as Armaflex or Insultube.

If the combustion air pipe is to be installed above a suspended ceiling or other area where dripping of condensation will be objectionable, insulation of the combustion air pipe may be required. Where required, use $\frac{1}{2}$ " thick closed cell foam insulation such as Armaflex or Insultube.

C. LOCATION OF EXHAUST AND INTAKE TERMINATIONS

1. All Installations

This furnace can be installed with either a vertical or horizontal direct vent. In either case, the exhaust vent and the combustion air intake pipe must be located on the same side of the structure and separated by no less than 3 inches and no more than 24 inches.

The following points must also be considered when installing the vent pipe in either a horizontal or vertical application:

1. The vent termination must be at least 3 feet above any forced air inlet located within 10 feet.

Exception: This provision shall not apply to the combustion air intake of a direct vent furnace.

2. The vent termination must be at least 12 inches from any door, window, or gravity air inlet into any building.
3. The vent must terminate at least 2 feet above ground level or roof level. If heavy snow accumulation is expected, this distance will need to be increased.
4. The vent shall not terminate over public walkways or over an area where condensate or vapor could create a nuisance or hazard or could be detrimental to the operation of regulators, relief valves, or other equipment.
5. In addition, the combustion air intake should not be terminated in areas that are frequently very dusty or dirty.



CAUTION

Do not terminate the combustion air intake where the air is often heavily contaminated with compounds containing chlorine or fluorine. Common residential sources of such compounds include:

- Swimming pools and swimming pool pumps/filter
- Clothes dryer vents
- Remote air conditioning or heat pump units (A refrigerant leak would contaminate the combustion air.)
- Plumbing vent stacks
- Bathroom or swimming pool exhaust fans
- Undried paint strippers, adhesives, paints, varnishes, sealers, waxes, and solvents. These are often used during new construction or remodeling.

Various commercial and industrial processes may also be sources of chlorine/fluorine compounds.

2. Horizontal Vent/Intake Terminations

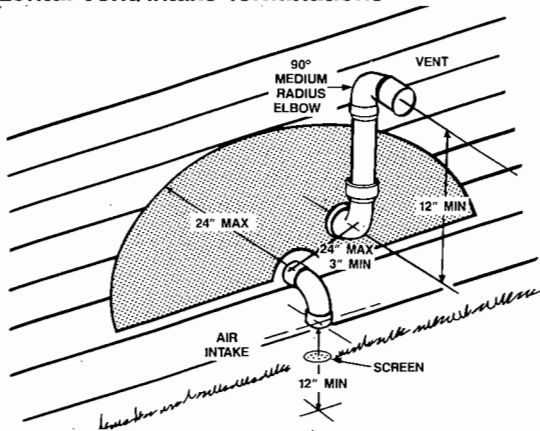


Figure 1. Horizontal Vent Termination

Position the combustion air intake terminal away from obstructions, above anticipated snow accumulations, and at least 12 inches above grade, as shown in Figure 1.

The exhaust vent must penetrate the wall within the shaded region as shown in Figure 1.

All exhaust vent and air intake terminal fittings must be medium radius ($\frac{1}{4}$ bend DWV) 90 degree elbows.

To prevent unnecessary shutdown of furnace due to pressure switch trips, always determine anticipated snow accumulation level, and install the terminals accordingly to prevent exhaust vent and air intake blockages.

If installation above snow accumulation is required, add additional elbows as shown in Figure 2. A 12" minimum clearance between the air intake and the highest anticipated snow level must be maintained. The exhaust vent must penetrate the wall within the shaded region as shown in Figure 2.

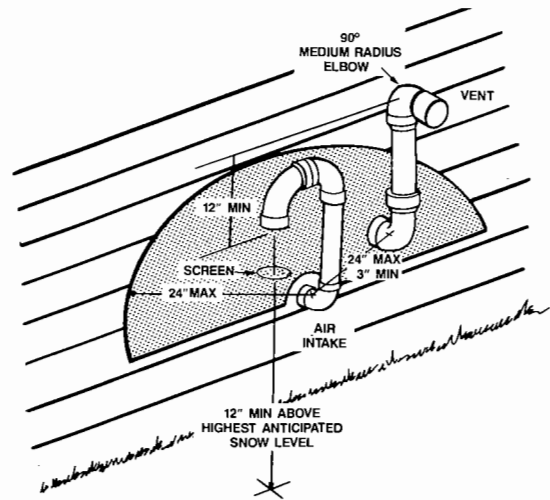


Figure 2. Horizontal Vent Termination Above Anticipated Snow Level

DO NOT point terminals into window wells, stairwells, alcoves or other recessed areas. It is preferable for the air intake to terminate on opposite or adjacent sides of the structure from the dryer vent. If this is not practical, maintain a 3 foot clearance (residential laundry) or a 10 foot clearance (commercial laundry).

3. Vertical Vent/Intake Terminations

If the vent and air intake pipes are to be run vertically through the roof, they must extend at least 12" above the roof line and shall be no closer than 12" to any vertical wall. The vent pipe must extend at least 12" above the air intake. See Figure 3. In areas where heavy snow accumulation is expected, these distances will need to be increased. The vent and air intake pipes must be made tight where they pass through the roof with a proper flashing such as used with a plastic plumbing vent.

Maintain at least a three foot clearance from the air intake pipe to plumbing vent stacks.

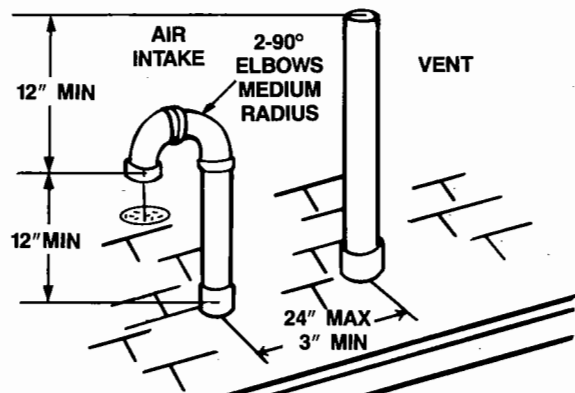


Figure 3. Vertical Vent Termination

The vent and air intake pipe may be run through an existing unused chimney. However, the pipes must be run all the way through the chimney, with the air intake pipe terminating at least 12" above the top of the chimney.

The flue pipe must terminate at least 12" above the air intake. The air intake and exhaust may run side by side or as far apart as necessary within the chimney.

See Figure 4 for explanation. The open space around the two pipes must be closed with a weather tight, corrosion resistant flashing. **NEVER VENT WITH AN EXISTING APPLIANCE OR A VENT USED BY A SOLID FUEL APPLIANCE.**

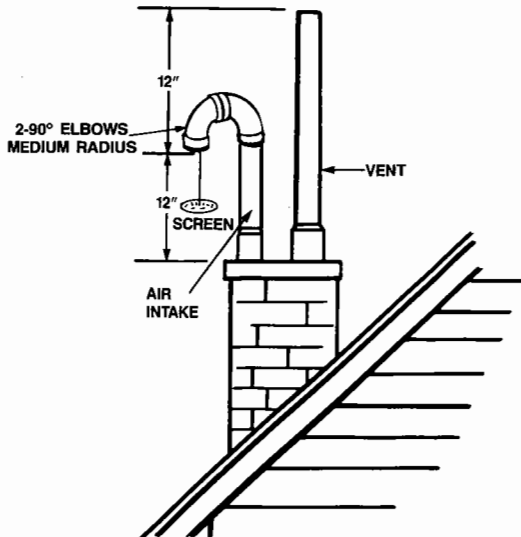


Figure 4. Venting Through An Existing Chimney

4. Vent/Intake Terminations for Installation of Multiple Direct Vent Furnaces

If more than one direct vent furnace is to be installed vertically through a common roof top, maintain the same clearances between the exhaust vent and air intake terminations of adjacent units as with the exhaust vent and air intake terminations of a single unit (Figure 3).

If more than one direct vent furnace is to be installed horizontally through a common side wall, maintain the clearances as shown in Figure 5. Always terminate all exhaust vent outlets at the same elevation and always terminate all air intakes at the same elevation.

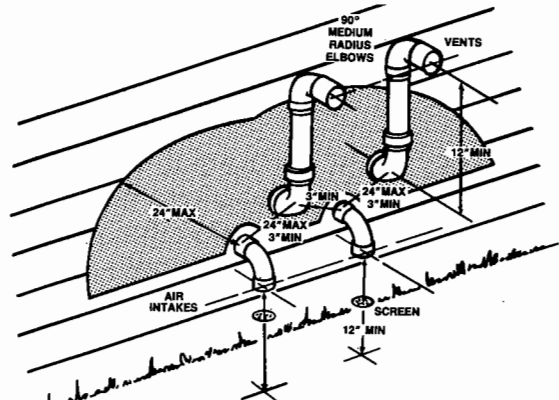


Figure 5. Horizontal Venting of Multiple Units

D. SIZING OF EXHAUST VENT AND COMBUSTION AIR INLET PIPES

Consult Tables 3 to 6 to select the proper diameter exhaust and combustion air piping. The vent and air intake piping is sized for each unit model number based on total line length and number of 90° elbows required. Two 45° elbows are equivalent to one 90° elbow. For horizontal piping, the elbow(s) used for vent & air pipe termination outside the structure as shown in Figure 1 are not counted when using Tables 3 thru 6. The additional two 90° elbows as shown in Figure 2 must be counted. If vertical piping is used, the two additional 90° elbows on the air intake as shown in Figure 3 and Figure 4 must be counted. **WHEN THE VENT SYSTEM REQUIRED IS BORDERLINE WITH NEXT SIZE COMBINATION CATEGORY, USE THE NEXT LARGER SIZE.**

IMPORTANT: One short radius 90° elbow is equivalent to 3 1/3 medium radius elbows. For this reason, short radius 90° elbows must not be used. The proper centerline-to-centerline dimensions for medium radius 90° elbows are shown below in Figure 6.

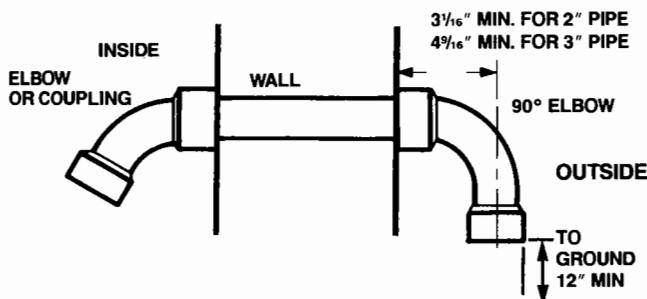


Figure 6.

EXAMPLE:

An installation calls for a 45,000 Btuh furnace. It must be vented 35 feet and use two medium radius 90° elbows on both inlet and exhaust. With this in mind, we must look at Table 3 to determine the correct vent and air intake pipe size. With two elbows and 35 feet of straight pipe, 3" air intake pipe must be used and 2" vent pipe.

TABLE 3 FOR 45,000 BTUH FURNACE								
No. of ELBOWS	VENT TYPE	FEET OF STRAIGHT PIPE EACH RUN						
		5-10	10-15	15-20	20-25	25-30	30-35	35-40
1	INLET	2	2	2	2	2	2	2
	EXHAUST	2	2	2	2	2	2	2
2	INLET	2	2	2	2	2	2	3
	EXHAUST	2	2	2	2	2	2	2
3	INLET	2	2	2	2	2	3	3
	EXHAUST	2	2	2	2	2	2	2
4	INLET	2	2	2	2	3	3	3
	EXHAUST	2	2	2	2	2	2	2
5	INLET	2	2	2	3	3	3	3
	EXHAUST	2	2	2	2	2	2	2
6	INLET	2	2	3	3	3	3	3
	EXHAUST	2	2	2	2	2	2	2

IMPORTANT: When three inch diameter exhaust pipe is used, the transition from two inch to three inch pipe must be made in a vertical run. This is necessary for proper condensate drainage and pressure switch operation.

TABLE 4 FOR 70,000 BTUH FURNACE

No. of ELBOWS	VENT TYPE	FEET OF STRAIGHT PIPE EACH RUN						
		5-10	10-15	15-20	20-25	25-30	30-35	35-40
1	INLET	2	2	2	2	2	2	2
	EXHAUST	2	2	2	2	2	2	2
2	INLET	2	2	2	2	2	2	3
	EXHAUST	2	2	2	2	2	2	2
3	INLET	2	2	2	2	2	3	3
	EXHAUST	2	2	2	2	2	2	2
4	INLET	2	2	2	2	3	3	3
	EXHAUST	2	2	2	2	2	2	2
5	INLET	2	2	2	3	3	3	3
	EXHAUST	2	2	2	2	2	2	2
6	INLET	2	2	3	3	3	3	3
	EXHAUST	2	2	2	2	2	2	2

TABLE 5 FOR 90,000 BTUH FURNACE

No. of ELBOWS	VENT TYPE	FEET OF STRAIGHT PIPE EACH RUN						
		5-10	10-15	15-20	20-25	25-30	30-35	35-40
1	INLET	2	2	3	3	3	3	3
	EXHAUST	2	2	2	2	2	2	2
2	INLET	2	3	3	3	3	3	3
	EXHAUST	2	2	2	2	2	2	2
3	INLET	3	3	3	3	3	3	3
	EXHAUST	2	2	2	2	2	2	3
4	INLET	3	3	3	3	3	3	3
	EXHAUST	2	2	2	2	2	3	3
5	INLET	3	3	3	3	3	3	3
	EXHAUST	2	2	2	2	3	3	3
6	INLET	3	3	3	3	3	3	3
	EXHAUST	2	2	2	3	3	3	3

TABLE 6 FOR 115,000 BTUH FURNACE

No. of ELBOWS	VENT TYPE	FEET OF STRAIGHT PIPE EACH RUN						
		5-10	10-15	15-20	20-25	25-30	30-35	35-40
1	INLET	2	3	3	3	3	3	3
	EXHAUST	2	2	2	2	2	2	2
2	INLET	3	3	3	3	3	3	3
	EXHAUST	2	2	2	2	2	2	3
3	INLET	3	3	3	3	3	3	3
	EXHAUST	2	2	2	2	2	3	3
4	INLET	3	3	3	3	3	3	3
	EXHAUST	2	2	2	2	3	3	3
5	INLET	3	3	3	3	3	3	3
	EXHAUST	2	2	2	3	3	3	3
6	INLET	3	3	3	3	3	3	3
	EXHAUST	2	2	3	3	3	3	3

E. VENT PIPE INSTALLATION

1. HORIZONTAL OR VERTICAL

The size of the vent and air intake pipes is determined by the heating capacity of the furnace and the length and number of elbows of the pipe runs. To properly size the pipes, refer to the previous Section. (IV-D.)

Use only the fittings, primer, and solvent cement which are described in Section IV-B. An air intake screen (as described in Section IV-B) must be installed. This screen is supplied with the furnace. Do not place a screen in the exhaust vent termination. It is not needed, and the furnace flue products could cause it to corrode.



WARNING

Solvent cements are combustible liquids and should be kept away from all ignition sources. (ie. sparks, open flames and excessive heat). Avoid breathing cement vapors or contact with skin and eyes.

Under some conditions, insulation of some or all of the vent pipe and/or combustion air pipe may be required. For further information, see Section IV-B and/or IV-F. Do not install insulation until after the flue system has been inspected for leaks as described below.



WARNING

Upon completion of the furnace installation, carefully inspect the entire flue system both inside and outside the furnace to assure it is properly sealed. Leaks in the flue system can result in serious personal injury or death due to exposure of flue products, including carbon monoxide.

2. HORIZONTAL ONLY

For each 2 inch pipe, drill a 2 $\frac{3}{8}$ inch diameter hole through the wall at the proper location.

For each 3 inch pipe, drill a 3 $\frac{1}{2}$ inch diameter hole through the wall at the proper location.

Cut a piece of PVC (ABS) pipe that is the thickness of the wall plus the depth of the sockets of the fittings to be installed on the inside and outside of the walls.

To prevent the vent pipe from moving, and possibly damaging the connections, locate the fittings on the inside wall and the elbow on the outside as shown in Figure 6 for the air intake.

In a basement installation, the vent pipe may be run between the joist spaces. If the pipes must go below the joists, then the pipes must run up into the last joist space to go through the header. Two 45° elbows should be used rather than 90's. The horizontal run of exhaust pipe must not have any sag that can hold condensate and should pitch up at least $\frac{1}{4}$ " per foot so that condensate will run back to the unit to drain. Support the horizontal run at least every three feet.

Allow for some expansion and contraction from temperature fluctuations. The normal direction changes usually account for this, but if you have a long run followed by a short offset of less than 40 inches such as going up into the last joist space, the pipes should be tightly clamped to prevent flex loading on the fittings. Seal around the pipe on the outside wall with silicone caulking material.

F. ADDITIONAL CANADIAN VENTING REQUIREMENTS

ADDITIONAL CANADIAN VENTING REQUIREMENTS

In Canada venting shall conform to the requirements of the current CANI-B149 Installation Codes.

Use only C.S.A. listed 2" or 3" nominal diameter PVC or ABS pipe and fittings throughout.

The minimum vent consists of 5 feet of straight 2" pipe and one elbow.

The maximum vent consists of 40 feet of straight pipe and six elbows. See chart for diameter.

The minimum air pipe consists of 5 feet of 2" straight pipe and one elbow.

The maximum air pipe consists of 40 feet of 3" straight pipe and six elbows.

A single wall vent shall not be run vertically through the roof. Although, the vent may be run through an existing *unused* chimney as described in the previous venting section provided the space between the vent pipe and the chimney is insulated and closed with a weather tight, corrosion resistant flashing.

Cut all vent pipe at right angles. Remove inside and outside burr at each cut. Use cleaner to clean pipe and fitting socket. Use CSA listed cement to fasten pipe and fittings. Follow manufacturers cleaning and cementing instructions carefully to avoid leakage.

NOTE: ALL PIPING EXPOSED OUTDOORS OR IN UNHEATED AREAS MUST BE INSULATED WITH 1/2" THICK CLOSED CELL FOAM INSULATION SUCH AS "ARMAFLEX" OR "INSULTUBE."

The vent terminal shall NOT be located:

1. Less than 12" above the finished grade line.
2. Less than 36" from any building opening or any gas service regulator (for gas service regulators in the Province of Ontario, 72").
3. Less than 72" from the combustion air inlet of another appliance.
4. Directly above a gas utility meter or service regulator.
5. Over a walkway unless 84" above grade.

V. CONDENSATE PIPING

CONDENSATE DRAIN

The Air Command 90 achieves its high efficiency by condensing some of the flue products into a slightly acidic water which must be piped to a drain. A drain well which is shipped with the furnace must be installed on either side of the furnace cabinet. See Figure 7. The condensate from the recuperative coil and the induced draft blower flows into this drain well which acts as a trap. No other trap must be used. A $\frac{3}{4}$ " nominal PVC (or CPVC) pipe must be run from the side of the well to a drain maintaining a horizontal downward slope in accordance with good plumbing practice. **DO NOT TRAP THIS LINE.**

PVC (or CPVC) pipe is recommended since it is corrosion resistant, rigid and not easily damaged. The drain line must not be routed outside where it could possibly freeze and become blocked. The top of the well must be left open so that any blockage in the drain line will be relieved out the top of the drain well and not back up in the unit.

See the separate condensate drain system Installation Instructions for details on properly installing the drain lines and standpipe.

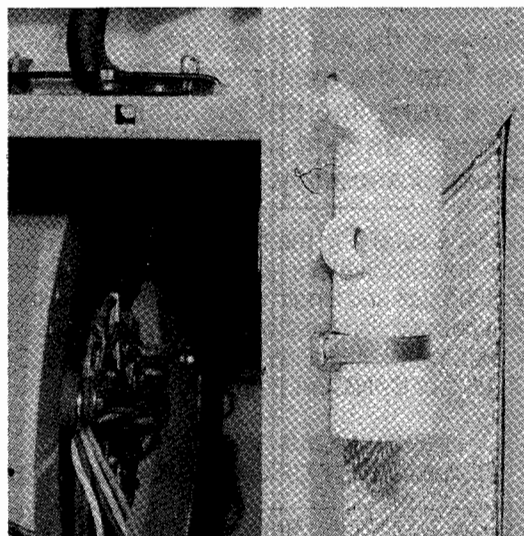


Figure 7.

VI. GAS PIPING

GAS SUPPLY AND PIPING

The rating plate is stamped with the model number, type of gas and gas input rating. Make sure the furnace is equipped to operate on the type of gas available.

INLET GAS PRESSURE	
NATURAL	MIN. 5.0", MAX. 10.0"
PROPANE	MIN. 11.0", MAX. 14.0"

Inlet Gas Pressure Must Not Exceed the Maximum Value Shown in Table Above.

The minimum supply pressure must not be varied downward because this could lead to unreliable ignition. In addition, gas input to the burners must not exceed the rated input shown on the rating plate. Overfiring of the furnace could result in premature heat exchanger failure.

HIGH ALTITUDE DERATE (UNITED STATES INSTALLATIONS ONLY)

When this furnace is installed at altitudes above 2,000 feet the furnace input must be derated 4% for each 1,000 feet above sea level because the density of the air is reduced.

In some areas the gas supplier will derate the gas at a rate of 4% for each 1,000 feet above sea level. If he does not do so, smaller orifices will be required at altitudes above 3,500 feet (non-derated natural gas) or 4,500 feet (non-derated propane).

A different pressure switch is required at altitudes more than 4,000 feet above sea level. This is required regardless of the heat content of the fuel used.

High altitude kits can be purchased depending upon the altitude.

Refer to the High Altitude Instruction Manual included with this furnace to determine which High Altitude Components to use and also for Detailed Installation Instructions.

Adjustment of the manifold pressure to a lower pressure reading than what is specified on the furnace nameplate is not a proper derate procedure. With a lower density of air and a lower manifold pressure at the burner orifice, the orifice will not aspirate the proper amount of air into the burner. This can cause incomplete combustion of the gas, flash back, and possible yellow tipping.

GAS PIPING



CAUTION

To avoid possible unsatisfactory operation or equipment damage due to underfiring of equipment, do not undersize the natural gas piping from the meter to the furnace. When sizing a trunk line per the tables, include all appliances on that line that could be operated simultaneously.

The gas pipe supplying the furnace must be properly sized based on the cubic feet per hour of gas flow required, specific gravity of the gas and length of the run. The gas line installation must comply with local codes, or in the absence of local codes, with the latest edition of the National Fuel Gas Code ANSI Z223.1 or CAN/CGA B149 Installation Codes.

NATURAL GAS CAPACITY OF PIPE IN CUBIC FEET OF GAS PER HOUR (CFH)

Length of Pipe in Feet	Nominal Black Pipe Size				
	1/2"	3/4"	1"	1 1/4"	1 1/2"
10	132	278	520	1,050	1,600
20	92	190	350	730	1,100
30	73	152	285	590	980
40	63	130	245	500	760
50	56	115	215	440	670
60	50	105	195	400	610
70	46	96	180	370	560
80	43	90	170	350	530
90	40	84	160	320	490
100	38	79	150	305	460

(Press. .5 Psig or less and Pressure Drop of 0.3" W.C.; Based on 0.60 Specific Gravity Gas)

$$CFH = \frac{BTUH \text{ FURNACE INPUT}}{\text{CALORIFIC VALUE OF GAS}}$$

CONNECTING THE GAS PIPING — NATURAL GAS

Refer to Figure 8 for the general layout of the furnace. The following rules apply:

1. Use black iron or steel pipe and fittings for the building piping.
2. Use pipe joint compound on male threads only. Pipe joint compound must be resistant to the action of the fuel used.
3. Use ground joint unions. (Inside or outside of furnace.)
4. Install a drip leg to trap dirt and moisture before it can enter the gas valve. The drip leg must be a minimum of three inches long.
5. Use two pipe wrenches when making connection to the gas valve to keep it from turning.
6. Install a manual shutoff valve. This shutoff valve should be conveniently located within (6) six feet of the unit, and between the meter and unit.
7. Tighten all joints securely.
8. The furnace shall be connected to the building piping by one of the following:
 - a. Rigid metallic pipe and fittings.
 - b. Semirigid metallic tubing and metallic fittings. Aluminum alloy tubing shall not be used in exterior locations.
 - c. Listed gas appliance connectors used in accordance with the terms of their listing that are completely in the same room as the equipment.

- d. In "b" and "c" above, the connector or tubing shall be installed so as to be protected against physical and thermal damage. Aluminum-alloy tubing and connectors shall be coated to protect against external corrosion where they are in contact with masonry, plaster or insulation or are subject to repeated wettings by such liquids as water (except rain water), detergents or sewage.

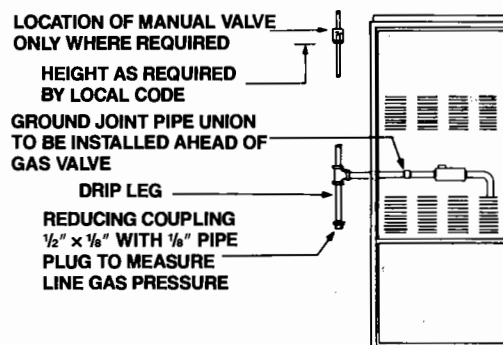


Figure 8.

When the gas piping enters through the top of the furnace, the installer must supply the following fittings (starting from the gas valve):

- 90 degree elbow
- Close nipple
- 90 degree elbow
- Straight pipe to reach exterior of furnace.

See Figure 9.

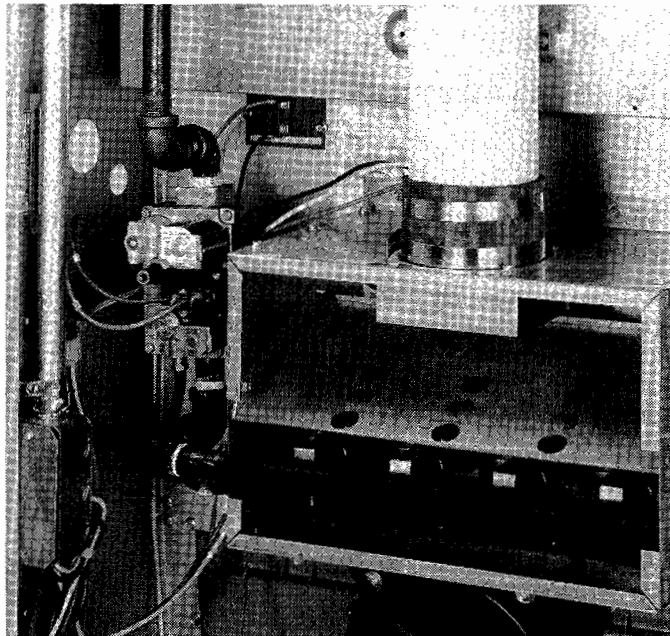


Figure 9.

A ground joint union, drip leg, and manual shutoff valve must also be supplied by the installer. In some cases, the installer may also need to supply a transition piece from 1/2" to another pipe size.

When the gas piping enters through the right side of the furnace, the installer must supply the following fittings (starting from the gas valve):

- 90 degree elbow
 - Close nipple
 - 45 degree elbow
 - Straight pipe to reach exterior of furnace.
- See Figure 10.

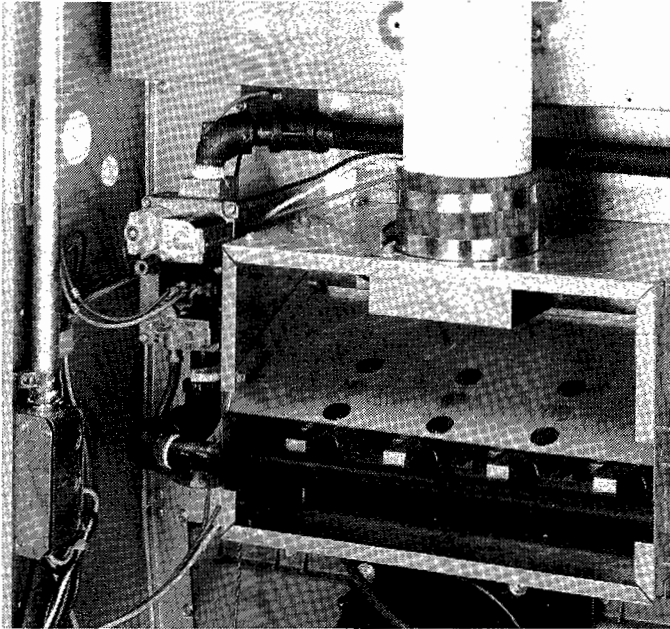


Figure 10.

To avoid the possibility of vibrations or noise, the gas piping should not come in contact with the air inlet or flue exhaust pipes. A ground joint union, drip leg, and manual shutoff valve must also be supplied by the installer. In some cases, the installer may also need to supply a transition piece from 1/2" to another pipe size.

When the gas piping enters through the left side of the furnace, the installer must supply the following fittings (starting from the gas valve):

- 90 degree elbow
- Straight pipe to reach exterior of furnace

A ground joint union, drip leg, and manual shutoff valve must also be supplied by the installer. In some cases, the installer may also have to supply a transition piece from 1/2" to another pipe size.

CHECKING THE GAS PIPING



CAUTION

To avoid the possibility of property damage, personal injury or fire, the following instructions must be performed regarding gas connections and pressure testing.



The unit and its gas connections must be leak tested before placing in operation. Because of the danger of explosion or fire, never use a match or open flame to test for leaks. Never exceed specified pressures for testing. Higher pressure may damage the gas valve and cause overfiring which may result in heat exchanger failure.



This unit and its individual shutoff valve must be disconnected from the gas supply piping system during any pressure testing of that system at test pressures in excess of 1/2 psig (3.48 kPa).



This unit must be isolated from the gas supply system by closing its individual manual shutoff valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 psig (3.48 kPa).

TANKS AND PIPING — PROPANE UNITS



WARNING

PERSONAL INJURY HAZARD

Iron oxide (rust) can reduce the level of odorant in propane gas. A gas detecting device is the only reliable method to detect a propane gas leak. Contact your local propane supplier about installing a gas detecting warning device to alert you in the event that a gas leak should develop.

Failure to detect a propane gas leak could result in an **EXPLOSION** or **FIRE** which could cause **SERIOUS PERSONAL INJURY OR DEATH**.

All propane gas equipment must conform to the safety standards of the National Board of Fire Underwriters (See NBFU Manual 58) or Natural Standards of Canada B149.2, Installation Code for Propane Gas Burning Appliances and Equipment.

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

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

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

Propane is an excellent solvent, and special pipe dope must be used when assembling piping for this gas as it will quickly dissolve white lead or most standard commercial compounds. Shellac base compounds resistant to the actions of liquified petroleum gases such as Gasolac, Stalactic, Clyde's or John Crane are satisfactory.

Refer to Fig. 11 for typical propane gas installations.

TYPICAL PROPANE PIPING

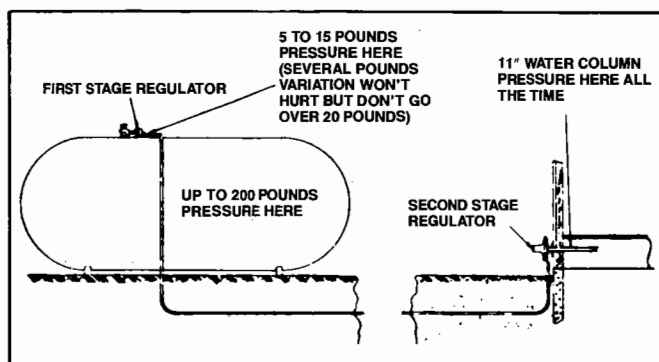


Figure 11.



WARNING

If your propane gas furnace is installed in a basement, an excavated area or a confined space, we strongly recommend that you contact your propane supplier about installing a warning device that would alert you to a gas leak.

...Propane gas is heavier than air and any leaking gas can settle in any low areas or confined spaces.

...Propane gas odorant may fade, making the gas undetectable except with a warning device.

An undetected gas leak would create a danger of explosion or fire. If you suspect the presence of gas, follow the instructions on the cover of this manual. Failure to do so could result in **SERIOUS PERSONAL INJURY OR DEATH.**

VII. ELECTRICAL WIRING



CAUTION

To avoid the risk of electrical shock, wiring to the unit must be properly polarized and grounded.



WARNING

To avoid electrical shock, injury or death, disconnect electrical power before changing any electrical wiring.

PROPANE PIPING CHARTS

Sizing Between First and Second Stage Regulator
Maximum Propane Capacities listed are based on 2 PSIG Pressure Drop at 10 PSIG Setting.
Capacities in 1,000 BTU/HR.

PIPE OR TUBING LENGTH, FEET	TUBING SIZE, O.D., TYPE L						NOMINAL PIPE SIZE, SCHEDULE 40	
	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/2"	2"
10	730	1,700	3,200	5,300	8,300	3,200	7,500	
20	500	1,100	2,200	3,700	5,800	2,200	4,200	
30	400	920	2,000	2,900	4,700	1,800	4,000	
40	370	850	1,700	2,700	4,100	1,600	3,700	
50	330	770	1,500	2,400	3,700	1,500	3,400	
60	300	700	1,300	2,200	3,300	1,300	3,100	
80	260	610	1,200	1,900	2,900	1,200	2,600	
100	220	540	1,000	1,700	2,600	1,000	2,300	
125	200	490	900	1,400	2,300	900	2,100	
150	190	430	830	1,300	2,100	830	1,900	
175	170	400	780	1,200	1,900	770	1,700	
200	160	380	730	1,100	1,800	720	1,500	

To Convert to Capacities at 15 PSIG Settings — Multiply by 1.130
To Convert to Capacities at 5 PSIG Settings — Multiply by 0.879

Sizing Between Single or Second Stage Regulator and Appliance*
Maximum Propane Capacities Listed are Based on 1/2" W.C. Pressure Drop at 11" W.C. Setting.
Capacities in 1,000 BTU/HR.

PIPE OR TUBING LENGTH, FEET	TUBING SIZE, O.D., TYPE L							NOMINAL PIPE SIZE, SCHEDULE 40				
	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/2"	1/2"	3/4"	1"	1 1/2"	2"
10	39	92	199	329	501	935	275	567	1,071	2,205	3,307	
20	26	62	131	216	346	630	189	393	732	1,496	2,299	
30	21	50	107	181	277	500	152	315	590	1,212	1,858	
40	19	41	90	145	233	427	129	267	504	1,039	1,559	
50	18	37	79	131	198	376	114	237	448	913	1,417	
60	16	35	72	121	187	340	103	217	409	834	1,275	
80	13	29	62	104	155	289	89	185	346	724	1,086	
100	11	26	55	90	138	255	78	162	307	630	976	
125	10	24	48	81	122	224	69	146	275	567	866	
150	9	21	43	72	109	202	63	132	252	511	787	
200	8	19	39	66	100	187	54	112	209	439	665	
250	8	17	36	60	93	172	48	100	185	390	590	

Line voltage wiring may enter through the top or the left side of the furnace. (See Fig. 12 and 13).

If it will enter through the top of the furnace, the (two) power supply and (one) ground wires must be enclosed in conduit throughout the interior portion of the furnace.

Remove the knockout in the top of the junction box, and use washers to connect the conduit to the junction box in accordance with NEC and local codes. See Figure 12. Connect hot, neutral, and ground wires as shown in the wiring diagram located on the blower door of the unit.

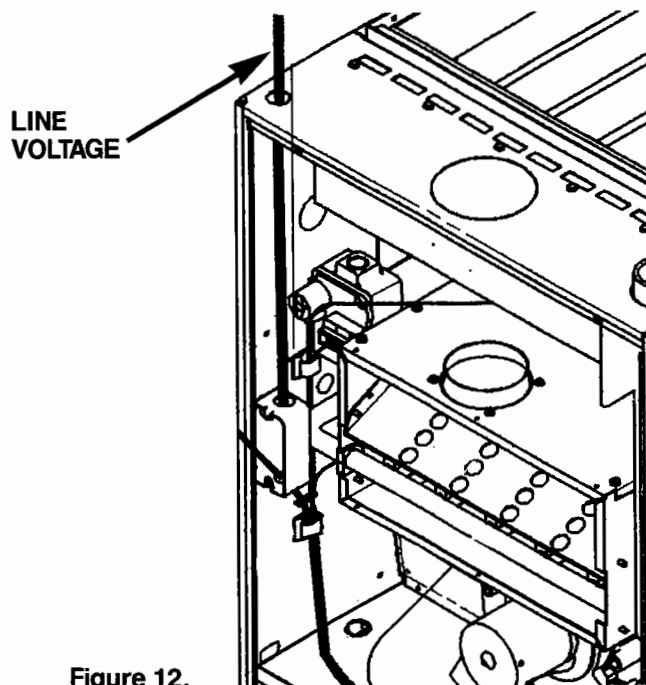


Figure 12.

If the line voltage wiring will enter through the left side of the furnace, remove the appropriate knockout from the left side of the junction box. Use washers to connect field-supplied conduit to the junction box in accordance with NEC and local codes. See Figure 13. Connect hot, neutral, and ground wires as shown in the wiring diagram located on the blower door of the unit.

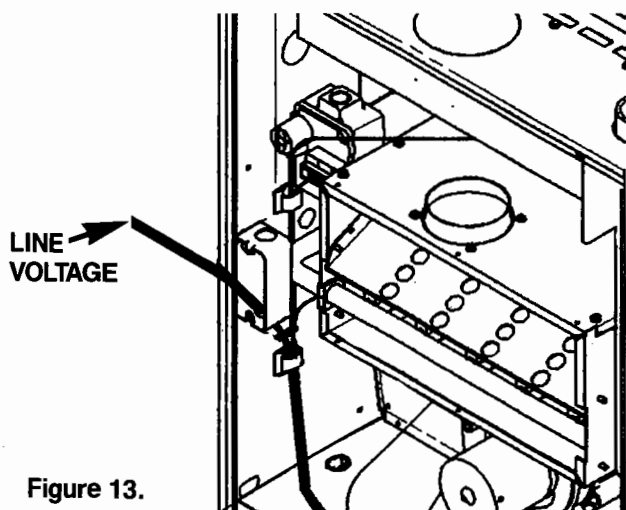


Figure 13.

LINE VOLTAGE CONNECTION OF OPTIONAL HUMIDIFIER AND ELECTRONIC AIR CLEANER

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

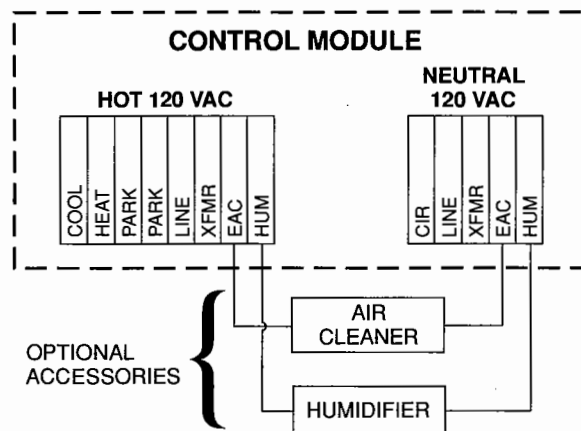
Accessory Load Specifications.

Air Cleaner: 1.0 Amp max. at 120 VAC

Humidifier: 1.0 Amp max. at 120 VAC

Accessory Installation. Follow the electronic air cleaner and humidifier manufacturers' instructions for mounting and electrically grounding these accessories. Check that the power supply to the furnace has been disconnected. Wire the accessories to the furnace control module as shown below. All connections to the control module are to be made through 1/4 (.250") receptacle (female) terminals.

If it is necessary for the installer to supply additional line voltage wiring to the inside of the furnace, the wiring must comply with all local codes. This wiring must have a minimum temperature rating of 105°C and must be routed away from the burner compartment. All line voltage wire splices must be made inside the furnace junction box.



Accessory Operation. The furnace control module energizes the humidifier whenever the combustion blower is energized (if there is an optional air cleaner on the system, the humidifier is **not** energized until the air cleaner is energized). The control module energizes the air cleaner whenever the air circulation blower is energized.

LOW VOLTAGE WIRING

Low voltage wiring may enter through either side of the furnace. See Section II for hole locations. Run the thermostat wires through either hole, down through a grommet in the blower deck, and through a hole provided in the side of the ignition control box. See Figure 14.

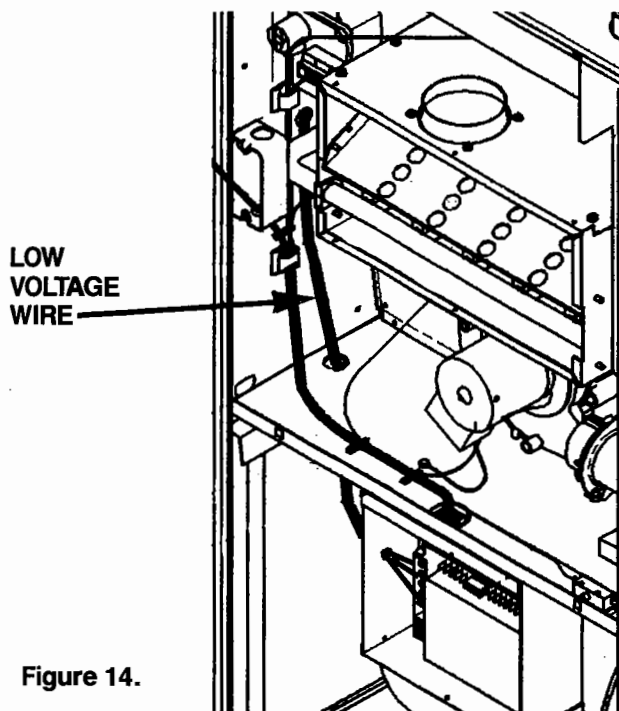


Figure 14.



CAUTION

To avoid possible equipment malfunction, be careful to route the low voltage wires so as not to interfere with filter removal or other maintenance.

Low voltage wires may then be connected to the terminal strip as shown in Figure 15.

TYPICAL FIELD WIRING (24V CONTROL CIRCUIT)

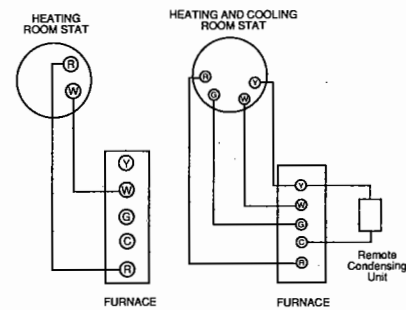


Figure 15.

A 40VA transformer and auxiliary fan relay are built into the furnace so that it may be used with most cooling equipment.

Consult the wiring diagram for both 115V and 24V wiring details. The diagram is located inside of the blower compartment door and in Section XIII of this manual.

HEAT ANTICIPATOR SETTING

The heat anticipator in the room thermostat must be correctly adjusted to obtain the proper number of heating cycles per hour and to prevent the room temperature from "overshooting" the room thermostat setting. Heat anticipator must be set at 0.7 amps.

VIII. CIRCULATING AIR AND FILTERS

DUCTWORK — AIR FLOW

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

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

It is recommended that the outlet duct be provided with an access panel. This access should be large enough to inspect the air chamber above the heat exchanger for any smoke or combustion gas leaks. A cover should be attached tightly to prevent air leaks.

Furnace models GUD045C30A, GUD070C30A, GUD070C40A, and GUD090C35A are shipped with one filter, (refer to Page 2 for size), intended for the return air duct to be attached to either side of the furnace cabinet. If the return air duct is to be attached to the bottom of the furnace cabinet, the filter that was supplied with the furnace may not be of the proper size. Refer to the chart below for filter sizes when using bottom return.

BOTTOM RETURN FILTER SIZES

Model	Filter Size	Type
GUD045C30A	14 x 25 x 1	P
GUD070C(30,40)A	16 x 25 x 1	P
GUD090C(35,50)A, GUD115C50A	20 x 25 x 1	P

The sketch below shows how the filter is retained over the bottom return air opening.



Furnace models GUD090C50A and GUD115C50A are shipped with two filters (refer to Page 2 for size). If these furnaces are to be operated at high speed, then two return air connections must be made. These may be made on both sides of the furnace cabinet, or on one side and the bottom. If one of the returns is connected to the bottom, refer to the chart above for proper filter size. If the furnaces are operated at high speed, failure to have two return air connections could result in insufficient airflow for air conditioning requirements and excessive air velocity through the filter. If these furnaces will not be run on high speed, one return air connection will be adequate.

Guide dimples locate the bottom or side cutouts. Use a straight edge to scribe lines connecting the dimples. Cut out the opening on these lines. For bottom return air connection the bottom of the cabinet has to be removed before the furnace is positioned on the raised platform or set on top of the return air duct.

A closed return duct system must be used, with the return duct connected to the furnace. Supply and return duct connections to the unit may be made with flexible joints to minimize noise transmission. If a central return is used, a connecting duct must be installed between the unit and the utility room wall. The room, closet or alcove must not be used as a return air chamber.

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

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

IX. SEQUENCE OF OPERATION

NORMAL SEQUENCE

1. Thermostat calls for heat.
2. The combustion blower is energized, and the pressure switch contacts close.
3. The ignitor is energized and is allowed to preheat for 17 seconds.
4. The gas valve is energized, delivering gas to the burners and starting combustion.
5. The control checks for a signal from the flame sensor within seven seconds after the gas valve is energized. Gas will continue to flow only if a signal is present.
6. The control waits 30 seconds and turns on the air circulation blower to the speed that was selected for heating

operation. At this time the optional humidifier and electronic air cleaner are also energized.

7. The thermostat is satisfied and opens.
8. The control de-energizes the gas valve.
9. After a 15 second delay, the combustion blower and optional humidifier are de-energized.
10. After another 75 second delay, the air circulation blower and optional electronic air cleaner are de-energized.

ABNORMAL OPERATION

1. **Internal Control Failure with White-Rodgers Control**
If the control determines it has an internal fault, it enters a locked-out state, and the diagnostic light will **light continuously with no flashes**. The control should be replaced.

2. System Lockout

If a flame is not sensed during the first 7 seconds after the gas valve is energized, the control turns off the gas. There will then be a 60 second delay while the combustion blower is energized to purge the heat exchanger. The ignitor will next be energized and preheated for 27 seconds. The gas valve will then be energized. If flame is not sensed in 7 seconds the gas valve will be de-energized and another purge will occur. The control will cycle the gas valve a total of three tries before it determines it cannot establish measurable combustion and enters a locked out state. If flame is sensed but lost after 10 seconds, the control will recycle this series of three tries four more times before locking out. The diagnostic light will indicate this condition with **one short flash** followed by a longer pause. The control can be reset and brought out of lockout mode by turning the thermostat off and then back on.

3. Pressure Switch Stuck Closed

If the control senses the pressure switch is closed when the vent blower is off, it waits until the fault is corrected. The light code for this problem is **two short flashes** followed by a longer pause. The probable cause is a faulty pressure switch or wiring.

4. Pressure Switch Stuck Open

If, after the vent blower is energized, the pressure switch

does not close, the control will keep the blower on and wait for the switch to close. The diagnostic light code for this problem is **three short flashes** followed by a pause. The probable causes are either disconnected hose to the pressure switch, faulty pressure switch or wiring, or restricted air intake or flue piping.

5. Open Limit Control

If the limit control opens, the air circulation and vent blower will be turned on until the limit closes. The diagnostic light code for this is **four short flashes** followed by a pause. The probable cause is either low conditioned air flow due to dirty filter or resistance in duct work, faulty limit, faulty blower, or blower speed set too low.

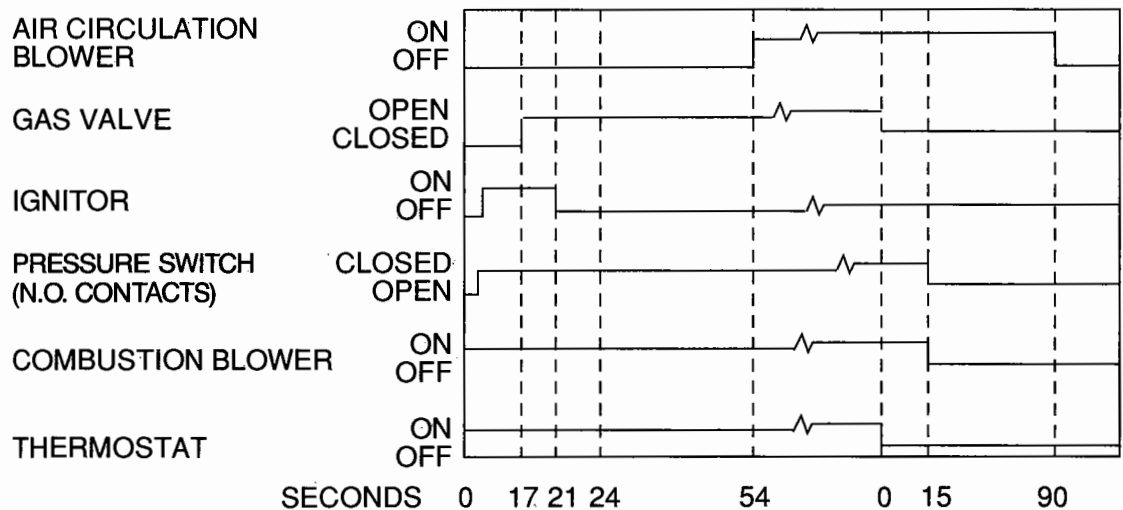
6. Missing Jumper Wire

If the jumper between R01 and R02 is not present, the air circulation blower and vent blower will be energized all the time. The diagnostic light code for this is **five flashes** followed by a pause. The probable cause is a missing jumper.

7. Flame Sensed with No Call for Heat

If the control senses a flame when the gas valve is de-energized, it will run the air circulation blower and the vent blower continuously. The diagnostic light code for this is **continuous light flashing**. Probable cause is miswiring.

TIMING CHART FOR NORMAL WHITE - RODGERS 50A50 OPERATION



WHITE RODGERS 50A50 CONTROL DIAGNOSTIC LIGHT SIGNAL MEANINGS	
LIGHT SIGNAL	REFER TO ABNORMAL OPERATION NUMBER
Continuous Light	1. Internal Control Failure
1 Flash	2. System Lockout
2 Flashes	3. Pressure Switch Stuck Closed
3 Flashes	4. Pressure Switch Stuck Open
4 Flashes	5. Open Limit Control
5 Flashes	6. Missing Jumper Wire on control connector
Continuous Flashing	7. Flame Sensed No Call For heat

X. START-UP AND ADJUSTMENT

GENERAL OPERATION

This furnace is equipped with an electronic ignition device which lights the burners. It also has an induced draft blower to exhaust combustion products.

Keep the blower access door and upper access panel in place except for inspection and maintenance. An interlock switch prevents furnace operation if the blower door is not in place.

On new installations, or if a functional part such as the gas valve, pressure switch, or fan/limit control has been replaced, the operation of the furnace should be checked.

Check furnace operation as outlined in the following instructions. If any sparking, odors, or unusual noises are encountered, shut off electrical power and recheck for wiring errors, or obstructions in or near the blower motor. Various shipping materials must be removed before the blower motor is operated.

ELECTRONIC CONTROL MODULE

This furnace is equipped with a self-diagnosing electronic control module. In the event a furnace component is not operating properly, the control module will repeatedly flash a red light on and off in a factory-programmed sequence, depending on the problem encountered.

If you suspect the furnace is not operating properly, look through the observation window in the blower access door and make note of the number of flashes in the sequence. Then see Section IX for further information.

RESET AFTER CONTROL LOCK-OUT

If ignition has not been achieved for any reason after three ignition cycles, the electronic control module will lock-out the furnace. A lock-out causes both the air blower and the vent blower to run continuously, and ignition is no longer attempted. The control's diagnostic light will then repeatedly flash once and then pause. When this occurs, it may be necessary to reset the control by turning the thermostat setting below room temperature for thirty seconds and then returning the setting to the desired temperature. The control may also be reset after a lock-out by turning off the electrical disconnect switch to the furnace for thirty seconds.

IMPORTANT: If you have to frequently reset your furnace, it means a problem exists that should be corrected. Contact a qualified servicer for further information.

HEAT ANTICIPATOR SETTING

The heat anticipator in the room thermostat must be set at 0.7 amps.

OPERATING INSTRUCTIONS

1. Close the manual gas valve external to the furnace.
2. Turn off the electrical power supply to the furnace.
3. Set room thermostat to lowest possible setting.
4. Remove the upper door on the front of the furnace.
5. This furnace is equipped with an ignition device which automatically lights the burner. Do not try to light burner by hand.
6. Rotate the gas valve control knob so that "OFF" is aligned with the position indicator shown in Figure 16.

POSITION
INDICATOR

GAS CONTROL
KNOB

Figure 16.

7. Wait five (5) minutes to clear out any gas. Then smell for gas including near the floor.
8. If you smell gas, immediately follow the instructions on the front of this manual. If you do not smell gas, rotate the gas valve control knob so that "ON" is aligned with the position indicator shown in Figure 16.
9. Replace the door on the front of the furnace.
10. Open the manual gas valve external to the furnace.
11. Turn on the electrical power supply to the furnace.
12. Set thermostat to desired setting.

NOTE: There is an approximate 20 second delay between thermostat energizing and burner firing.

CHECK GAS INPUT AND PRESSURES

Gas supply pressure and manifold pressure with the burners operating must be as specified on the rating plate.

CHECK THE MANIFOLD PRESSURE

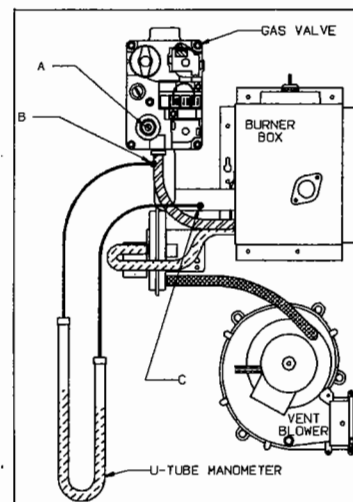
A tapped opening is provided in the gas manifold to facilitate measurement of the manifold pressure. A "U Tube" manometer having a scale range from 0 to 12 inches of water should be used for this measurement. The manifold pressure must be measured with the burners operating. See Figure 17.



WARNING

PERSONAL INJURY HAZARD

All hoses must be connected as shown in Fig. 17. Failure to connect the hose between the pressure switch and the burner box could result in excess generation of carbon monoxide if the air inlet is blocked. This could cause serious personal injury or death.



- A - CAP OVER ADJUSTMENT SCREW MUST BE IN PLACE WHEN FURNACE IS OPERATING.
- TO MEASURE MANIFOLD PRESSURE CONNECT MANOMETER BETWEEN B AND C.
- B - HOSE BETWEEN GAS VALVE AND AIR BOX (TEE TO BE SUPPLIED BY SERVICER.)
- C - TAPPED OPENING IN MANIFOLD (HOSE BARB TO BE SUPPLIED BY SERVICER.)

Figure 17.

To adjust the pressure regulator, remove the adjustment screw or cover on the gas valve ("A" in Figure 17). Turn out (counterclockwise) to decrease pressure, turn in (clockwise) to increase pressure. Only small variations in gas flow should be made by means of the pressure regulator adjustment. In no case should the final manifold pressure vary more than plus or minus 0.3 inches water column from the specified pressure. Any major changes in flow should be made by changing the size of the burner orifices.

CHECK THE GAS INPUT (NATURAL GAS ONLY)

To measure the gas input using the gas meter proceed as follows:

1. Turn off gas supply to all other appliances except the furnace.
2. With the furnace operating, time the smallest dial on the meter for one complete revolution. If this is a 2 cubic foot dial, divide the seconds by 2; if it is a 1 cubic foot dial, use the seconds as is. This gives the seconds per cubic foot of gas being delivered to the furnace.
3. $\text{INPUT} = \text{GAS HTG VALUE} \times 3600 \div \text{SEC. PER CUBIC FOOT}$

Example: Natural gas with a heating value of 1000 BTU per cubic foot and 34 seconds per cubic foot as determined by Step 2, then:

$$\begin{aligned}\text{Input} &= 1000 \times 3600 \div 34 \\ &= 106,000 \text{ BTU per Hour}\end{aligned}$$

NOTE: BTU content of the gas should be obtained from the gas supplier.

This measured input must not be greater than the input indicated on the rating plate of the furnace.

4. Relight all other appliances turned off in Step 1 above. Be sure all pilot burners are operating.

CHECK MAIN BURNER FLAME

Natural gas flames should be stable, soft, and blue. Propane gas flames may appear slightly yellow. Dust may cause orange tips. The flames should extend directly outward from the burner without curling, floating, or lifting off.

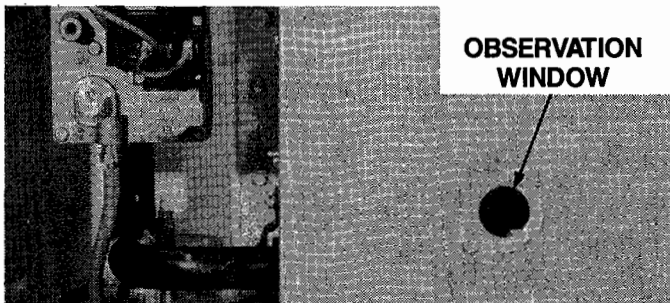


Figure 18.

The flames can be inspected through the Observation Window on the front cover of the box. (Fig. 18)

CHECK TEMPERATURE RISE

Check the temperature rise through the unit by placing thermometers in supply and return air registers as close to the furnace as possible. Thermometers must not be able to "see" the furnace's heat exchangers, or false readings could be obtained.

1. All registers must be open; all duct dampers must be in their final (fully or partially open) position, and the unit operated for 15 minutes before taking readings.
2. The temperature rise must be within the range specified on the rating plate.

NOTE: Air temperature rise is the temperature difference between supply and return air.

With a properly designed system, the proper amount of temperature rise will normally be obtained when the unit is operated at rated input with the recommended blower speed.

If the correct amount of temperature rise is not obtained, it may be necessary to change the blower speed. A higher blower speed will lower the temperature rise. A slower blower speed will increase the temperature rise.

NOTE: Blower speed must be set to give the correct air temperature rise through the furnace as marked on the rating plate.

CHANGING BLOWER SPEEDS



WARNING

To avoid electrical shock, injury or death, when changing speed taps turn off power to the furnace.

A multi-speed motor is used in the furnace blower. It provides easy speed selection for both heating and cooling air flow. Page 5 shows the CFM and E.S.P. relationship for proper selection of heating and cooling speeds.

Refer to the WIRING DIAGRAM on the furnace to connect the correct motor leads to the correct control terminals. All unused motor leads that are not connected to "park" terminals on the control must be taped.

CHECK LIMIT AND FAN CONTROL



WARNING

To avoid premature failure of heat exchanger or possible property damage, injury or fire, do not adjust the limit control, which is factory preset.

Check limit control operation after 15 minutes of operation by blocking the return air grille(s).

1. After several minutes the main burners must go OFF. Blower will continue to run.
2. Remove air restrictions and main burners will relight after a cooldown period of a few minutes.

Adjust the thermostat setting below room temperature.

1. Main burners must go off.
2. Circulating Air Blower will continue to run for 90 seconds.



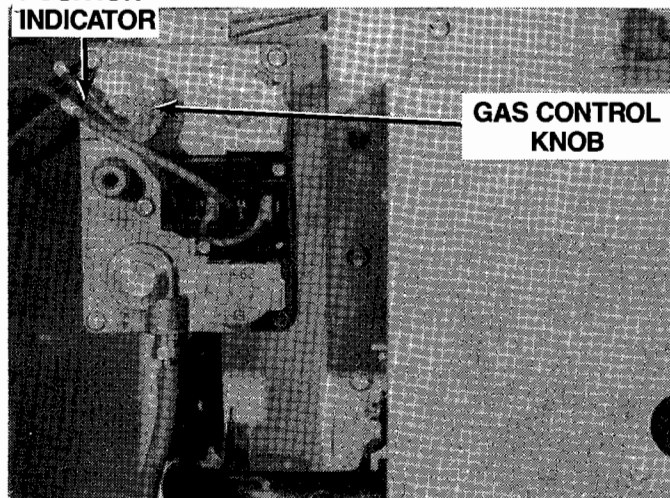
CAUTION

This unit should not be used as a “construction heater” during the finishing phases of construction on a new structure. This type of use may result in premature failure of the unit due to extremely low return air temperatures and exposure to very dirty atmospheres.

TO TURN OFF FURNACE

1. Set the thermostat to its lowest setting.
2. Turn off the electrical power supply to the furnace.
3. Rotate the gas valve control knob so that “OFF” is aligned with the position indicator shown in Figure 19.
4. Close manual gas shutoff valve external to the furnace.
5. Replace the door on the unit.

POSITION
INDICATOR



GAS CONTROL
KNOB

Figure 19.

XI. MAINTENANCE



WARNING

To avoid electrical shock, injury or death, disconnect electrical power before performing any maintenance.

Have the furnace checked at least once every year, before the heating season begins, to be sure that there is adequate combustion air and that the vent system is working properly.

Have vent piping (exhaust and combustion) checked to be sure it is not blocked by debris, which would prevent proper operation of the furnace. Replace any leaking sections of vent pipe.

AIR FILTER



WARNING

Never operate furnace without a filter installed as dust and lint will build up on internal parts resulting in loss of efficiency, equipment damage and possible fire.

The furnace is equipped with a permanent type washable high-velocity filter(s). Filter(s) should be inspected and cleaned every two months, or as required. If the replacement of the filter(s) becomes necessary, it must be replaced with a filter of the same type and size.

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

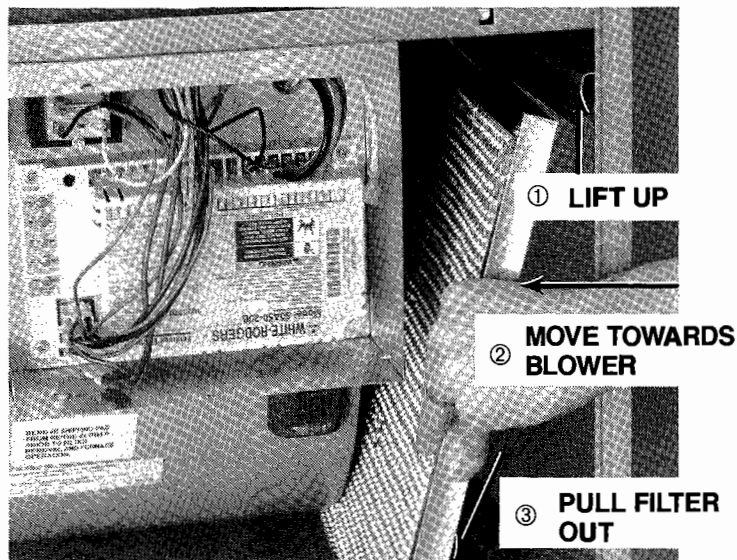


Figure 20. Filter Removal



WARNING

Disconnect the electrical power to the furnace before removing the filter or performing any other maintenance.

To remove the filter turn the latches on lower door. Remove the door. The blower motor will automatically stop through the interlock switch.

The filter may be removed by taking a hold of the lower portion of the filter, lift up to disengage it from the lower railing, move towards blower, drop filter down. Pull filter outward.

The filter must be of the permanent washable type with dimensions of 16 x 25 x 1. (Side return(s) only.)

Use a vacuum cleaner to clean out the blower area and the adjacent area of the return air duct.

Clean, wash and dry the permanent filter. Both sides should then be sprayed with a dust adhesive as recommended on adhesive container. Re-install filter by placing it into the furnace along the side of the blower. Engage filter in the top rail, move towards side of furnace and drop it into the bottom rail. BE SURE AIRFLOW DIRECTION ARROW POINTS TOWARDS BLOWER.

When the filter is located in the bottom of the furnace on a bottom return system the filter is held in its location by a sheet metal retainer strap. To change or clean the filter merely slide one end of the retainer towards the front and remove the filter.

BLOWER MOTOR (QUALIFIED SERVICER ONLY)

If desired, the blower motor may be oiled by adding 4 to 6 drops of SAE#20 oil to each oil port, once a year. TO AVOID PREMATURE MOTOR FAILURE, DO NOT OVER OIL.

(NOTE: Some blower motors which are permanently lubricated do not have oil ports. Oil cannot be added to these motors.)

VENT BLOWER MOTOR (QUALIFIED SERVICER ONLY)

The vent blower motor may be oiled annually with 6 drops of Anderoil 465 oil. (3 drops in each oil tube. See Figure 21) TO AVOID PREMATURE MOTOR FAILURE, DO NOT OVER OIL.

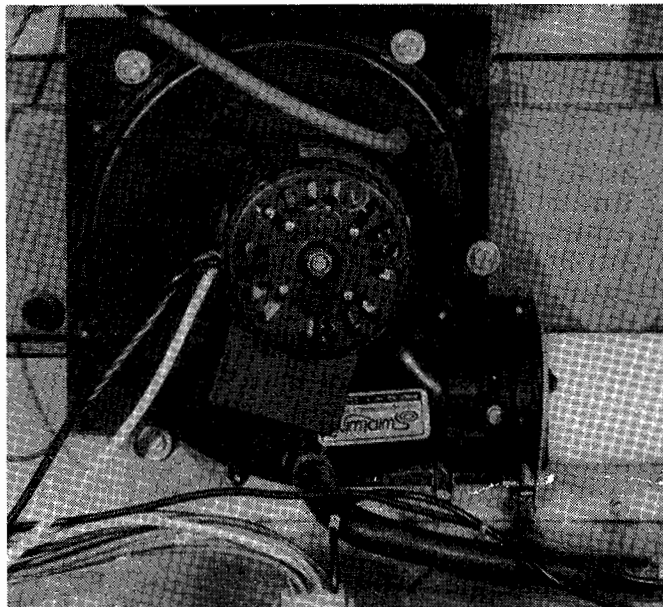


Figure 21. Vent Blower Motor



CAUTION

If you must handle the ignitor, handle with care. Touching the ignitor body with bare fingers, rough handling, or vibration could result in early ignitor failure. Only a qualified servicer should ever handle the ignitor.



CAUTION

NOTE: This furnace is equipped with a sealed combustion chamber. It is mandatory to replace all gaskets that are removed. Order replacement gaskets prior to starting service. Only a qualified servicer should ever open the combustion chamber.

SEALED COMBUSTION CHAMBER (QUALIFIED SERVICER ONLY)

At the start of each heating season, shut off the electrical power and gas supply, then inspect the combustion chamber by looking through the observation window (Figure 21). If significant amounts of dirt, soot, or debris are present, remove the cover, and clean the combustion chamber.

FLUE PASSAGES (QUALIFIED SERVICER ONLY)

At the start of each heating season, inspect and, if necessary, clean the furnace flue passages.

CLEANING FLUE PASSAGES (QUALIFIED SERVICER ONLY)

1. Turn off electrical power and the gas supply to the furnace.
2. Remove the burner assembly by disconnecting the gas line and removing the manifold brackets from the partition panel.
3. Remove the turbulators from the entrance to the heat exchanger tubes if they are present.
4. Remove the collector box insulation and then remove the collector box from the partition panel.
5. Disconnect the PVC vent from the induced draft blower so that the blower can be removed from the recuperator coil cover.
6. Remove the recuperator coil cover and remove the turbulators from the recuperator coil tubes.
7. The recuperator coil tubes can now be cleaned using a long handled round wire brush, such as a gun cleaning brush.
8. The primary heat exchanger tubes can be cleaned using a round wire brush attached to a length of high grade stainless steel cable, such as drain cleanout cable. Attach a variable speed reversible drill to the other end of the spring cable. Slowly rotate the cable with the drill and insert it into one of the primary heat exchanger tubes. While reversing the drill, work the cable in and out several times to obtain sufficient cleaning. Repeat for each tube.
9. When all heat exchanger tubes have been cleaned and the residue removed with a vacuum, replace all the parts in the reverse order in which they were removed.
10. To reduce the chances of repeated fouling of the flue passages, perform steps listed in "Startup and Adjustment", Section X.

BURNERS



WARNING

Electrical components are contained in both compartments. To avoid electrical shock, injury or death, do not remove any internal compartment covers or attempt any adjustment. Contact a qualified servicer at once if an abnormal flame appearance should develop.

Periodically during the heating season make a visual check of the burner flames. Turn the furnace on at the thermostat. Wait a few minutes, since any dislodged dust will alter the normal flame appearance. Natural gas flames should be stable, soft, and blue. Propane gas flames may appear slightly yellow. Dust may cause orange tips. Flames should extend directly outward from the burner ports without curling downward, floating or lifting off the ports. (See Figure 22.)

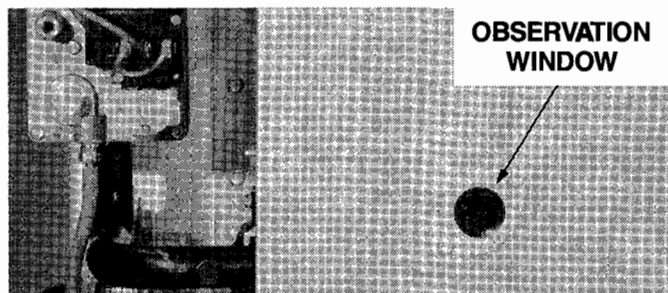


Figure 22.

The flames can be inspected through the Observation Window on the front cover of the box.

XII. FUNCTIONAL PARTS LIST

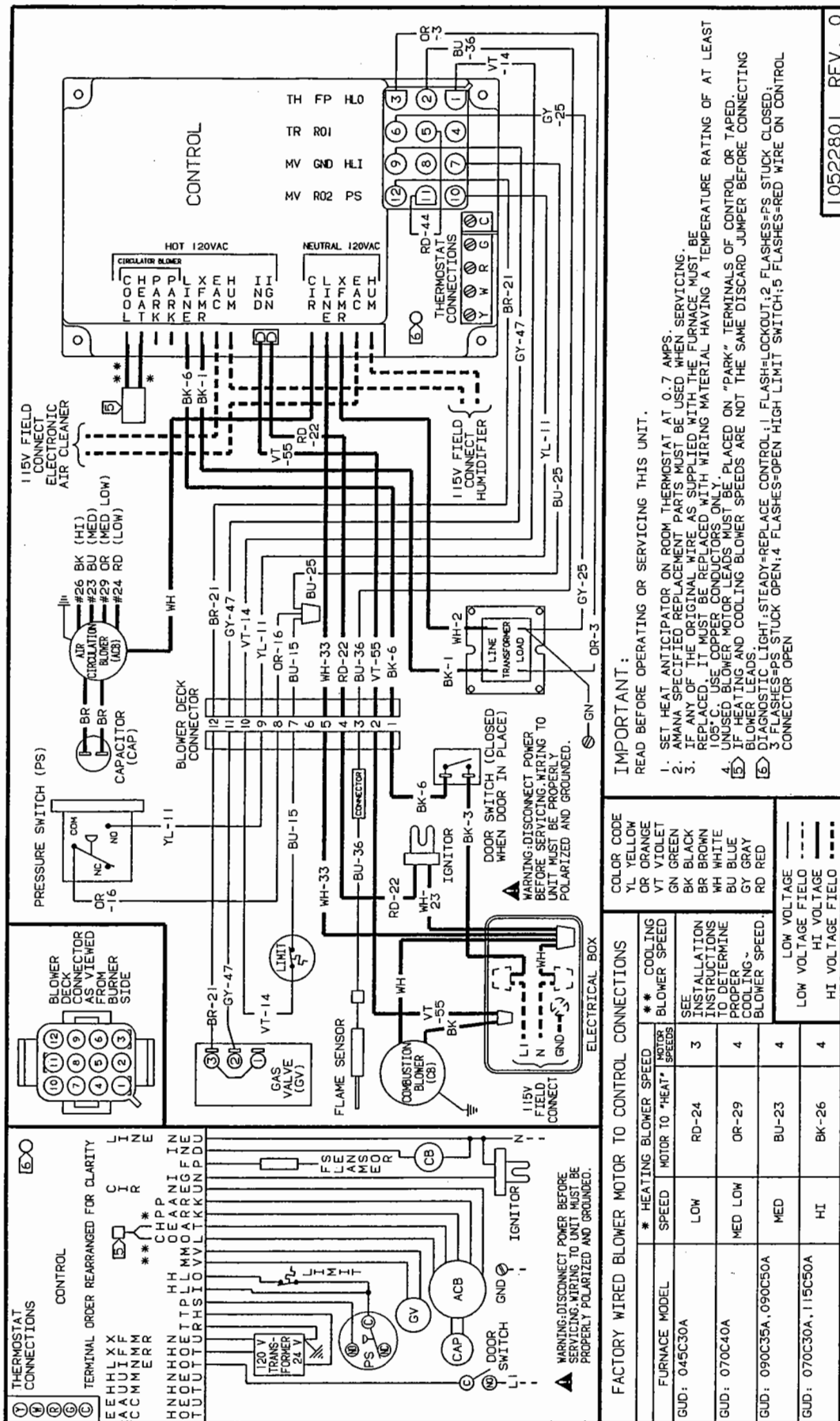
GENERAL INFORMATION

1. When ordering any of the listed functional parts, be sure to provide the furnace model, manufacturing, and serial numbers with the order.
2. Although only functional parts are shown in the parts list, all sheet metal parts, doors, etc. may be ordered by description.
3. Functional parts are available from your Amana distributor.

Gas Valve
Gas Orifice, Natural
Burner
Ignitor
Flame Sensor
Ignitor Clip
Gas Manifold
Ignition Control
Pressure Switch
Induced Draft Blower
Collector Box
Limit Switch
Coil Front Cover

Recuperator Coil
Heat Exchanger
Door Switch
Transformer
Terminal Board
Blower Wheel
Blower Housing
Blower Cutoff
Blower Mount Bracket
Capacitor
Filter Permanent
16 x 25 x 1

XIII. WIRING DIAGRAM



WARNING

To avoid electrical shock, injury or death, disconnect the electrical power before performing any maintenance.