

INSTALLATION INSTRUCTIONS

STANDARD EFFICIENCY GAS FURNACES

**MODELS:
HI-BOY
COUNTERFLOW**

MANUAL 2100-128 REV. H
SUPERSEDES REV. G
FILE VOL. I, TAB 2

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I. EQUIPMENT SELECTION

An accurate heating load calculation must be conducted using American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) or Air Conditioning Contractors of America (ACCA) manuals. DO NOT add a large safety factor above the calculated value. If the calculated heating load requirement exceeds the heating capacity rating of a given model, use only the next larger size available. Never increase by any more than absolutely necessary based upon available equipment heating capacities. Always select based upon heating capacity (output), never use input capacities.

II. APPLICATION

This is a non-fan assisted category I forced air gas furnace for indoor installation in building constructed on site. The furnace installation must conform with local building codes and ordinances or, in their absence with the National Fuel Gas Code, ANSI Z223.1-latest edition, and the National Electrical Code ANSI/NFPA 70-latest edition. It is the personal responsibility and obligation of the purchaser to contract a qualified installer to assure that installation is adequate and is in conformance with governing codes and ordinances.

III. TRANSPORTATION DAMAGE

All units are packed securely in shipping container. All units should be carefully inspected upon arrival for damage. In the event of damage, the consignee should:

1. Note on delivery receipt of any damage to container.
2. Notify carrier promptly, and request an inspection.
3. In case of concealed damage, the carrier must be notified as soon as possible within 15 days after delivery.
4. Claims for any damage, apparent or concealed, should be filed with the carrier, using the following supporting documents and within the nine month statutes of limitations.
 - A. Original Bill of Lading, certified copy, or indemnity bond.
 - B. Original paid freight bill of indemnity in lieu thereof.
 - C. Original invoice or certified copy thereof showing trade and other discounts or deductions.
 - D. Copy of the inspection report issued by carrier's representative at the time damage is reported to carrier.

The carrier is responsible for making prompt inspection of damage and for a thorough investigation of each claim.

IV. LOCATING THE FURNACE

When selecting a location for the furnace, observe the following points:

1. The furnace should be set on a level floor. If the floor may become damp or wet at times, the furnace should be supported above the floor using a concrete base, bricks, patio blocks, etc., making sure adequate support is available for the furnace. Counterflow furnaces require use of combustible floor base if installed on combustible surface. The combustible floor base is not part of the furnace and must be ordered separately. Furnaces approved for installation on combustible flooring shall not be installed directly on carpeting, tile or other combustible material other than wood flooring.

2. The furnace should be as centralized as practical with respect to the air distribution system.
3. Provisions must be made for venting combustion products outdoors through an individual venting system.
4. Provide at least the minimum clearances specified in Table 1 for fire protection, proper operation and service access. These clearances must be permanently maintained. The combustion and ventilating air openings in front of the furnace must never be obstructed.
5. Minimum service clearances must take precedence over fire protection clearances (minimum installation clearances).
6. All models are approved for a utility room or closet installation.
7. A gas-fired furnace installed in a residential garage must be installed so that the burners and ignition source are located not less than 18 inches above the floor, and the furnace must be located or protected to avoid physical damage by vehicles.

TABLE 1
MINIMUM CLEARANCES (INCHES)

Model	Minimum Installation Clearances (1)							Minimum Service Clearances (1)
	Top	Front	Vent	Back	Left Side	Right Side	Floor	Front
H60DB, EH60DB H80DB, EH80DB H80D36B, EH80D36B	1	6	(2) (4) 6	0	(3)(4) 1	(3) (4) 1	C	24
H105D36B, EH105D36B H105D48B, EH105D48B H120D48B, EH120D48B H120D60B, EH120D60B H140D48B, EH140D48B H160D48B, EH160D48B	1	6	6	0	0	0	C	24
H200A, EH200A	1	6	6	1	1	1	C	24
C60DA, EC60DA C80D36A, EC80D36A	1	6	(2) (4) 6	0	(3)(4) 1	1	NC	24
C105D42A, EC105D42A C120D42A, EC120D42A C140D48A, EC140D48A C160D48A, EC160D48A	1	6	6	0	0	0	NC	24

- (1) All clearances are in inches.
(2) 1" if Type B-1 vent is used.
(3) 0" if Type B-1 vent is used.
(4) On these models, reduced clearances per note (2) and (3) do not apply if vent damper is used.
(5) 0" if not (3) applies.
C - Floor may be combustible material.
NC - Floor must be non-combustible material.

V. DUCT WORK

Inadequate Supply Air and/or Return Air Duct Systems. Short cycling because of limit control operation can be created by incorrectly designed or installed supply and/or return air duct systems.

The duct systems must be designed using ASHRAE or ACCA design manuals and the equipment cfm and external static pressure ratings to insure proper air delivery capabilities.

On replacement installations, particularly if equipment is oversized, the duct systems can easily be undersized. Modifications may be required to assure that the equipment is operating within the approved temperature rise range when under full input conditions, and that no short cycling on limit controls is occurring.

CAUTION

When a furnace is installed so that supply ducts carry air circulated by the furnace to areas outside the space containing the furnace, the return air must also be handled by a duct(s) sealed to the furnace casing and terminating outside the space containing the furnace. This is to prevent drawing possible hazardous combustion products into the circulated air.

When the furnace is used in connection with a cooling unit*, the furnace shall be installed 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 flow of air shall 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.

*A cooling unit is an air conditioning coil, heat pump coil or chilled water coil.

VI. COMBUSTION AND VENTILATION AIR

The furnace and furnace room must have an adequate supply of air for safe combustion and ventilation. The provisions necessary to assure an adequate air supply will vary depending upon differences in the tightness of house construction and in the location of the furnace. Methods of providing air from some typical situations are described below. Consult local codes and ordinances for requirements applicable to your specific furnace installation conditions and comply with them. In the absence of local codes and ordinances, comply with the National Fuel Gas Code, ANSI Z223.1-(NFPA 54), latest edition.

SAMPLE LISTING OF CONTAMINANTS TO BE AVOIDED

The recommended source of combustion air is to use the outdoor air supply option indicated on page 6. However, the use of indoor air in most applications is acceptable if these guidelines are followed:

1. If the furnace is installed in a confined space, the necessary combustion air must come from the outdoors by way of a ventilated attic, crawl space, air duct, or direct opening.
2. If indoor combustion air option is used, there must be no exposure to the installations or substances listed below.
3. All provisions for indoor combustion air must meet the requirements for combustion air supply indicated in the National Fuel Gas Code, Z223.1 (NFPA 54), latest edition.

4. The following types of installation will require OUTDOOR AIR for combustion, due to chemical exposures:

- o Commercial buildings
- o Buildings with indoor pools
- o Furnaces installed in laundry rooms
- o Furnaces installed in hobby or craft rooms
- o Furnaces installed near chemical storage areas

Exposure to the following substances in the combustion air supply will also require OUTDOOR AIR for combustion:

- o Permanent wave solutions
- o Chlorinated waxes and cleaners
- o Chlorine based swimming pool chemicals
- o Water softening chemicals
- o De-icing salts or chemicals
- o Carbon tetrachloride
- o Halogen type refrigerants
- o Cleaning solvents (such as perchloroethylene)
- o Printing inks, paint removers, varnishes, etc.
- o Hydrochloric acid
- o Cements and glues
- o Antistatic fabric softeners for clothes dryers
- o Masonry acid washing materials

EXAMPLE 1--FURNACE LOCATED IN AN UNCONFINED SPACE

An unconfined space (such as an open basement) must have a minimum volume of 50 cubic feet per 1000 BTUH of total of all appliances in area. Adjoining rooms may be counted as one area, only if there are no doors between the rooms.

Table 2 shows the required minimum area in square feet to qualify as an unconfined space for different BTUH input ratings. The table is based on a room(s) with 8 foot ceiling heights. The table also shows the required round duct size to provide the necessary outside air and the maximum BTUH input that the duct size will handle.

If the area is an unconfined space, provide an opening(s) having a total free area of one square inch per 4,000 BTUH of the total of all appliances. The required duct size is shown in Table 2.

TABLE 2

4000 BTUH Per Square Inch Round Duct Size	Maximum BTUH Input	Unconfined Space Minimum Area In Square Feet 8' Ceiling Height
4 3/8	60,000	375
5 1/8	80,000	500
5 1/4	85,000	531
5 7/8	105,000	656
6 1/8	115,000	719
6 1/4	120,000	750
6 3/4	140,000	875
6 7/8	145,000	906
7 1/4	160,000	1000
8	200,000	1250

EXAMPLE 2--FURNACE LOCATED IN A CONFINED SPACE

- A. When the furnace is in a closet or utility room, install two open grilles in a wall or door opening to the rest of the house. Each grille must have a free area of at least one square inch for each 1,000 Btuh of total input rating of all gas appliances in the confined space. Refer to Figure 1. The grilles must communicate with other open areas having adequate air infiltration from outdoors.
- B. If the building is tightly constructed, not enough outside air may enter for safe combustion. Install a fresh air duct from a point near the burners to the outside or to a ventilated attic or crawl space. Refer to Figure 2. This duct must have a free area of at least one square inch for each 4,000 Btuh of total input of all gas appliances in the space. The minimum dimension of a rectangular duct must not be less than three inches.

CAUTION

When a furnace is installed in a closet or utility room, never use this room as a return air plenum.

FIGURE 1
FURNACE LOCATED IN CONFINED SPACE

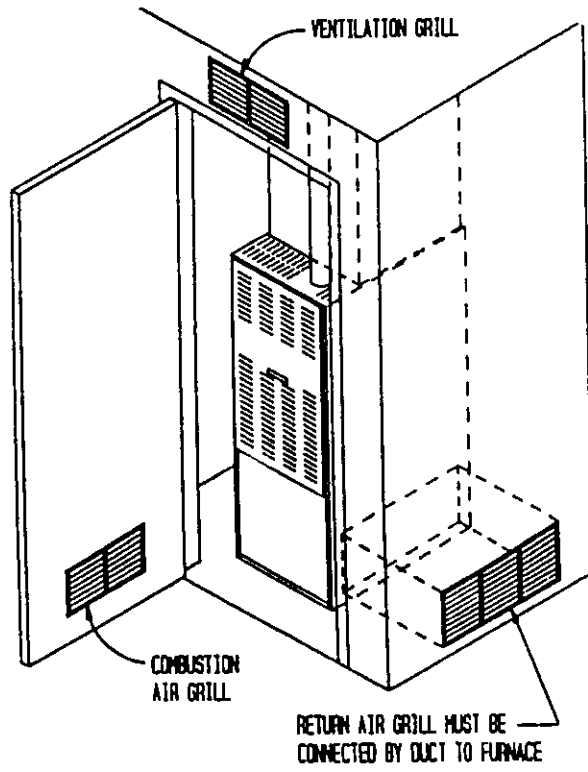
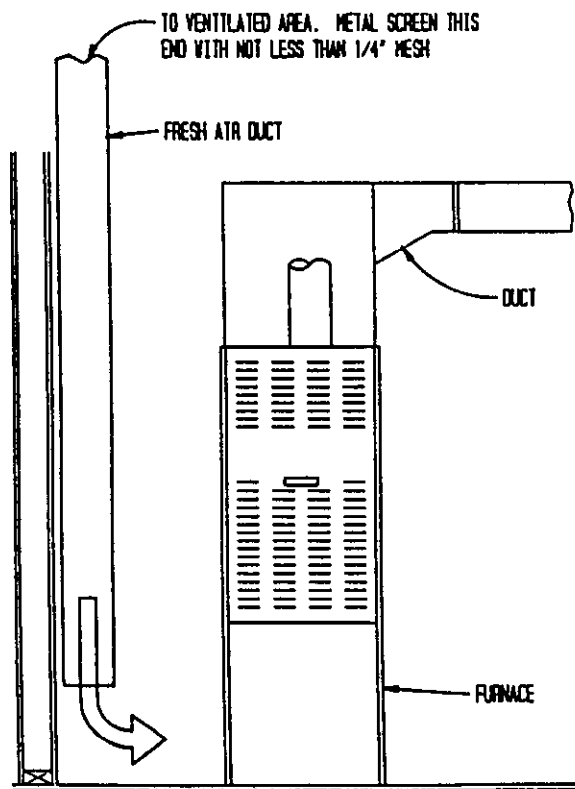


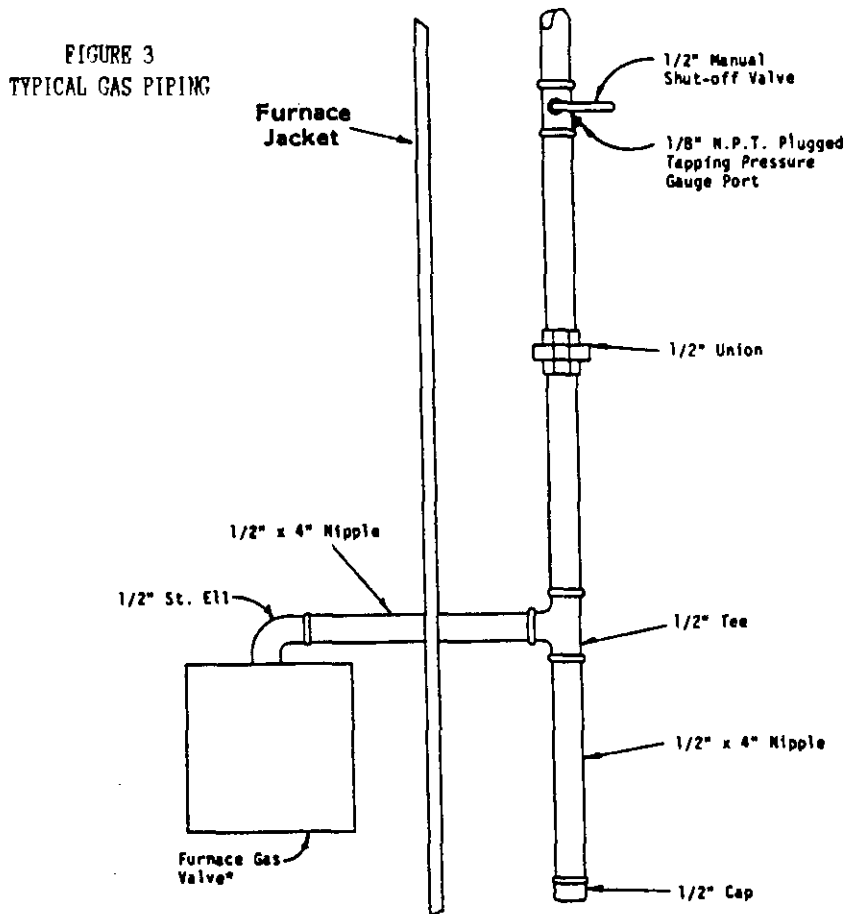
FIGURE 2
FRESH AIR DUCT FOR TIGHTLY SEALED BUILDING



VII. GAS SUPPLY AND PIPING

GENERAL RECOMMENDATIONS

1. Be sure the gas line complies with the local codes and ordinances, or in their absence with National Fuel Gas Code, ANSI Z223.1-latest edition.
2. A sediment trap or drip leg must be installed in the supply line to the furnace.
3. A ground joint union shall be installed in the gas line adjacent to and upstream from the gas valve and downstream from the manual shut off valve.
4. An 1/8" N.P.T. plugged tapping accessible for test gauge connection shall be installed immediately upstream of the gas supply connection to the furnace for the purpose of determining the supply gas pressure.
5. A manual shut-off valve shall be installed in the supply gas line external to the furnace when required by local code. See Figure 3.



*Gas valve is covered to prevent dirt from entering.
Remove cover only when ready to connect pipe.

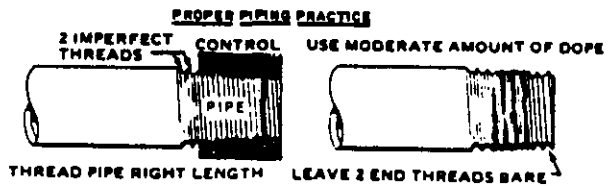
6. Use steel or wrought iron pipe and fittings.

7. DO NOT thread pipe too far. Valve distortion or malfunction may result from excess pipe within the control. Use pipe joint compound resistant to the action of liquified petroleum gases on male threads only. DO NOT use Teflon tape. See Table 3 and Figure 4.

TABLE 3
LENGTH OF STANDARD PIPE THREADS (inches)

Pipe Size	Effective Length of Thread	Overall Length of Thread
3/8	3/8	9/16
1/2	1/2	3/4
3/4	1/2-9/16	13/16
1	9/16	1

FIGURE 4



8. Refer to Table 4 for Gas Pipe Sizes for natural gas. If more than one appliance is supplied from a single line size, capacity must equal or exceed the combined input to all appliances, and the branch lines feeding the individual appliances properly sized for each input.

TABLE 4
GAS PIPE SIZES--NATURAL GAS

Length of Pipe, Ft.	Pipe Capacity--Btu Per Hour Input Pipe Size			
	1/2"	3/4"	1"	1-1/4"
10	132,000	278,000	520,000	1,050,000
20	92,000	190,000	350,000	730,000
30	73,000	152,000	285,000	590,000
40	63,000	130,000	245,000	500,000
50	56,000	115,000	215,000	440,000
60	50,000	105,000	195,000	400,000
70	46,000	96,000	180,000	370,000
80	43,000	90,000	170,000	350,000
100	38,000	79,000	150,000	305,000

CHECKING THE GAS PIPING

Before turning gas under pressure into piping, all openings from which gas can escape should be closed. Immediately after turning on gas, the system should be checked for leaks. This can be done by watching the 1/2 cubic foot test dial and allowing 5 minutes to show any movement, and by soaping each pipe connection and watching for bubbles. If a leak is found, make the necessary repairs immediately and repeat the above test. The furnace must be isolated from the gas supply piping system by closing the manual shutoff valve on the combination gas control valve during pressure testing of the gas supply piping system at pressures up to 1/2 psig. The furnace must be disconnected from supply piping and supply piping capped during any pressure testing of supply piping system at test pressures in excess of 1/2 psig.

Defective pipes or fittings should be replaced and not repaired. Never use a flame or fire in any form to locate gas leaks, use a soap solution.

After the piping and meter have been checked completely, purge the system of air. DO NOT bleed the air inside the furnace. Be sure to check and relight all the gas pilots on other appliances that may have been extinguished because of interrupted gas supply.

DETERMINING GAS INPUT--NATURAL GAS

The following is a procedure in which to measure gas input:

1. Turn off all gas appliances other than the furnace.
2. From local gas supplier, obtain the average heating value in BTU/CU FT of gas supplied to the installation site.
3. Light furnace following the lighting and operating instructions label.
4. With a stop watch, measure the amount of time, in seconds, it takes to consume two (2) cubic feet of gas.
5. Use the following formula to calculate the gas input of the furnace.

$$\text{Gas input rating in BTU/HR} = \frac{\text{BTU/CU FT} \times 7200}{\text{Time in seconds for two Cubic feet of gas flow}}$$

Example: Assume a time of 60 seconds for two cubic feet has been determined with a heating value of 1,000 BTU/CU FT.

$$\text{Gas input rating} = \frac{1000 \times 7200}{60}$$

$$\text{Gas input rating} = 120,000 \text{ BTU/HR}$$

6. If the input rate is not within two percent of the rated input, it may be achieved by adjusting the manifold pressure. If the specified input cannot be obtained, the furnace must be reorificed.

CAUTION: For operation at elevations above 2,000, the installer must comply with the "Orifice Sizing" section.

DETERMINING GAS INPUT--LP GAS

The pressure regulator on the storage tank must be adjusted to maintain a manifold pressure of 10.0" W.C. on the exit side of the furnace gas valve. This pressure will result in correct input when the burners are orificed properly.

GAS PRESSURE SPECIFICATIONS

This furnace is equipped with fixed orifices for rated input with the following gas pressures:

TABLE 5

	Supply		
	Minimum	Maximum	Manifold
Natural @ 1,000 BTU/CU FT	4.5" WC	11.0" WC	3.5" WC
LP @ 2,550 BTU/CF FT	11.0" WC	13.0" WC	10.0" WC

The supply pressure may be measured by attaching a water column gauge to a pressure tap adjacent to and up stream from the gas valve. The manifold pressure may be measured by removing the small pipe plug located in the top of the main burner manifold, and inserting a pressure tap. Attach water column gauge to tap and ignite main burner. Small variations in the gas pressure may be made, not to exceed ± 0.1 " W.C., to achieve rated manifold pressure. This may be achieved by turning the gas valve regulator adjusting screw clockwise to increase pressure or counter-clockwise to decrease pressure. Major changes in flow rate must be made by changing the size of the main burner orifices.

Underfire Conditions. Underfire conditions (not setting up furnace installation for full input operation) can also cause condensation and corrosion problems. Natural gas models are to be operated at 3.5 inches W.C. manifold pressure with standard factory supplied orifice sizes. Models converted to L.P. gas are to be operated at 10.0 inch W.C. using the designated orifices from the approved L.P. conversion kit.

It is not acceptable to either reduce manifold pressure or to reduce orifice size to compensate for oversized equipment. It is mandatory that manifold pressure be checked at time of installation/start-up of the furnace. Adjustments if necessary must be made to achieve correct manifold pressures as stated above and also on the rating plate on the furnace.

ORIFICE SIZING

Rating of gas utilization equipment are based on sea level operation and need not be changed for operation at elevations up to 2,000 feet. For operation at elevations above 2,000 feet and, in the absence of specific recommendations from the local authority having jurisdiction, equipment ratings shall be reduced at the rate of 4 percent for each 1,000 feet above sea level before selecting appropriately sized equipment. (Ref. National Fuel Gas Code Z223.1 (NFPA 54), latest edition.

TABLE 6
EQUIVALENT ORIFICE SIZES AT HIGH ALTITUDE
(INCLUDES 4% INPUT REDUCTION FOR EACH 1,000 FEET)

Model	Gas Type	Orifice Size At Sea Level	Orifice Size Required At Other Elevations								
			2000	3000	4000	5000	6000	7000	8000	9000	10,000
H & EH60DB C & EC60DA	Nat LP	38 53	39 54	40 54	41 54	41 54	42 54	42 54	43 55	43 55	44 55
H & EH80DB H & EH80D36B H & EH120D48B H & EH120D60B H & EH160D48B H & EH200A C & EC80D36A C & EC120D42A C & EC160D48A	Nat LP	32 51	33 51	34 52	35 52	35 52	36 52	36 53	37 53	38 53	40 54
H & EH105D36B H & EH105D48B H & EH140D48B C & EC105D42A C & EC140D48A	Nat LP	35 52	36 52	36 53	37 53	37 53	38 53	39 53	40 54	41 54	42 54

TABLE 7
ORIFICE DRILL SIZE DECIMAL EQUIVALENTS

Drill No.	31	32	33	34	35	36	37	38	39	40	41	42	43
Decimal	.120	.116	.113	.111	.110	.1065	.104	.1015	.0995	.098	.096	.0935	.089
Drill No.	44	45	46	47	48	49	50	51	52	53	54	55	56
Decimal	.086	.082	.081	.0785	.076	.073	.070	.067	.0635	.0595	.055	.052	.0465

VIII. WIRING

CAUTION

For your personal safety, turn off electric power at service entrance panel before making any electrical connections.

All electrical work must conform with local codes and ordinances or, in their absence, with the National Electrical Code, ANSI/NFPA 70-latest edition.

ELECTRICAL POWER SUPPLY

Run a separate 120 volt, AC circuit from a separate fuse or circuit breaker in the service entrance panel with an ampacity rating per Table 8. Locate a shut off switch at the furnace. Make connections from this switch to the furnace junction box as shown in the furnace wiring diagram.

TABLE 8

Model	Volts/HZ/PH	Total Amps	Blower Motor HP	Minimum Circuit Ampacity	Maximum Time Delay Fuse or HACR Circuit Breaker
H & EH60DB C & EC60DA H & EH80DB	115/60/1	6.7	1/6	10	10 amp
H & EH80D36B H & EH105D36B C & EC80D36A	115/60/1	6.4	1/3	10	10 amp
H & EH105D48B H & EH120D48B C & EC105D42A C & EC120D42A	115/60/1	9.0	1/3	15	15 amp
H & EH140D48B H & EH160D48B C & EC140D48A C & EC160D48A	115/60/1	10.50	1/2	15	15 amp
H & EH200A	115/60/1	7.8	1/2	10	10 amp
H & EH120D60B	115/60/1	12.54	3/4	16	20 amp

ELECTRICAL GROUNDING

Recommended Grounding Method

When installed, the furnaces must be electrically grounded in accordance with local codes or in the absence of local codes, with the National Electrical Code, ANSI/NFPA No. 70-latest edition. Use a #14 AWG copper wire from green screw or green ground wire on the furnace to a grounded connection in the service panel or a properly driven and electrically grounded ground rod.

Alternate Ground Method

If the recommended grounding method is impossible, permanently ground the furnace from the ground connector to a grounded cold water pipe* using a separate, green colored, insulated conductor of appropriate size. THIS, HOWEVER, IS NOT RECOMMENDED.

*Cold water pipe must have metal continuity to electrical ground and not be interrupted by plastic, rubber or other electrically insulating connectors (including water meter or pump) without adding a jumper wire at these connections.

NOTE: DO NOT ground to a gas supply pipe. DO NOT connect to electric power supply until appliance is permanently grounded.

FIELD INSTALLED EQUIPMENT

Wiring to be done in the field between the furnace and devices not attached to the furnace, or between separate devices which are field installed and located, shall conform with the temperature limitation for Type T wire (63 degree F rise (36 degree C)) when installed in accordance with the manufacturer's instructions. Refer to wiring diagrams, pages 29 thru 36.

IX. VENTING APPLICATIONS

MARGINAL EXISTING VENT SYSTEMS (REPLACEMENT FURNACES)

Undersized or Oversized Vents

With an undersized or oversized vent system, flue products may have difficulty venting. In order to assure proper venting without condensation or spillage through the draft relief opening, design and install a vent system in accordance with National Fuel Gas Code ANSI Z223.1 (NFPA 54), latest edition.

Factors Resulting In Condensation

Several additional factors may contribute to condensate formation in the vent. The physical mass of the vent is as important as size. All masonry chimneys must be lined. Oversize masonry chimneys, particularly outside (one or more sides exposed), can cause condensation problems because the flue gas products may not contain enough heat to keep the chimney primed and dry.

Underground vent connectors or flue gas passages are unacceptable.

No solid fuel burning appliances are permitted to be commonly vented with these furnaces.

Presale Inspection

The following information will describe for distributors, dealers, and installing contractors, a method for identifying an acceptable vent before the furnace is installed.

Existing vents must always be inspected before furnace installation. Most replacement dealers conduct this vent inspection and this practice is heartily endorsed. Vent inspections are doubly important when high-efficiency furnaces are installed, because of the reduced heat input to the vent. This inspection should be conducted before the sale of the furnace. Venting conditions should also be addressed before the sale by specifically stating that the quoted price either does or does not include modifications to the vent system. In any case, the inspection must be conducted before installation. This practice will reduce the possibility of call-backs to correct venting problems, and will increase customer satisfaction.

SUGGESTED VENT REMEDIES

The following actions are suggested to improve vent system operation:

1. For any venting problem:

- A. Set furnace to full input rate, *and
- B. adjust blower temperature rise within nameplate range.

*NOTE: Care must be taken to derate furnaces installed at elevations more than 2,000 feet above sea level. Refer to "Orifice Sizing" section of this manual.

2. Vent connectors:

- A. Avoid unnecessary elbows, bends, or restrictions in the flue system.
- B. Insulate any long single-wall metal vent connectors or replace with double-wall pipe.
- C. Avoid blowing conditioned air from the plenum or outside combustion air directly across the vent connector leaving the furnace. It may be necessary to insulate the vent connector to avoid this problem.

3. For excess condensate from a type B-1 vent:

- A. Insulate those sections of the vent exposed in unheated spaces and outdoors, or
- B. check for oversized vent system.
- C. Provide suitable drain.

4. For recurring lockout of the vent safety shutoff and/or flame roll-out switch.

- A. Check for adequate supply of combustion air. A very tight basement or furnace room can create air starvation which will cause the flue products to become toxic. An outdoor air supply to the furnace room or a lowered door may be required.
- B. Remove all unnecessary elbows or restrictions from the vent system, especially in the first foot of vent connector above the furnace.
- C. Check the vent system for any obstructions and correct as necessary.
- D. Insulate vent connectors or replace them with double wall pipe.
- E. If vent is undersized, replace it with a new properly sized vent.
- F. Check for an exhaust air fan or device that may create a negative pressure within the structure. If such a device is present, provisions must be made to separate the furnace room or enclosure from the rest of the structure affected by the negative pressure.

Adequate combustion air must then be introduced to the furnace room for proper operation.

VENT RESIZING INSTRUCTIONS

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

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

1. Seal any unused openings in the common venting system.
2. 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.
3. 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.
4. Follow the lighting instructions. Place the appliance being inspected in operation. Adjust thermostat so appliance will operate continuously.
5. Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle.
6. 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.
7. If improper venting is observed during any of the above tests, the common venting system must be corrected.

VENTING TROUBLESHOOTING PROCEDURES

TABLE 9

Symptoms	Possible Causes	How To Check And/Or Correct
Downdrafting through the furnace	Negative pressure within the structure caused by exhaust fan of device	Check for downdraft in vent where vent connects to unit with flame from a candle or a match, or smoke from a cigarette, cigar, or pipe.
	Location of vent terminal	Verify that vent termination is position with the recommended specifications stated in this manual.
	Incorrect or absent vent terminal	Verify that the vent terminal is designed for and is compatible with the venting system.
Condensation in venting system	Oversized venting system	Look for condensation in or around vent pipe joints or around flue connections at furnace. To correct this condition, design the venting system in accordance with the National Fuel Gas Code, ANSI-Z223.1-latest edition and addenda Z223.1a latest edition
	Uninsulated vent installed in an unconditioned space	Check for condensation in or around vent pipe joints. Also check around the flue connecting areas on the unit. Insulate the vent in unconditioned space to prevent the above condition.
	Running vent as a liner up an existing chimney without capping off the chimney	Check to make sure the space between the vent and the inside of the chimney has been sealed. With this space being open, it may allow too much cold air in and around the vent pipe allowing the flue products to condense causing condensation back at the unit.

Most installing dealers check the suitability of the vent or chimney when installing a replacement furnace. Their observations and experience have produced a set of guidelines for judging the suitability of the vent or chimney. Generally, these guidelines have proven workable. They have been modified over a period of years, taking successes and setbacks into account. For the last 30 years, furnace technology has remained relatively constant. That technology is now changing. With the benefits that new technology brings, we must all reevaluate our past practices and make changes where needed. For those who, as a matter of course, check add-on and replacement vents according to the provisions contained in the National Fuel Gas Code (NFPA 54-latest edition or ANSI Z223.1-latest edition), these installation instructions contain only supporting information. For those who do not currently ensure that the existing vents satisfy these requirements, we provide the following cautions and guidelines.

General Instructions

1. Vent connectors serving Category I and Category II appliances shall not be connected into any portion of mechanical draft systems operating under positive pressure.
2. For Category II, III, and IV furnaces, the venting system shall be installed in accordance with the furnace manufacturer's installation instructions.
3. This furnace shall be connected to a factory built chimney or vent complying with a recognized standard, or a masonry or concrete chimney lined with a lining material acceptable to the authority having jurisdiction.
4. The vent connector must be metal pipe and shall be the same size as the flue outlet on the furnace. Keep the vent as short and direct as possible. Type B-1 pipe is recommended.
5. Maintain a minimum clearance of 6" (1" for B-1) to any portion of the vent connector from any adjacent combustible materials. Single wall vent connector is permitted only within the same space (room or area) as the furnace. B-1 vent is required whenever the vent is enclosed or passes through floors, walls, ceilings, roofs or furred-out spaces. Joists, studs, floors, dry wall, paneling, sheating, rafters, roofing and other materials classified as combustible must not be closer than 1" clearance to B-1 vent.

6. If connected into masonry chimney, the vent pipe must be inserted into, but not beyond the inside wall of the chimney.
7. The gas vent must extend at least 2 feet above the highest point where it passes through the roof of a building (3 feet for a chimney) and at least 1 foot higher than any portion of a building within a horizontal distance of 10 feet. See Figure 5.
8. The vent pipe system shall be installed so as to avoid excessive turns which create unnecessary resistance to flow of vent gases.
9. Horizontal runs shall be as short and direct as possible. The maximum length of a single-wall vent pipe shall not exceed 75 percent of the height of the vent system. The maximum length of a Type B-1 double wall flue connection shall not exceed 100 percent of the height of the vent system.
10. All horizontal vent pipe shall be pitched upward from the furnace at least 1/4 inch per foot.
11. All vent systems shall be adequately supported to maintain proper clearances, to prevent physical damage, and to prevent separation to joints.
12. Vents passing through an exterior combustible wall must use a ventilated wall thimble. See Figure 6.
13. Vents passing through floors or ceilings must be fire-stopped. See Figure 7 and Figure 8.
14. Horizontal portions of the vent system shall be supported to prevent sagging. Pipe strap or equivalent means should be used every 3 to 5 feet depending upon pipe joint lengths.
15. A furnace shall not be connected to a chimney flue serving a separate appliance designed to burn solid fuel.

FLAME ROLLOUT SWITCH

This unit is equipped with a flame rollout switch which is wired in series with the control circuit. This is a manual reset switch and is used for the purpose of preventing possible fire hazard in the event of a system malfunction. If this switch has opened the control circuit, there could be a possible system malfunction. Some of the conditions that might cause a rollout to occur are blockage or sooting of primary heat exchanger, over-firing of furnace due to improper main burner orifices or incorrect manifold pressure, insufficient combustion air, or installation deficiencies with respect to return air duct design or sizing.

Once the problem has been resolved, reset the switch by pressing down on the black button on top of the switch.

FIGURE 5 -- CHIMNEY OR VENT CAP INSTALLATION

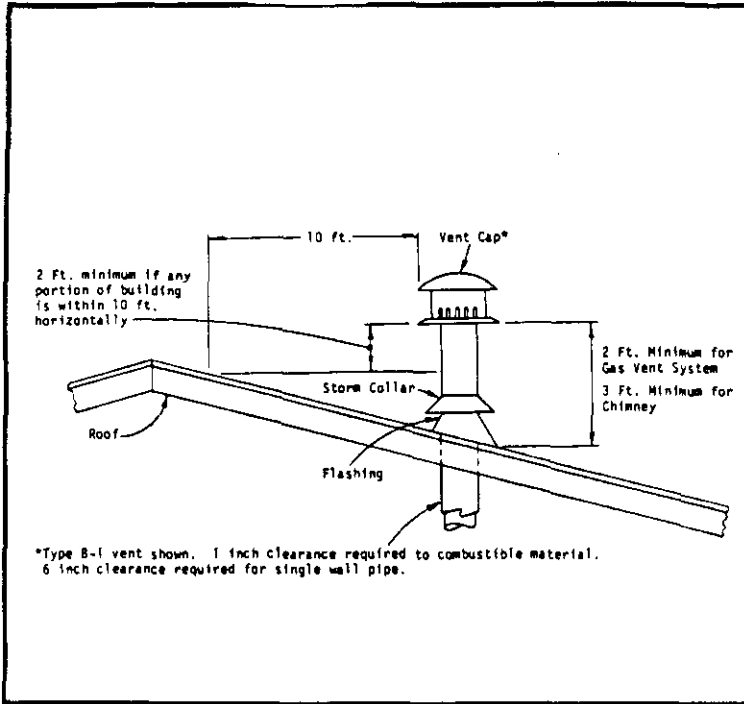


FIGURE 7 -- VENT THROUGH FLOOR

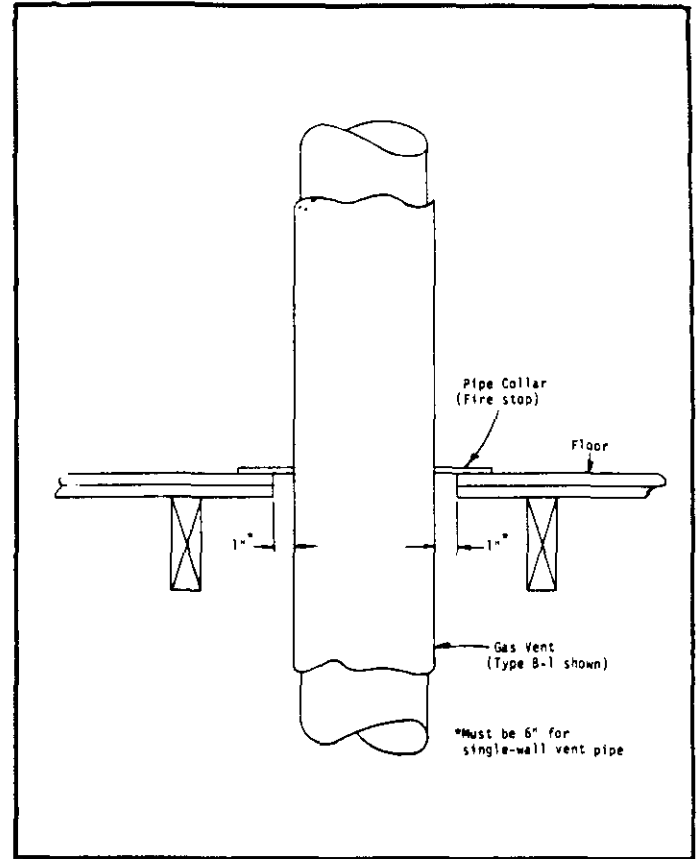


FIGURE 6 -- HORIZONTAL VENTING, COMBUSTIBLE WALL

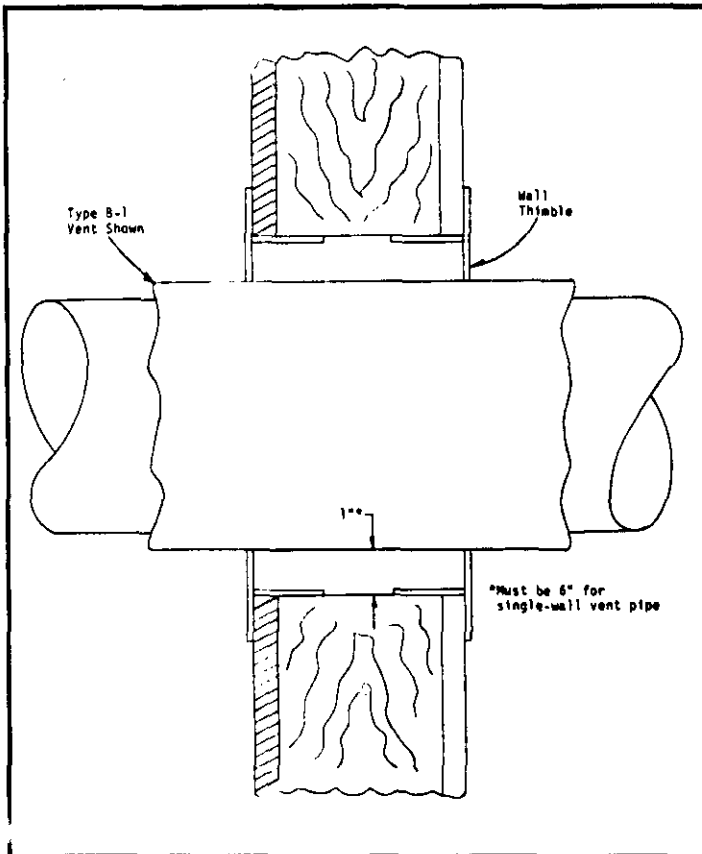
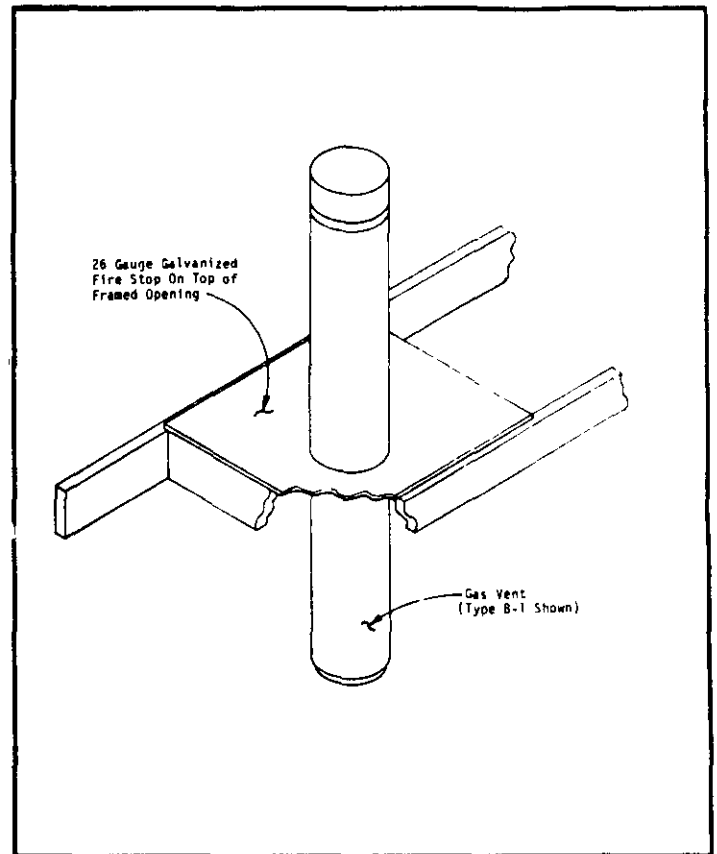


FIGURE 8 -- VENT THROUGH CEILING



X. THERMOSTAT

Install the thermostat in accordance with instructions packed with it. Locate the thermostat 4-1/3 feet from the floor on an inside wall away from drafts, warm air registers and floor or table lamps. Refer to furnace wiring diagrams for connections.

All 24V wall thermostats have heat anticipators to compensate the thermostat for various system controls and allow the best possible cycle rates. Some anticipators are fixed and require no adjustment. However, the majority of wall thermostats have adjustable anticipators and do require adjustment to match the current rating of the gas valve. The current flow in the "W" conductor should be checked with ammeter if at all possible.

Failure to adjust the anticipator lever to correspond to the actual current draw through the thermostat will cause severe short cycling if set too low and room temperature may never attain the thermostat set point, and if set too high, will cause room temperature to overshoot the set point.

XI. BLOWER OPERATION

All models are three or four speed direct drive and are equipped with a heating-cooling blower relay. When matched with the appropriate wall thermostat offers manual blower operation from the wall thermostat for air circulation.

Blower Speed Adjustment

WARNING

When servicing or changing blower motor speeds, always turn off electrical power supply to the furnace to prevent possibility of electrical shock hazard.

In the event that more air or less air is desired for either the heating or cooling mode, blower speeds may be adjusted by removing the undesired motor lead from its appropriate wire and replacing it with the speed desired.

WARNING

Unused motor wires within the junction box are electrically energized when the motor is operating and must be adequately insulated. Failure to do so can cause the motor to short out or slow down which could result in the furnace overheating and/or electrical shock and/or fire hazard.

CAUTION

After the furnace is operating with filters installed and all cabinet panels are in place, check the temperature rise through the unit to insure it is within the range specified on the furnace rating plate. If it is not, adjust blower speed until the temperature rise is within specified range.

XII. FILTERS

All models are shipped with filters. See Table 10 for sizes. Hi-Boy models have the filters in their intended positions. Hi-Boy models are shipped with filter on the left side. They can alternately be located on right side or bottom. See following information. The counterflow models require a bracket installation and final filter location projects into return air plenum attachment to furnace, see Figures 12 and 13.

TABLE 10

FILTER SIZES FOR GAS FURNACES	
Model	Size
H & EH60DB H & EH80DB H & EH80D36B H & EH105D36B H & EH105D48B H & EH120D48B H & EH120D60B H & EH140D48B H & EH160D48B	(1) 16 x 25 x 1 P
H & EH200A	(2) 16 x 25 x 1 P
C & EC60DA C & EC80D36A	(1) 15 x 20 x 1 P
C & EC105D42A C & EC120D42A	(2) 10 x 20 x 1 P
C & EC140D48A	(1) 15 x 20 x 1 P
C & EC160D48A	(1) 10 x 20 x 1 P

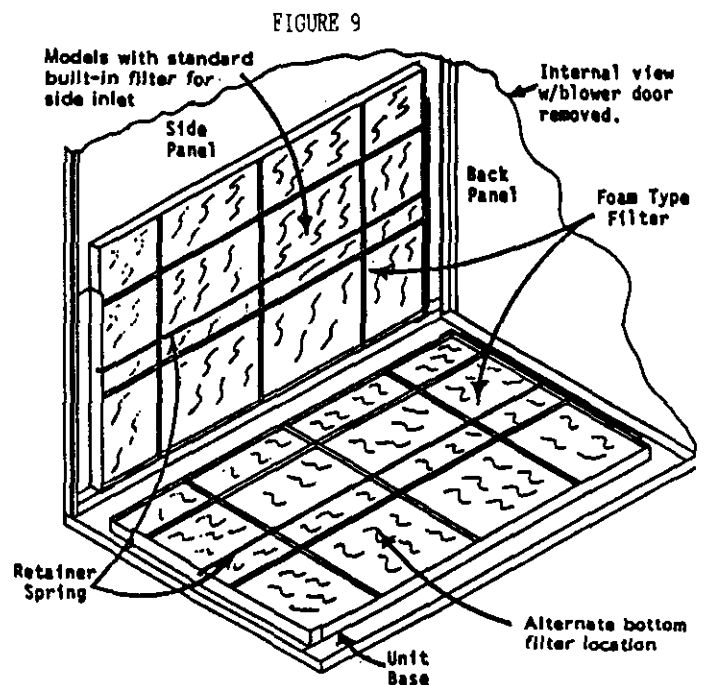
P = Permanent

Filter Locations--Removal and Replacement Procedures--Hi-Boy Models

To remove filters from ALL sectional Hi-Boys, first remove the upper burner door and then the lower blower compartment door by grasping top of door and pull up and away from the furnace. Then, remove the "S" clip and spring by pulling the clip towards the front of the furnace.

For right hand side filter location, relocate filter and retaining spring assembly to right side filter brackets.

For right hand side filter location on H60DB, EH60DB, H80DB, EH80DB, H80D36B, and EH80D36B model furnaces, the optional filter rack is required because there is no room between the blower motor and right side of furnace to remove or install filter.



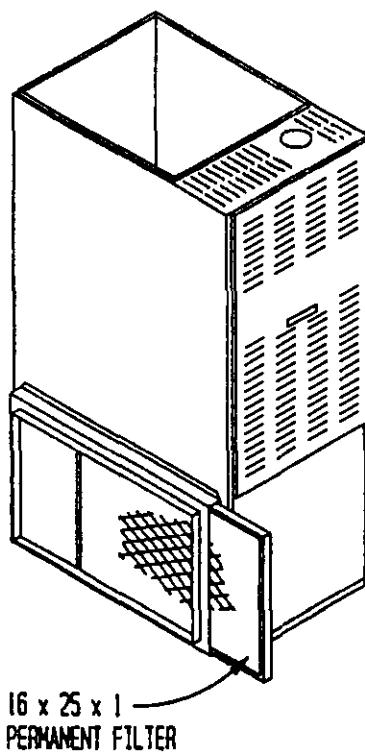
The filter may now be removed simply by pulling it towards the center of the furnace and outward.

The location may vary, depending on which side the installer located the return air duct.

This filter is the permanent high velocity type foam filter which may be washed and used over and over. DO NOT replace it with a fiberglass filter of the same size.

To replace filter, reverse the above process.

FIGURE 10



To remove filter from the optional external filter rack, grasp the exposed end of the filter and pull from the filter rack.

The location may vary, depending on which side the installer located the return air duct.

This filter is the permanent high velocity type foam filter which may be washed and used over and over. DO NOT replace it with a fiberglass filter of the same size.

To replace filter, reverse the above process.

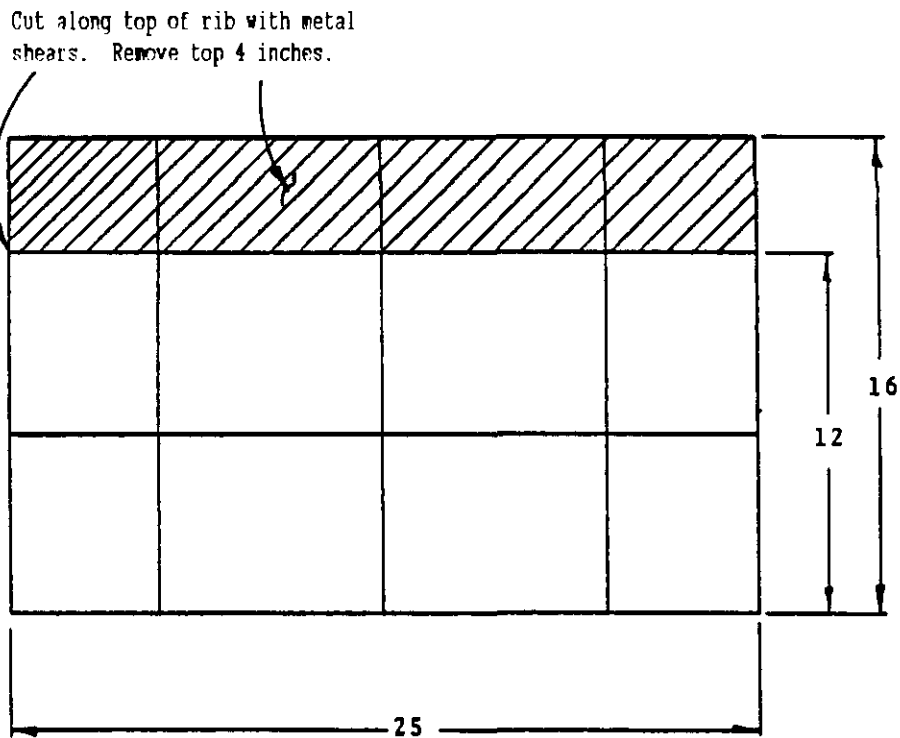
Alternate Bottom Filter Location

All Hi-Boy models except H200A and EH200A have a removable panel on the base for a bottom return air installation.

To utilize this feature, remove the fill plate by bending the four tabs up 90 degrees. Relocate filter retainer spring from side to bottom brackets. Leave the four tabs bent in the upright position as they will now serve to keep the filter positioned left to right.

On the H60DB, EH60DB, H80DB, EH80DB H80D36B, and EH80D36B model the standard 16x25x1 filter must be cut down to 12x25x1. See Figure 11.

FIGURE 11



Filter Locations--Counterflow Models

Counterflow models normally have filters installed in the return air plenum above the furnace unless a common return air/filter grille is used.

The electrical switch should be turned "off" before the front door to furnace is removed. After removing the front door, remove the left side filter door in the upper section of the furnace. Refer to Figures 12 and 13 below for proper filter locations.

FIGURE 12
C60DA, EC60DA
C80D36A, EC80D36A

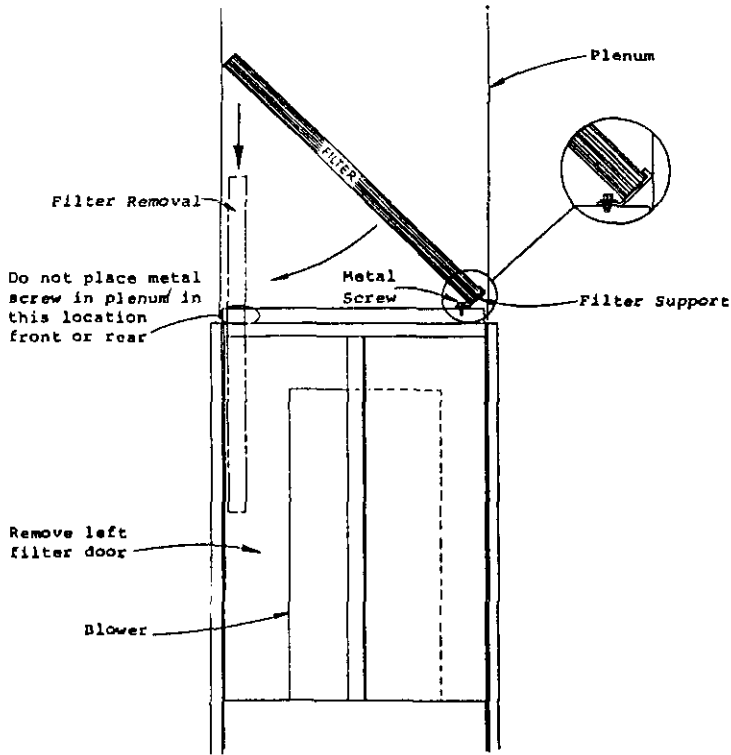
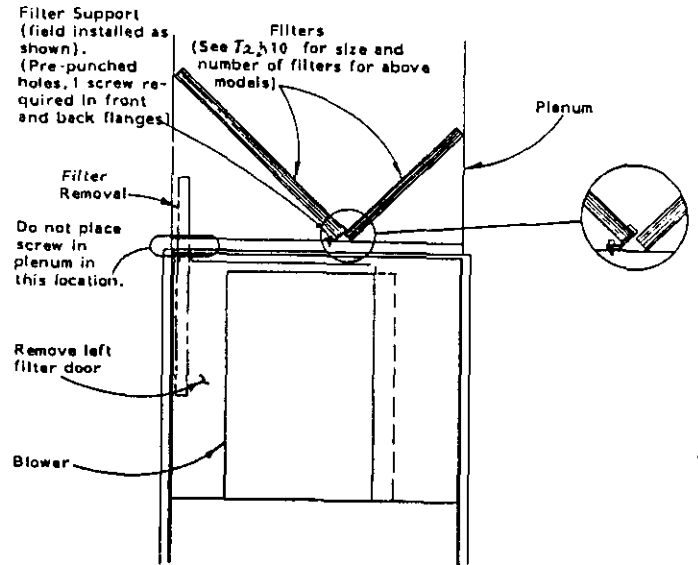


FIGURE 13
C105D42A, EC105D42A
C120D42A, EC120D42A
C140D48A, EC140D48A
C160D48A, EC160D48A



Attach filter support to furnace as shown with two sheet metal screws. The filter can be installed and removed through the left filter door.

XIII. MAINTENANCE INSTRUCTIONS

The furnace and its vent system should be inspected annually by a qualified service agency, generally prior to the heating season.

NOTE: Prior to the start of any of the following maintenance procedures shut off all power to the unit.

Routine maintenance procedures are the responsibility of the owner and are contained in the Owner's Manual. These are briefly outlined below:

1. Air Filters. Check the condition on at least a monthly basis when the furnace is in use or replace whenever it is necessary.
2. Lubrication Requirements. Direct drive motors are permanently lubricated, no maintenance required.
3. Check Temperature Rise. Adjust blower speed if necessary to obtain a temperature rise within the range specified on the furnace rating plate.
4. Basic Examination of Furnace. Visual inspection of pilot flame and the main burners. Also inspection of the burner compartment and the vent system for sooting and scaling.
5. Periodic Inspection of the Vent System. Visual inspection of the vent system from the furnace to the chimney for any leaking or defective parts.

XIV. REPLACEMENT PARTS

Replacement parts for the gas furnaces are available through local distributors.

Parts list covering all of the normally serviceable items are listed in the Replacement Parts Manual supplied with this furnace. When ordering parts or making inquiries pertaining to any of the furnaces covered by these instructions, it is very important to always supply the COMPLETE model number and serial number of the furnace. This is necessary to assure that the correct parts (or approved alternate parts) are issued to the service agency.

The replacement parts manual numbers are as follows:

H - EH Series Hi-Boy -- 2110-851
C - EC Series Counterflow -- 2110-852

XV. SERVICE AGENCY PROCEDURES

1. If the furnace is a standing pilot model (burns all the time), observe the pilot flame. The pilot flame should be a "soft blue flame" enveloping or covering approximately 1/2 inch of the tip of the thermostat. See Figure 14.

The intermittent pilot lights only when the thermostat calls for heat and the main burner lights within a few seconds thereafter. It is recommended that any observation of pilot or main burner operation be done only with the burner compartment door in place and viewing through the combustion air slots. See Figure 15.

The pilot flame can be adjusted by removing the pilot adjustment cover screw. See Figures 14 and 15. Turn inner adjustment screw clockwise to decrease and counterclockwise to increase pilot flame. Be sure to replace cover screw after adjustment to prevent possible gas leakage.

FIGURE 14
STANDING PILOT

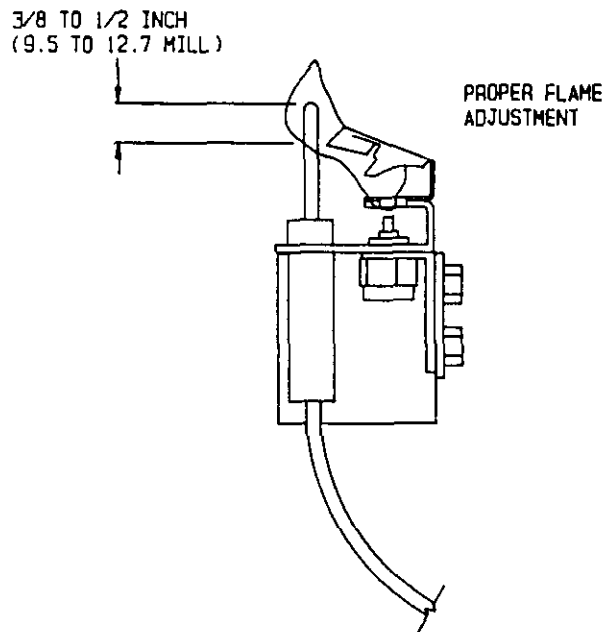


FIGURE 15
INTERMITTENT PILOT

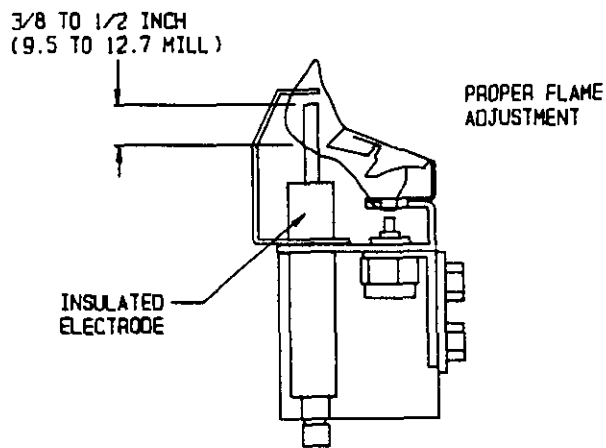


FIGURE 16
 ALL "EH" and "EC" MODELS 140,000 BTU AND LARGER
 TOP VIEW OF VR8440 GAS CONTROL

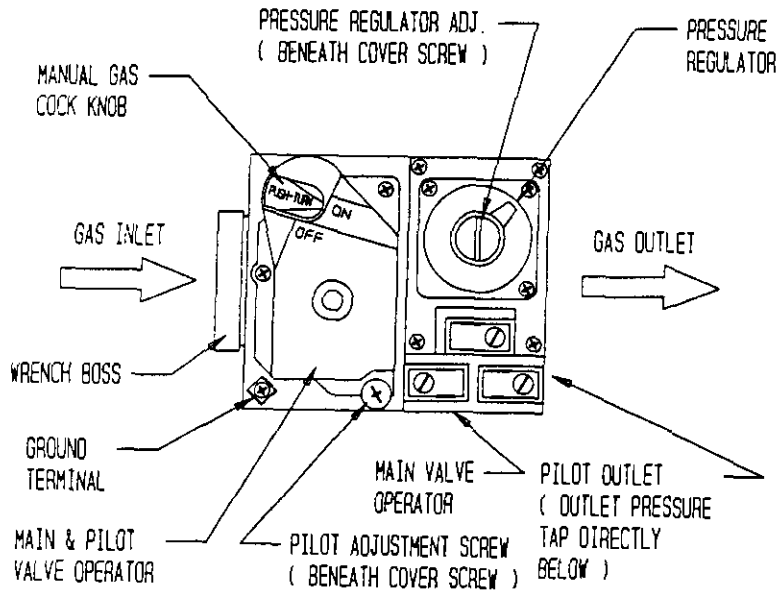


FIGURE 17
 ALL "EH" AND "EC" MODELS 120,000 BTU AND SMALLER
 TOP VIEW OF VR8200 GAS CONTROL

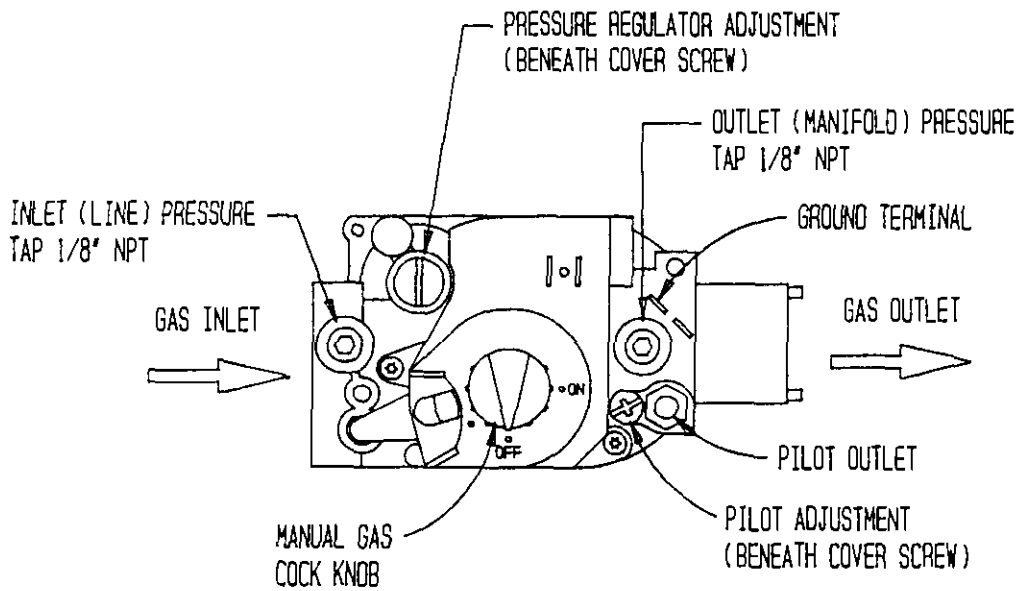


FIGURE 18
 ALL "H" AND "C" MODELS 140,000 BTU AND LARGER
 TOP VIEW OF VR8440 GAS CONTROL

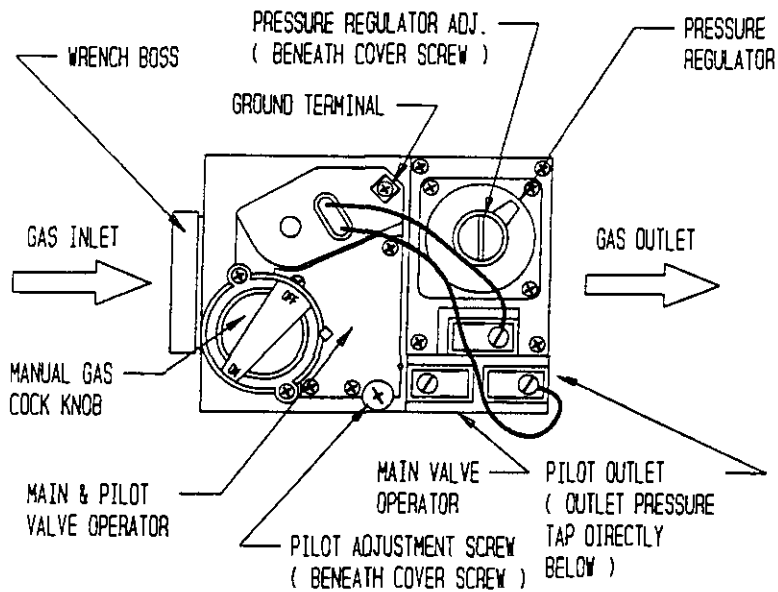
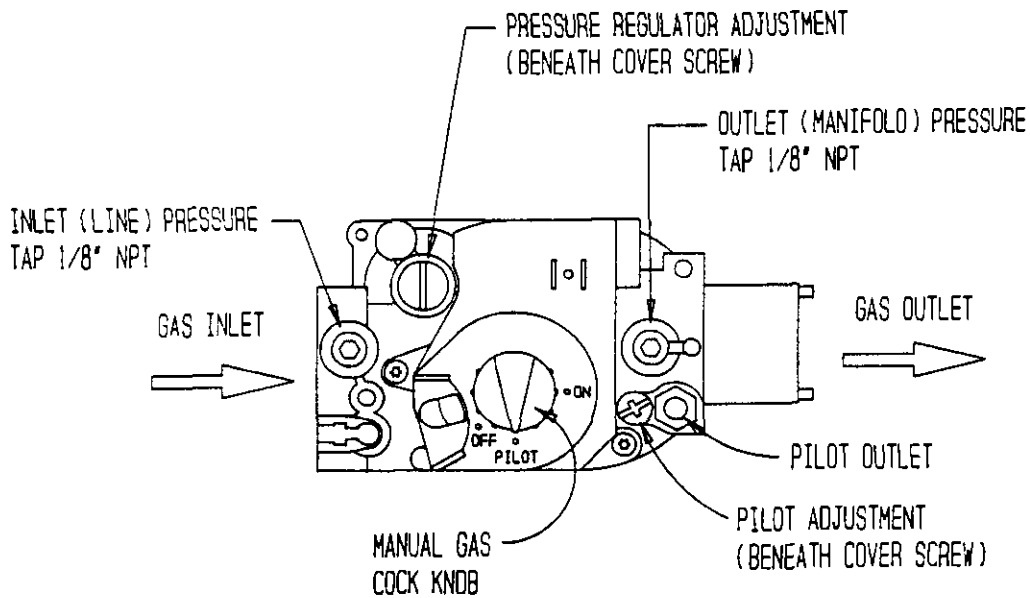


FIGURE 19
 FOR "H" AND "C" MODELS 120,000 BTU AND SMALLER
 TOP VIEW OF VR8200 GAS CONTROL



2. Observe the main burners in operation, viewing through the combustion air slots. The flame should be mostly "blue" with possibly a little orange at the tips of the flames. The flames should be in the center of the heat exchanger compartments and not impinging on the heat exchanger surfaces themselves.

The inner cone of the flame as shown below should be approximately 1 inch to 1-1/4 inches tall from the burner ports when natural gas is used. When LP gas is used, the inner cones should be approximately 1/2 inch tall from the burner ports. If no primary air adjustment has been made after the furnace has been converted for use with LP gas, the inner cones may be lying flat on the burner ports. This condition can be corrected by decreasing the amount of primary air in the burners. Slowly close down the primary air shutters at the end of each burner until the desired inner cone height is obtained. Be sure to tighten all the air shutter set screws once the adjustment has been made.

Observe the fire until the blower starts (there is a normal delay period until the heat exchanger warms up). There should be no change in the size or shape of the flame. If there is any wavering or blowing of the flame on the blower start-up, it is an indication of a possible leak in the heat exchanger.

The air shutters are factory adjusted for use with natural gas. If flashback occurs, the air shutters may be closed slightly to prevent the flashback. If converted to LP gas, the air shutters must be adjusted as specified above. Once adjusted, the combustion should be checked to verify the absence of carbon monoxide.

FIGURE 20

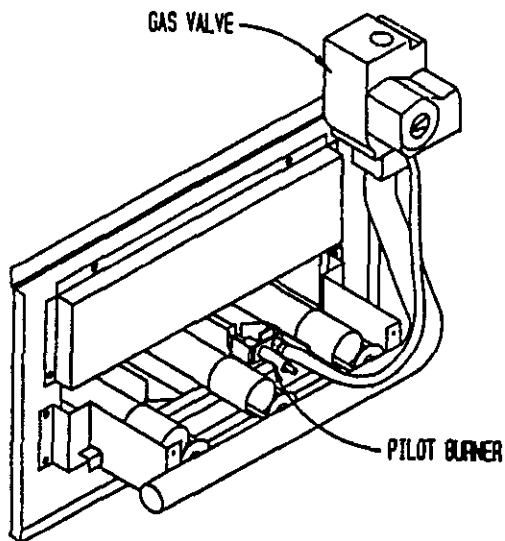
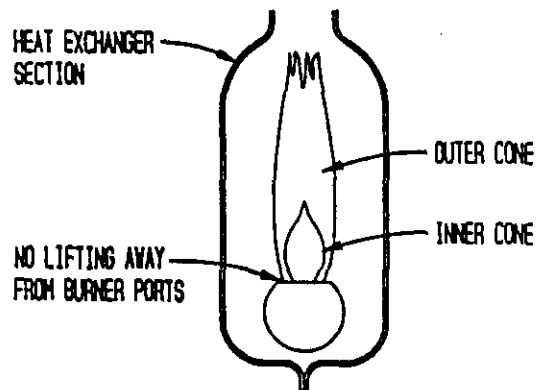
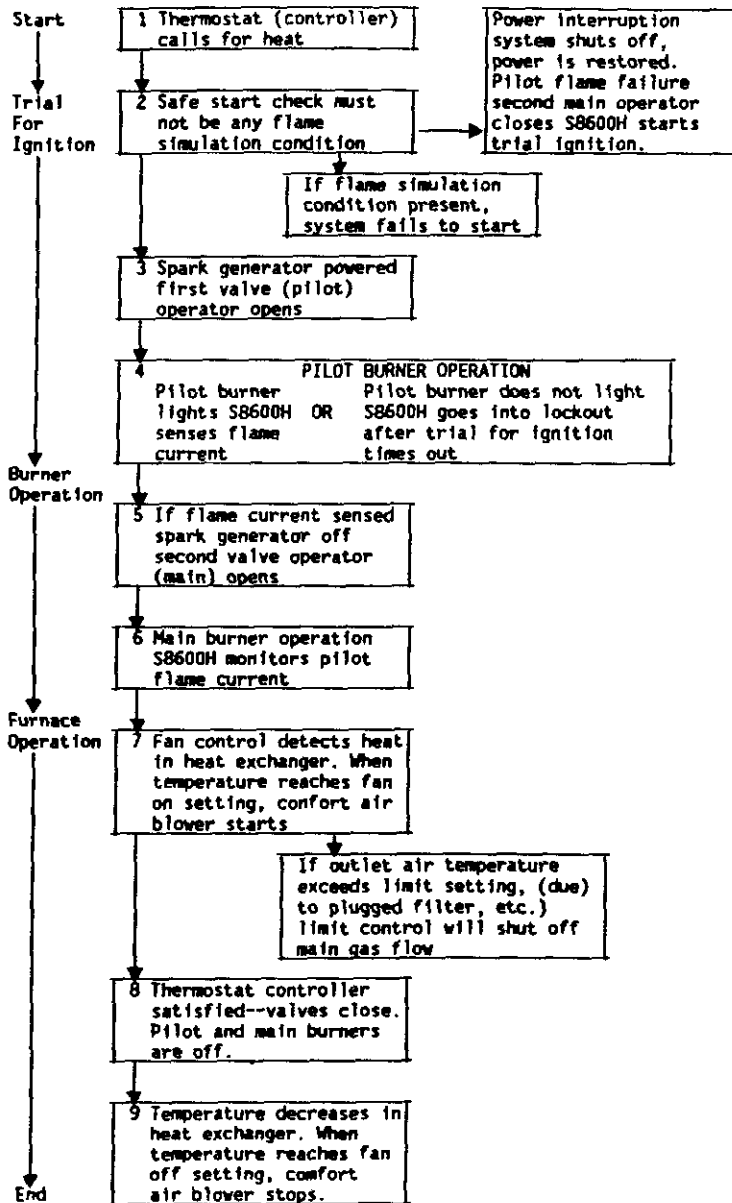


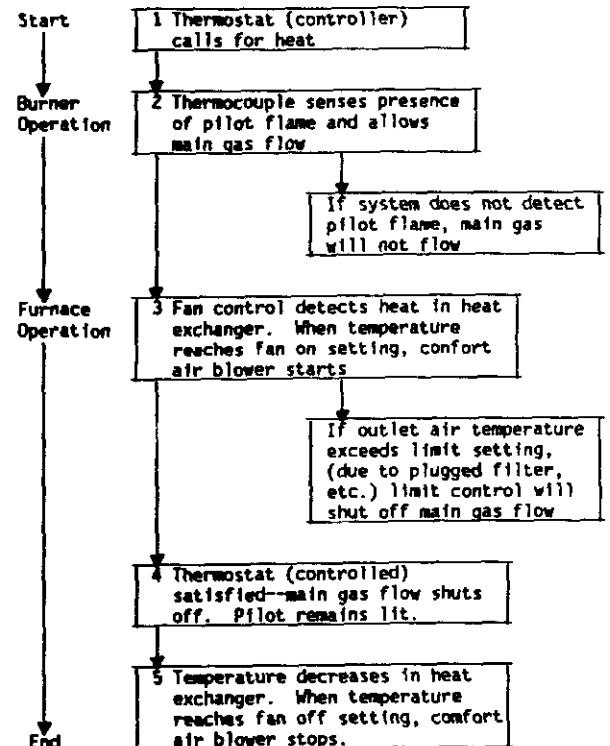
FIGURE 21



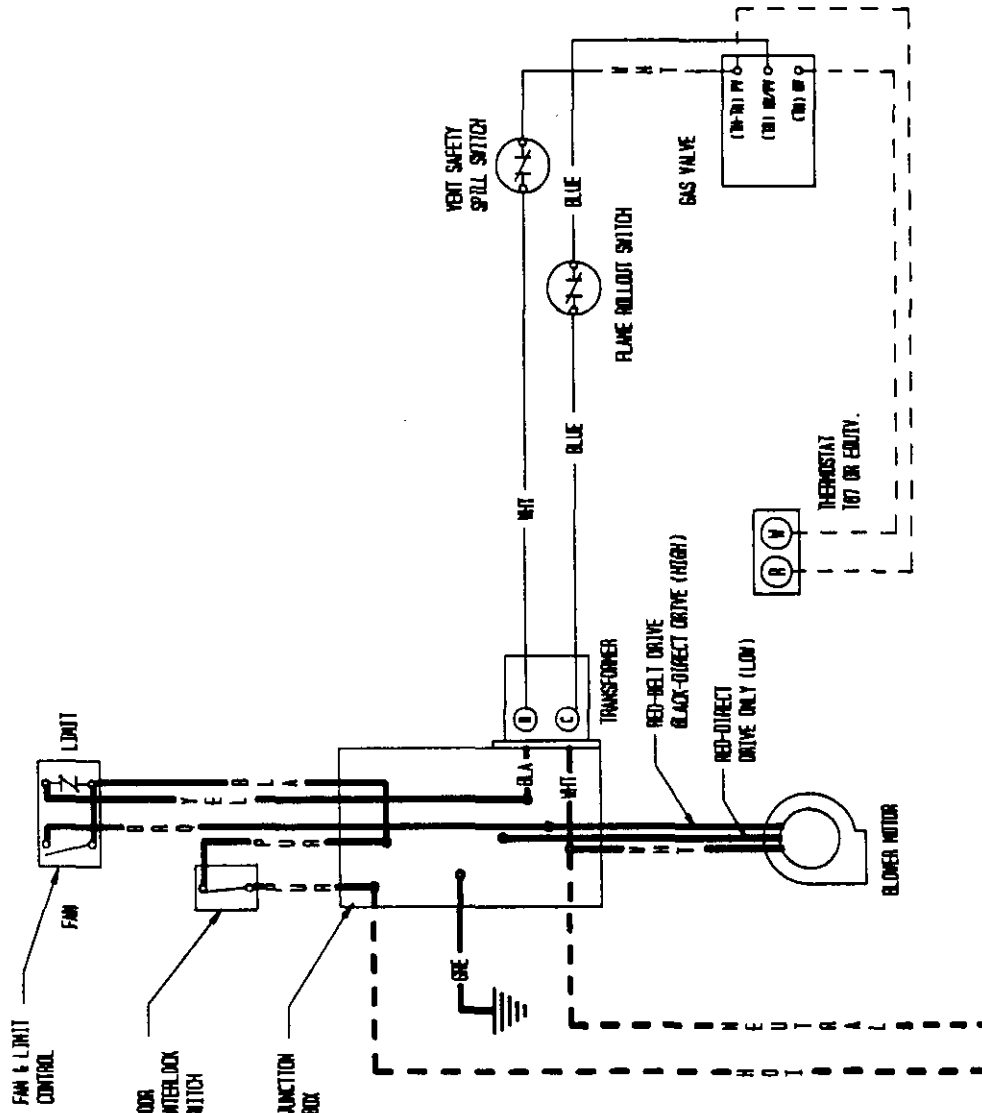
ELECTRIC IGNITION GAS FURNACE
SEQUENCE OF OPERATION



STANDING PILOT GAS FURNACE
SEQUENCE OF OPERATION



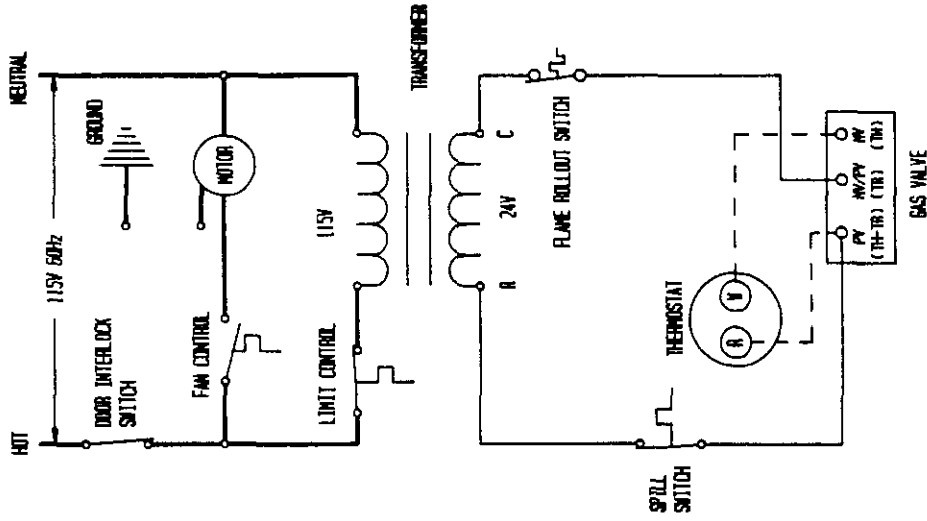
CONNECTION DIAGRAM
 DANGER: ELECTRICAL SHOCK HAZARD.
 DISCONNECT POWER BEFORE SERVICING



Low Voltage
 High Voltage

FACTORY WIRING
 FIELD WIRING

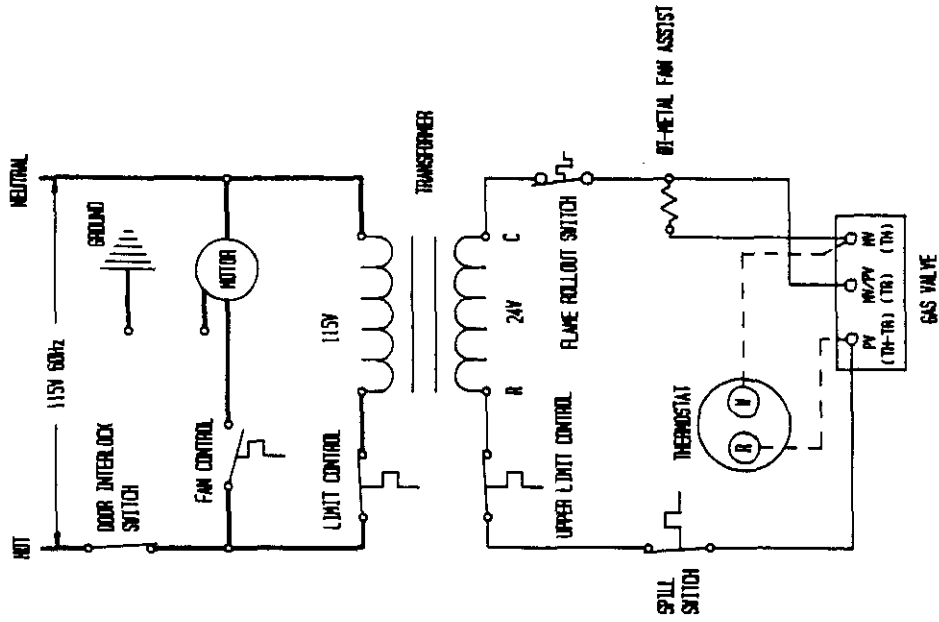
LADDER DIAGRAM



IF ANY OF THE ORIGINAL WIRE AS SUPPLIED WITH THE APPLIANCE MUST BE REPLACED,
 IT MUST BE REPLACED WITH WIRING MATERIAL HAVING A TEMPERATURE RATING OF AT
 LEAST 105°C.

UPRON MODELS, 1 & 2 SPEED, STANDING PILOT

LADDER DIAGRAM

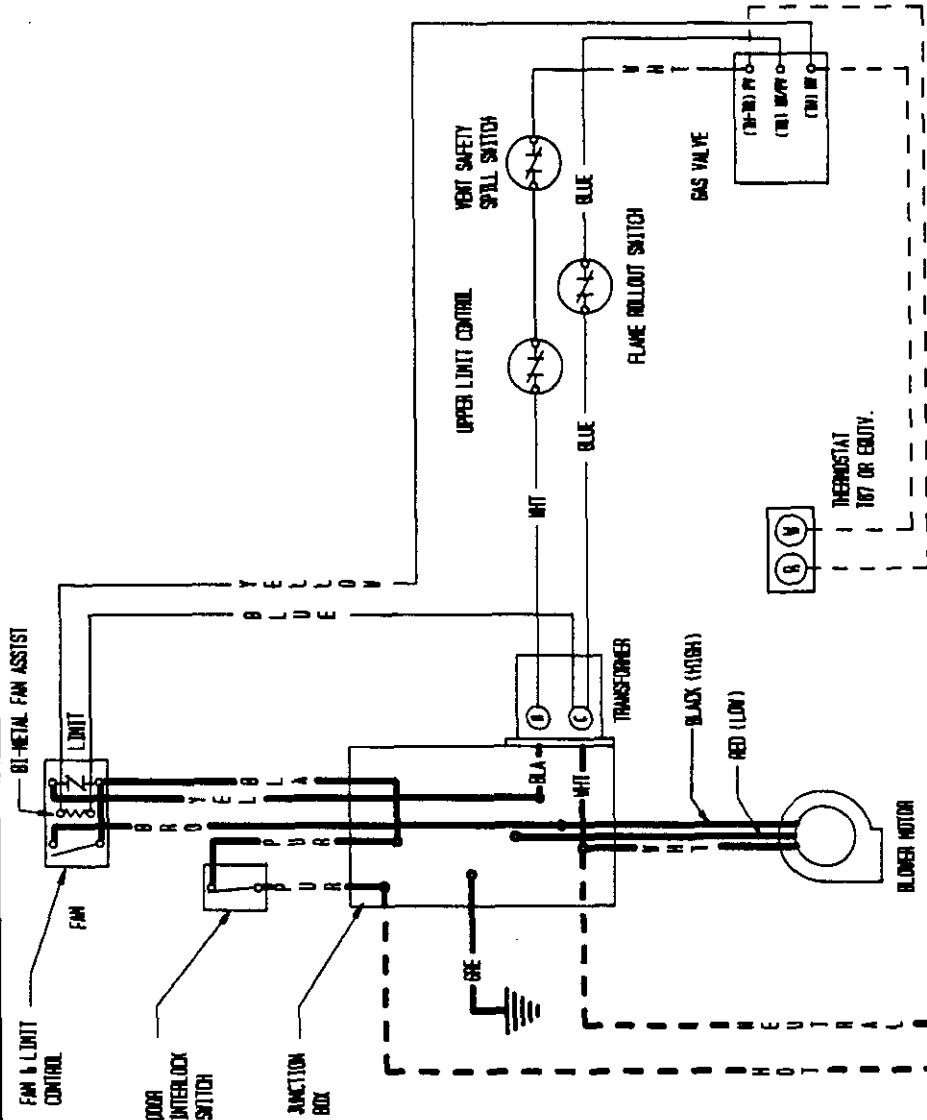


IF ANY OF THE ORIGINAL WIRE IS SUPPLIED WITH THE APPLIANCE MUST BE REPLACED. IT MUST BE REPLACED WITH WIRING MATERIAL HAVING A TEMPERATURE RATING OF AT LEAST 105°C.

COUNTERFLOW MODELS, 2 SPEED, STANDING PILOT

4046-111

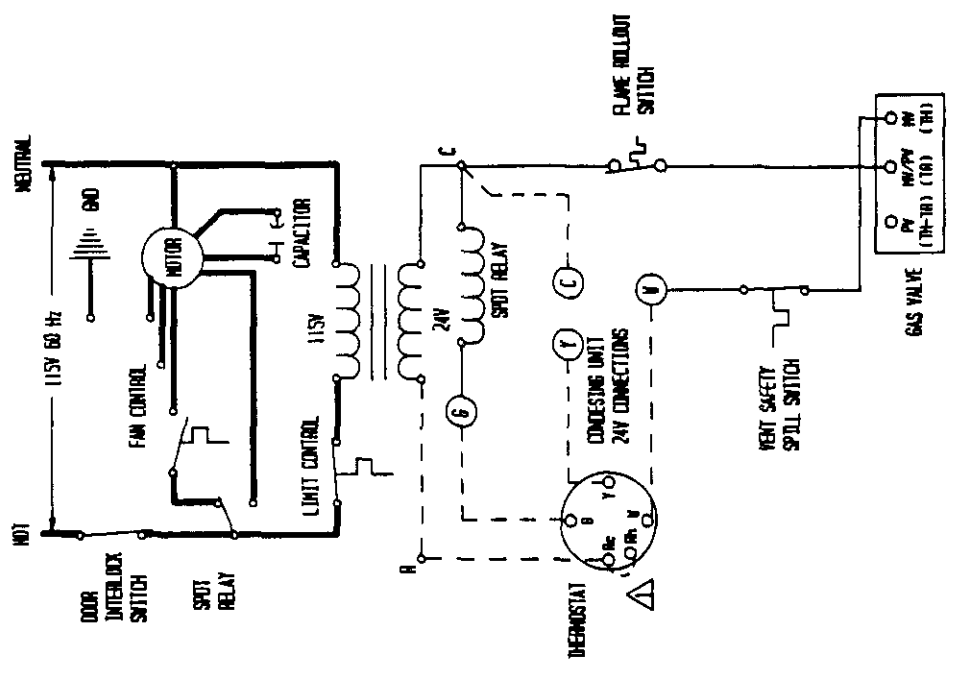
CONNECTION DIAGRAM
DANGER: ELECTRICAL SHOCK HAZARD. DISCONNECT POWER BEFORE SERVICING



FACTORY WIRING	SOLID LINE
FIELD WIRING	DASHED LINE
Low Voltage	WHITE
High Voltage	BLUE

115 - 60 - 1

LADDER DIAGRAM



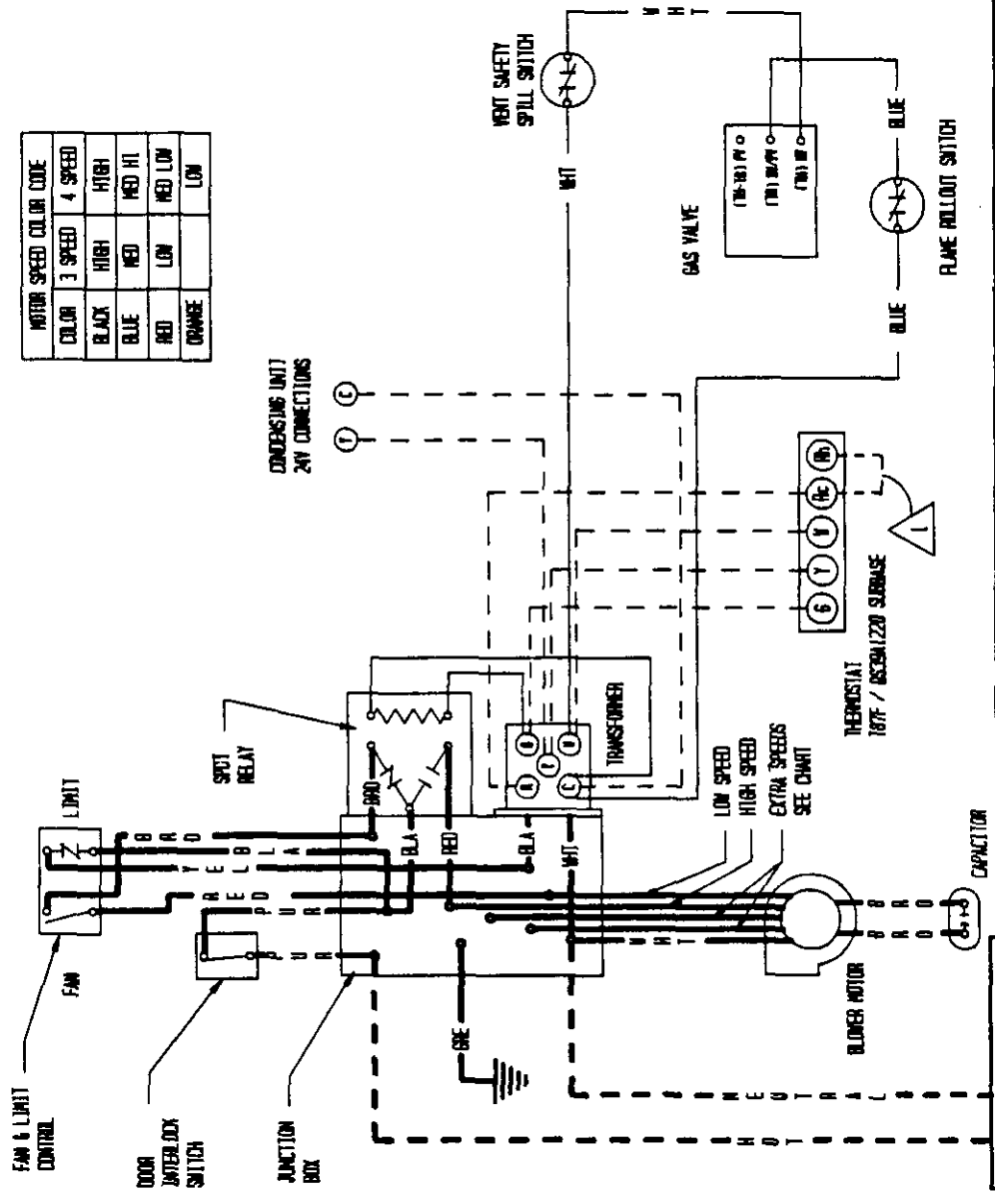
IF ANY OF THE ORIGINAL WIRE AS SUPPLIED WITH THE APPLIANCE MUST BE REPLACED, IT MUST BE REPLACED WITH WIRING MATERIAL HAVING A TEMPERATURE RATING OF AT LEAST 105°C.

UPFLOW A/C MODELS 3 AND 4 SPEED, STANDING PILOT

4046-112

CONNECTION DIAGRAM

⚠ DANGER: ELECTRICAL SHOCK HAZARD. DISCONNECT POWER BEFORE SERVICING



MOTOR SPEED COLOR CODE		
COLOR	3 SPEED	4 SPEED
BLACK	HIGH	HIGH
BLUE	MED	MED HI
RED	LOW	MED LOW
ORANGE		LOW

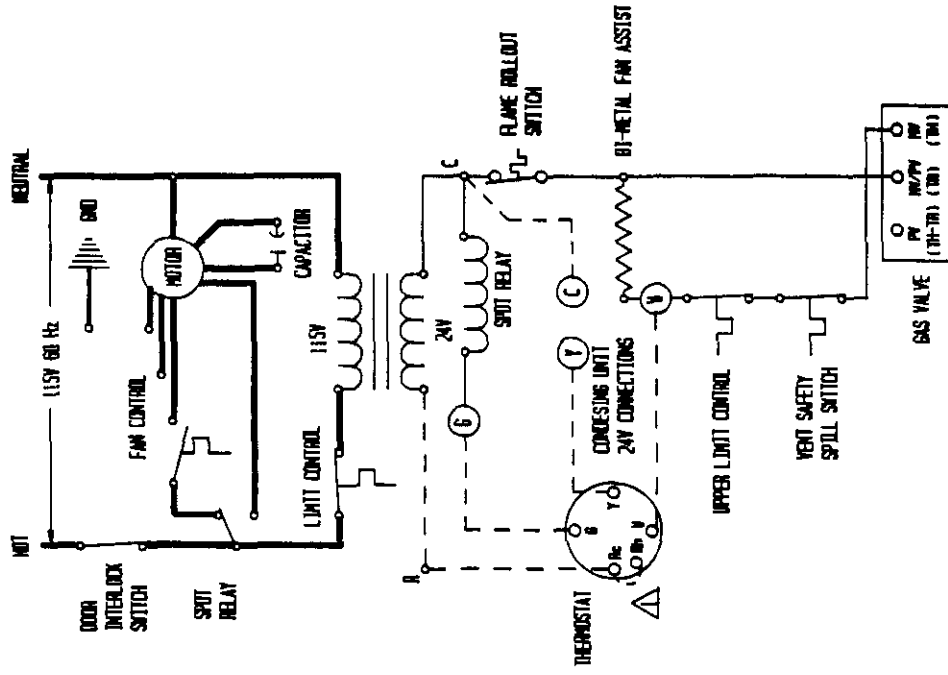
Low Voltage
High Voltage

FACTORY WIRING (solid line)
FIELD WIRING (dashed line)

⚠ JUMPER R_c - R_n REQUIRED ON DESIGN 120

115-60-1

LADDER DIAGRAM



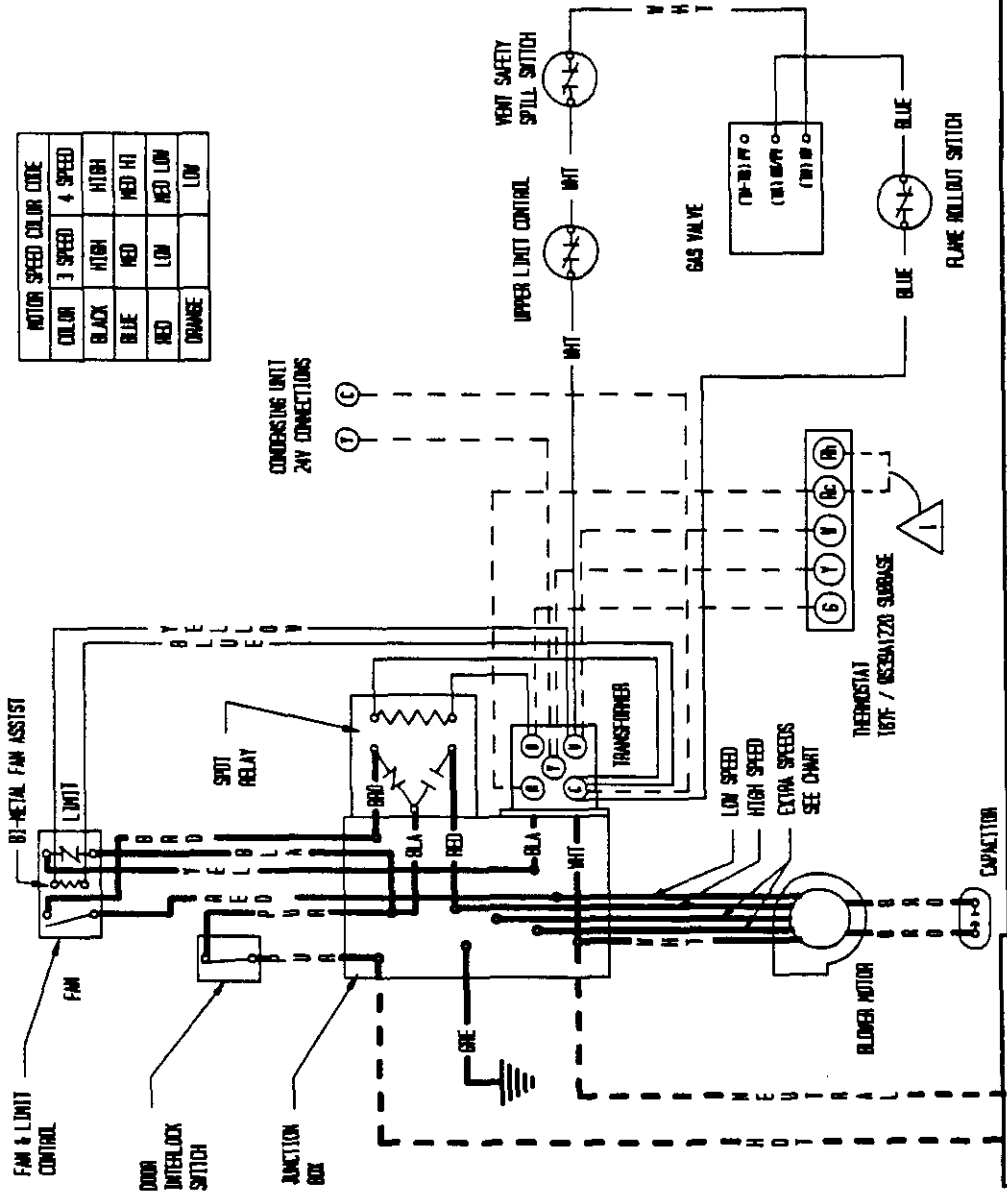
IF ANY OF THE ORIGINAL WIRE AS SUPPLIED WITH THE APPLIANCE MUST BE REPLACED, IT MUST BE REPLACED WITH WIRING HAVING A TEMPERATURE RATINGS OF AT LEAST 105°C.

COUNTERLOW A/C MODELS, 3 AND 4 SPEED, STANDING PILOT

4046-113

CONNECTION DIAGRAM

DANGER: ELECTRICAL SHOCK HAZARD. DISCONNECT POWER BEFORE SERVICING



MOTOR SPEED	COLOR CODE
3 SPEED	4 SPEED
BLACK	HIGH
BLUE	HIGH HI
RED	LOW
ORANGE	LOW

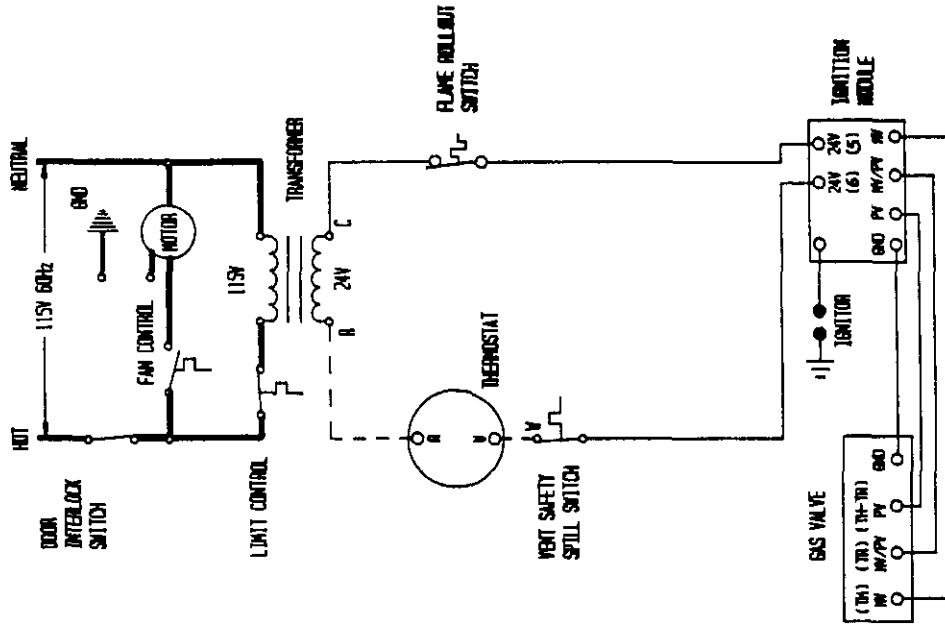
FACTORY WIRING (solid line)
FIELD WIRING (dashed line)

Low Voltage
High Voltage

JUMPER Rc - Rb REQUIRED ON 6259A1220

115-60-1

LADDER DIAGRAM

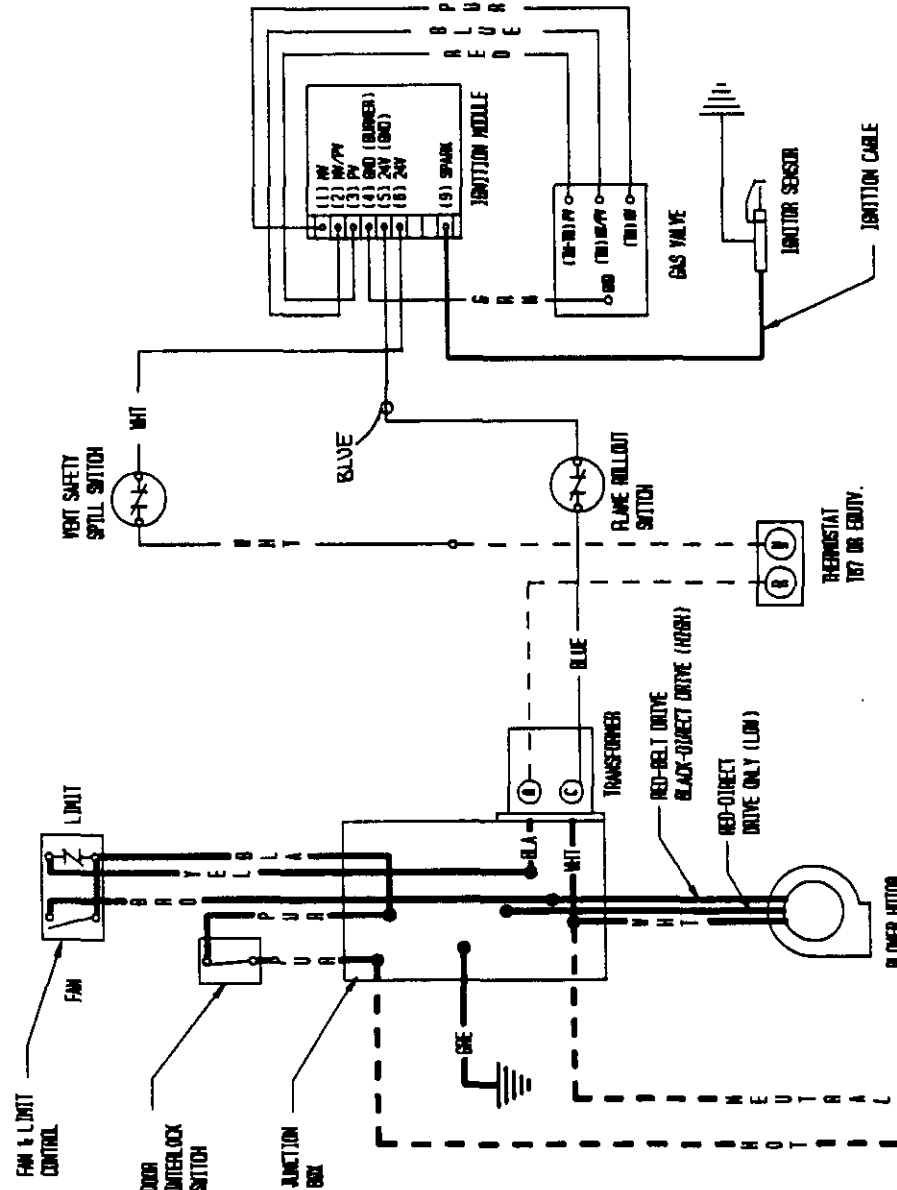


IF ANY OF THE ORIGINAL WIRE AS SUPPLIED WITH THE APPLIANCE MUST BE REPLACED, IT MUST BE REPLACED WITH WIRING MATERIAL HAVING A TEMPERATURE RATING OF AT LEAST 105°C. EXCEPT THE IGNITION CABLE WHICH IS 250°C. HIGH VOLTAGE CABLE.

UPFLON 1 & 2 SPEED MODELS, ELECTRIC IGNITION

4946-114 A

CONNECTION DIAGRAM DANGER: ELECTRICAL SHOCK HAZARD. DISCONNECT POWER BEFORE SERVICING

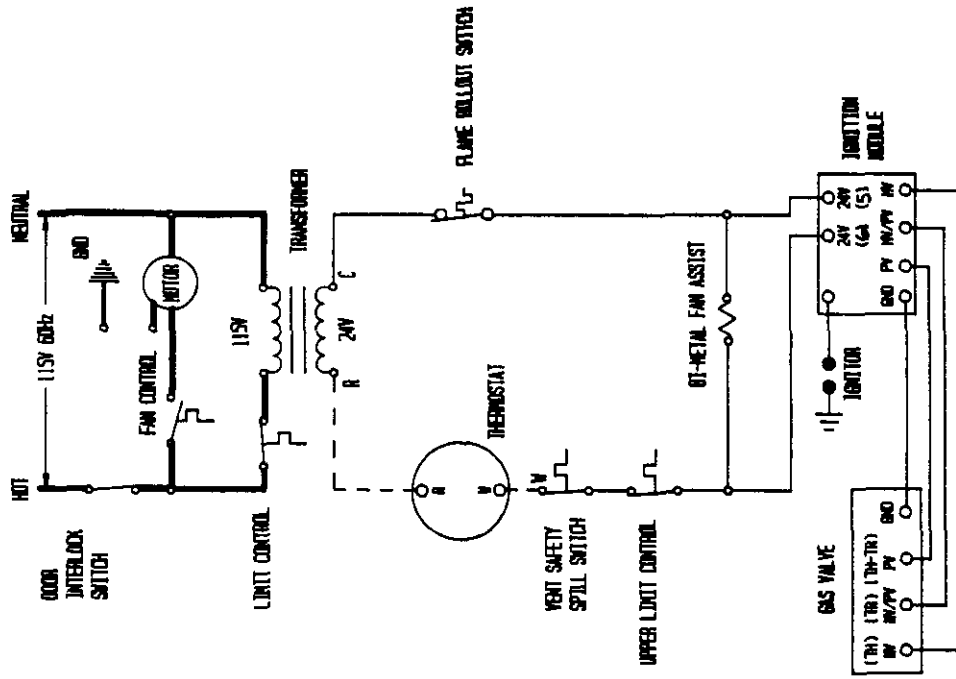


Low Voltage
High Voltage

FACTORY WIRING
FIELD WIRING

115-60-1

LADDER DIAGRAM

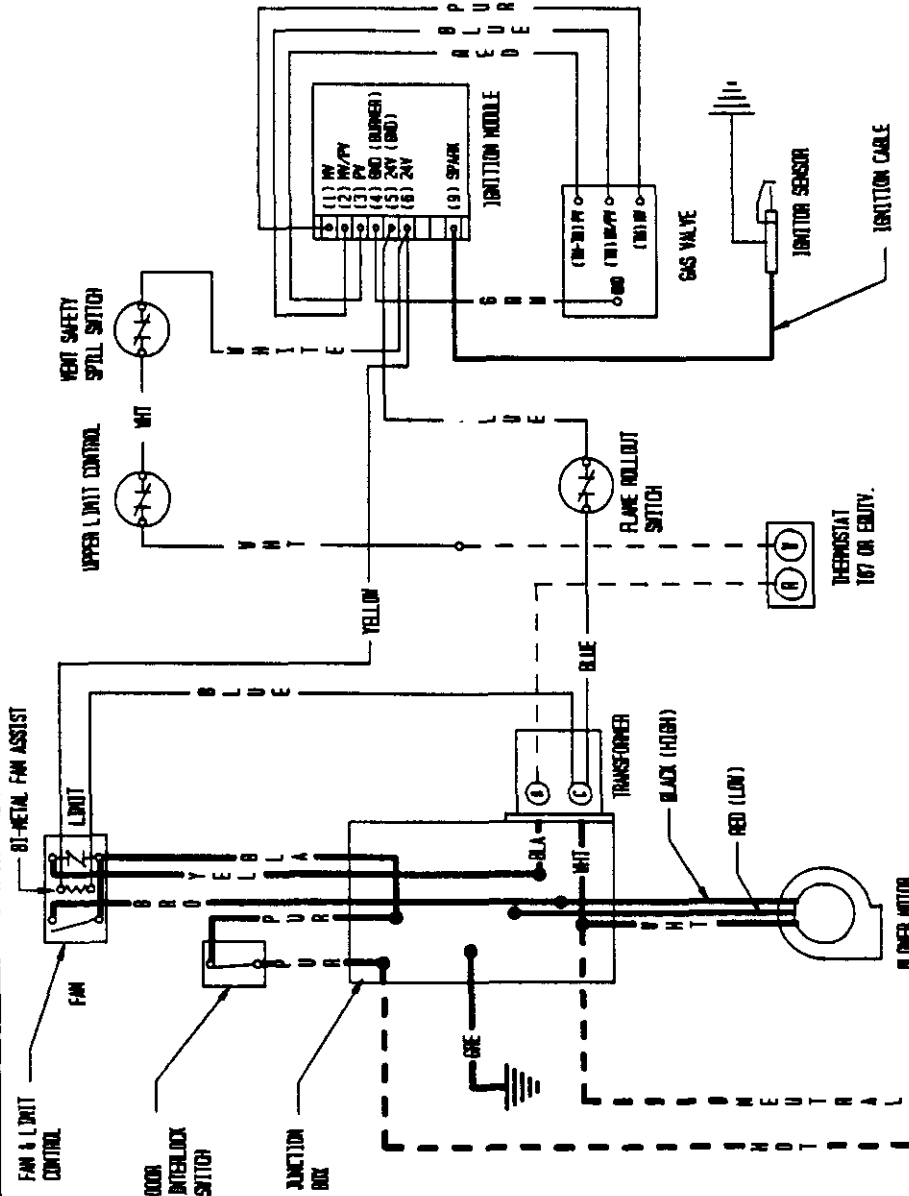


IF ANY OF THE ORIGINAL WIRE IS SUPPLIED WITH THE APPLIANCE MUST BE REPLACED. IT MUST BE REPLACED WITH WIRING MATERIAL HAVING A TEMPERATURE RATING OF AT LEAST 105°C. EXCEPT THE IGNITION CABLE WHICH IS 250°C. HIGH VOLTAGE CABLE.

COUNTERFLOW 2 SPEED MODELS, ELECTRIC IGNITION

4046-115A

CONNECTION DIAGRAM
DANGER: ELECTRICAL SHOCK HAZARD.
DISCONNECT POWER BEFORE SERVICING

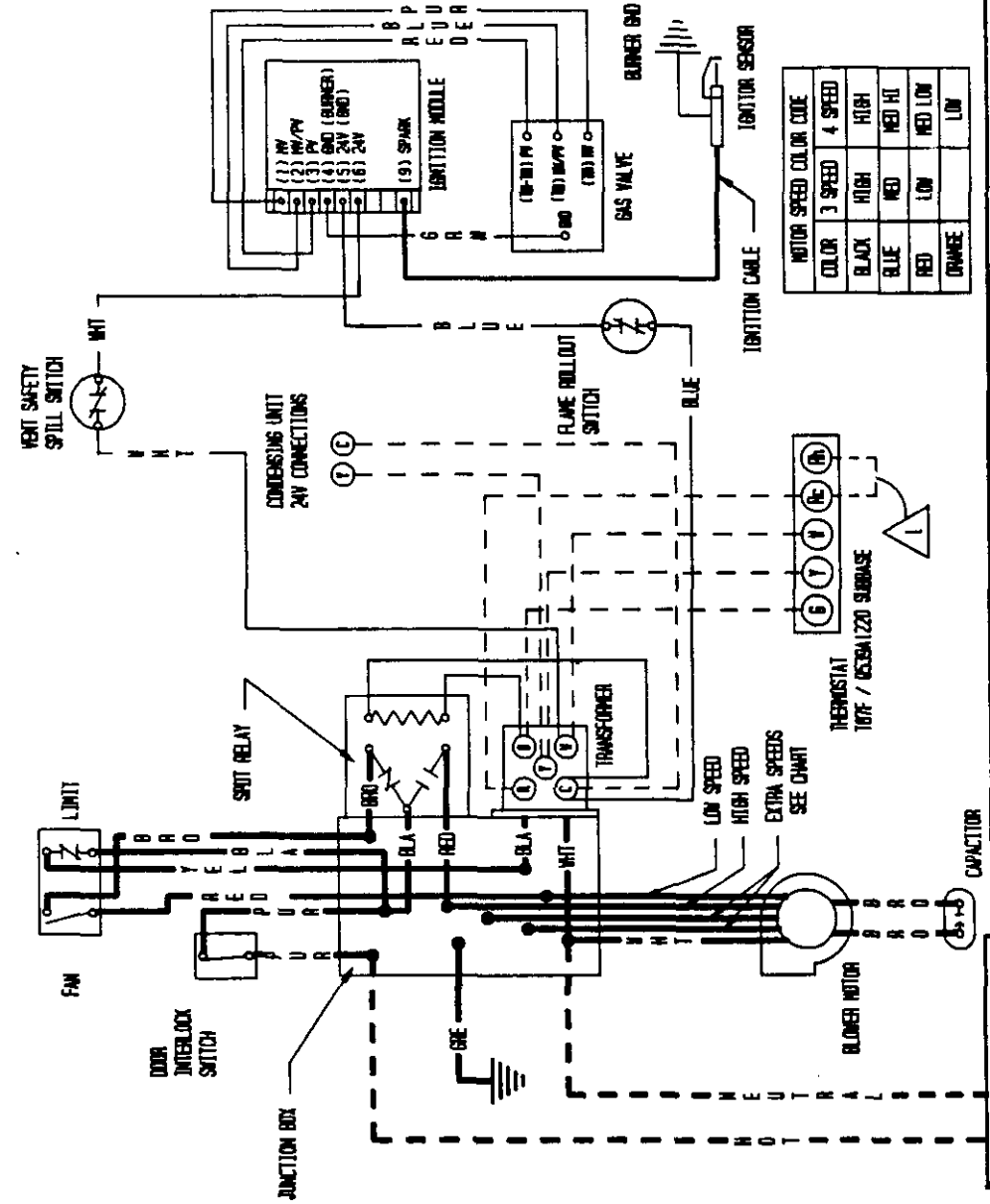


FACTORY WIRING	FIELD WIRING
—————	- - - - -
Low Voltage	High Voltage

115-60-1

CONNECTION DIAGRAM

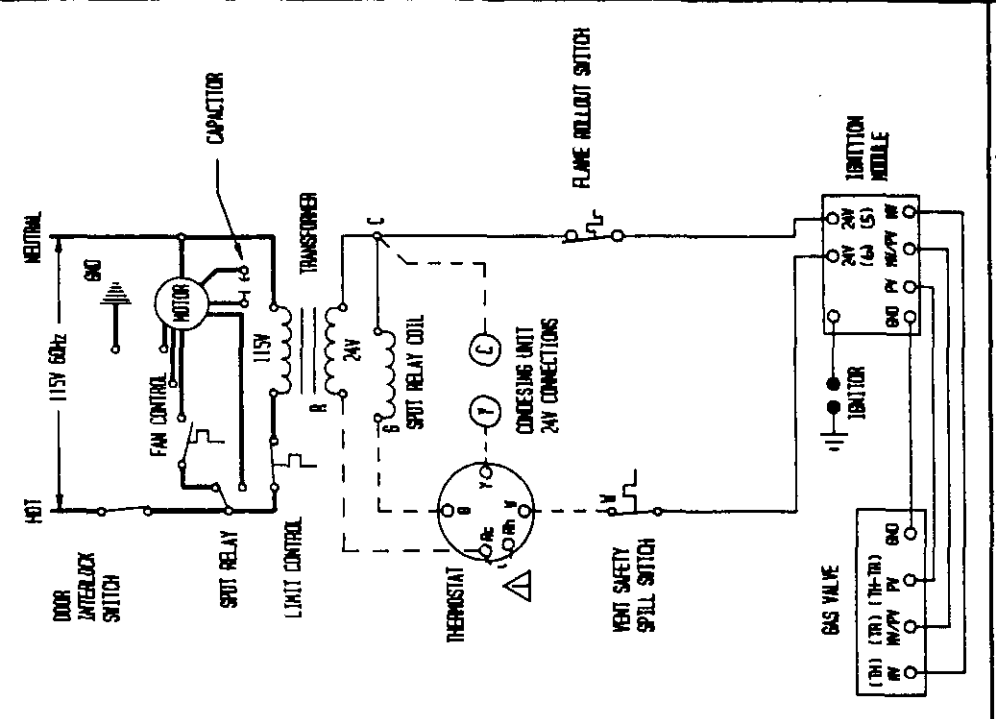
DANGER: ELECTRICAL SHOCK HAZARD.
DISCONNECT POWER BEFORE SERVICING



1 JUMPER R_e - R_H REQUIRED ON 6536A120

115-60-1

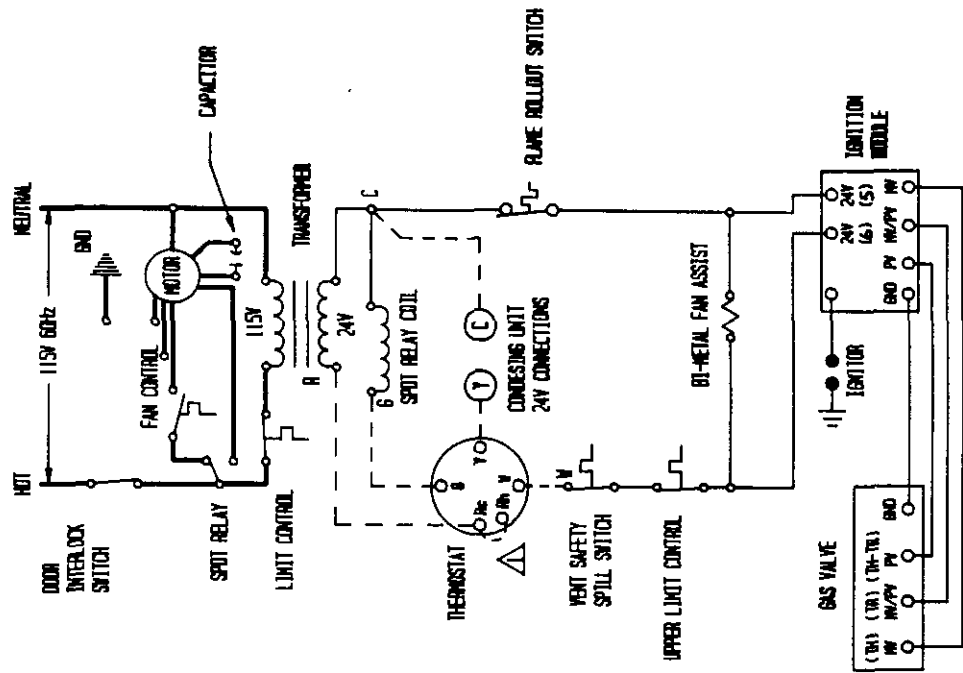
LADDER DIAGRAM



IF ANY OF THE ORIGINAL WIRE AS SUPPLIED WITH THE APPLIANCE MUST BE REPLACED, IT MUST BE REPLACED WITH WIRING MATERIAL HAVING A TEMPERATURE RATING OF AT LEAST 105°C, EXCEPT THE IGNITION CABLE WHICH IS 250°C, HIGH VOLTAGE CABLE.

UPFLON A/C 3 & 4 SPEED MODELS, ELECTRIC IGNITION

LADDER DIAGRAM

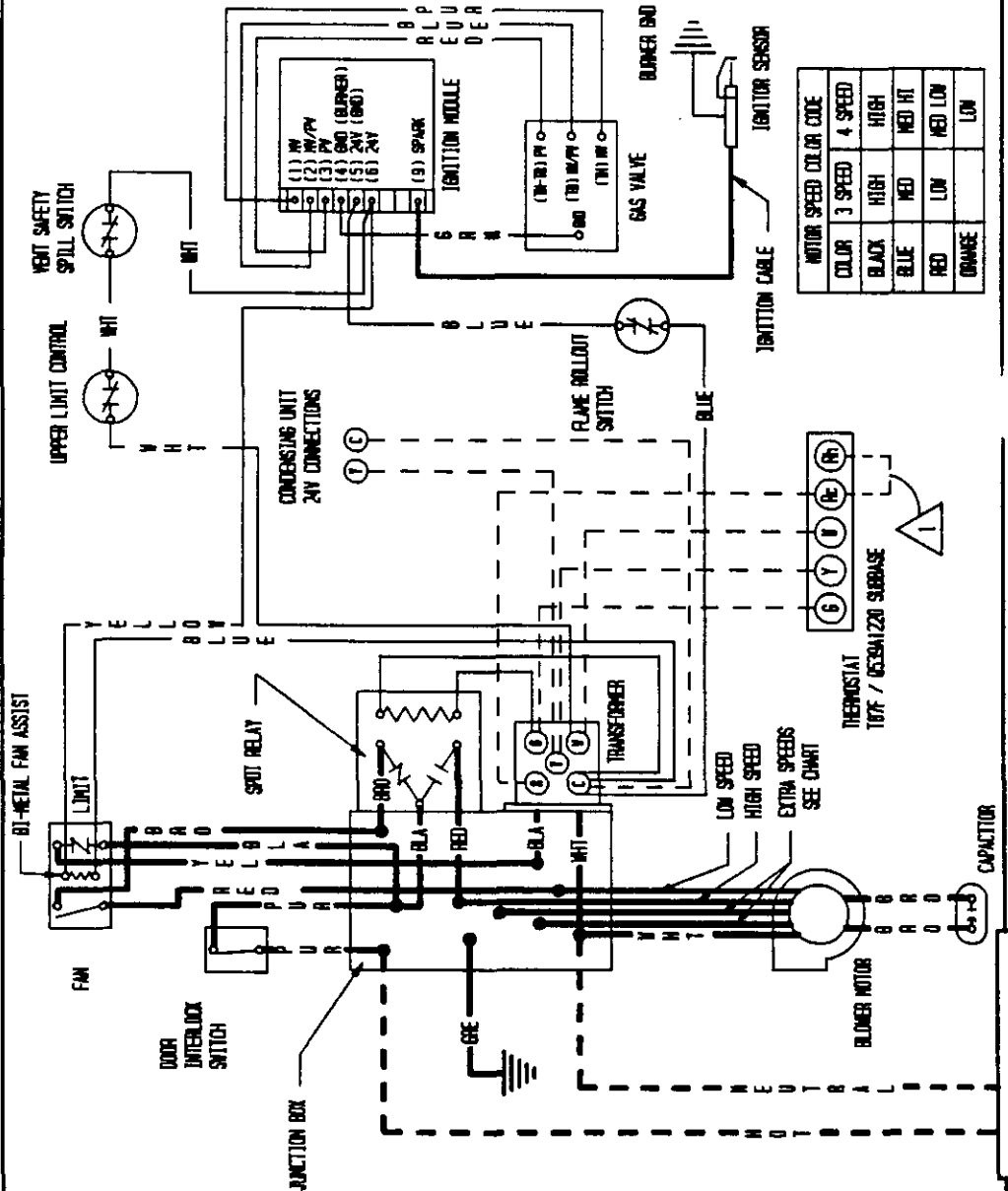


IF ANY OF THE ORIGINAL WIRE AS SUPPLIED WITH THE APPLIANCE MUST BE REPLACED, IT MUST BE REPLACED WITH WIRING MATERIAL HAVING A TEMPERATURE RATING OF AT LEAST 105°C. EXCEPT THE IGNITION CABLE WHICH IS 250°C. HIGH VOLTAGE CABLE.

COUNTERFLOW 4/3 & 4 SPEED MODELS, ELECTRIC IGNITION

4046-117A

CONNECTION DIAGRAM
 DANGER: ELECTRICAL SHOCK HAZARD.
 DISCONNECT POWER BEFORE SERVICING



MOTOR SPEED	COLOR	3 SPEED	4 SPEED
LOW	ORANGE	LOW	LOW
MED LOW	RED	MED LOW	MED LOW
MED HI	BLUE	MED HI	MED HI
HIGH	BLACK	HIGH	HIGH

FACTORY WIRING
 FIELD WIRING

Low Voltage
 High Voltage

1 JUMPER R_c - R_r REQUIRED ON 0633A1220

115-60-1

S86 INTERMITTENT PILOT SYSTEM TROUBLESHOOTING

