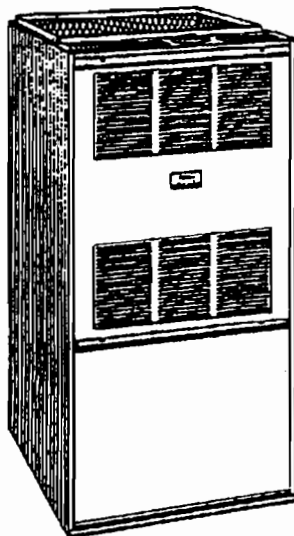
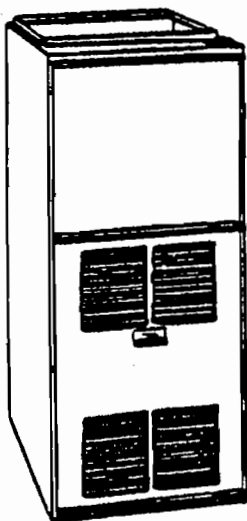
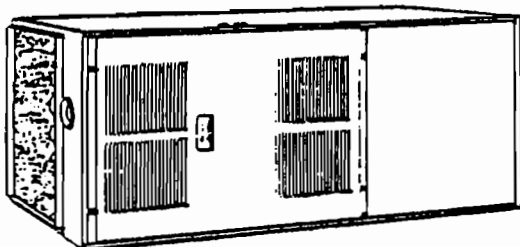


Amana

A **Raytheon** Company



**GUI
GCI
GSI
SERIES
GAS
FURNACE**



SERVICE INSTRUCTIONS

AMANA REFRIGERATION, INC., AMANA, IOWA 52204

**MANUFACTURING NUMBERS
COVERED IN THIS MANUAL**

SEE PAGE 3 OF MANUAL FOR MANUFACTURING NUMBERS.

INDEX

PRODUCT IDENTIFICATION	3 - 8
SPECIFICATIONS	9 - 17
PRODUCT DESIGN	18 - 45
Air for Combustion and Ventilation	23 - 25
Standard Venting	26 - 59
Definintions and Terms	27
Furnace Listings	29
Vent Sizing Examples	29
Masonry Chimneys	34
A. General Information	34
B. Check List Summary	35
Suggested Check-Out Procedure	41
Table 1A Flexible Aluminum Liners	42
Venting Tables for Category I Central Furnaces	43
SYSTEM OPERATION	67 - 71
SCHEDULED MAINTENANCE	72 - 73
POLARIZATION AND PHASING	74 - 75
SERVICING	76 - 91
WIRING DIAGRAMS	92 - 99
TYPICAL SCHEMATICS	100 - 102

REV. 1 - ADDED MODELS TO MANUAL.

REV. 2 - ADDED MODELS TO MANUAL AND DELETED 90 PERCENT FURNACE MODELS FROM MANUAL.

IMPORTANT INFORMATION

Great pride and workmanship go into every Amana product to provide our Customers with the highest possible quality. We realize, however, that during its lifetime the product may require service. The information contained in this manual is intended for use by a qualified Amana service technician who is familiar with the safety procedures required in the repair and who is equipped with the proper tools and testing instruments.



REPAIRS COVERED IN THIS MANUAL THAT ARE MADE BY UNQUALIFIED PERSONS CAN RESULT IN HAZARDS DUE TO IMPROPER ASSEMBLY OR ADJUSTMENTS SUBJECTING INEXPERIENCED PERSONS MAKING SUCH REPAIRS TO THE RISK OF INJURY OR ELECTRICAL SHOCK WHICH CAN BE SERIOUS OR EVEN FATAL.

IMPORTANT NOTE TO CONSUMER



IF YOU PERFORM SERVICE ON YOUR OWN AMANA PRODUCT, YOU MUST ASSUME RESPONSIBILITY FOR ANY PERSONAL INJURY OR PROPERTY DAMAGE WHICH MAY RESULT. AMANA WILL NOT BE RESPONSIBLE FOR ANY INJURY OR PROPERTY DAMAGE ARISING FROM IMPROPER SERVICE AND/OR SERVICE PROCEDURES.

In order to locate an authorized Amana service agency, please consult your telephone book or the dealer from whom you purchased this product. If you require further assistance, please contact:

CUSTOMER RELATIONS DEPT.	OR	1-319-622-5511
AMANA REFRIGERATION, INC.	CALL	and ask for the
AMANA, IOWA 52204		Customer Relations Department

Users of Amana products outside of the United States and Canada should contact:

EXPORT CUSTOMER RELATIONS DEPARTMENT
AMANA REFRIGERATION, INC.
AMANA, IOWA 52204, USA
TELEX: 4330076 AMANA
CABLE: "AMANA", AMANA, IOWA, USA

RECOGNIZE SAFETY SYMBOLS, WORDS AND LABELS

DANGER - Immediate hazards which **WILL** result in severe personal injury or death.



WARNING - Hazards or unsafe practices which **COULD** result in severe personal injury or death.



CAUTION - Hazards or unsafe practices which **COULD** result in minor personal injury or product or property damage.



FORWARD

This manual covers the Gas Furnaces listed below.

The use of this manual will assist the service technician in diagnosing customer complaints when they arise and enable him to perform faster and more efficient service for the customer.

PRODUCT IDENTIFICATION

MODEL NUMBER	MANUFACTURING NUMBER	MODEL NUMBER	MANUFACTURING NUMBER
GUI045B25A	P9898101F	GUI045C25B	P1106401F
GUI070B30A	P9898102F	GUI070C30B	P1106402F
GUI070B40A	P9898103F	GUI070C40B	P1106403F
GUI090B30A	P9898104F	GUI090C30B	P1106404F
GUI090B50A	P9898105F	GUI090C50B	P1106405F
GUI115B35A	P9898106F	GUI115C35B	P1106406F
GUI115B30A	P9898107F	GUI115C50B	P1106407F
GUI140B35A	P9898108F	GUI140C35B	P1106408F
GUI140B50A	P9898109F	GUI140C50B	P1106409F
GCI045B25A	P9898201F	GCI045B25B	P1106501F
GCI070B30A	P9898202F	GCI070B30B	P1106502F
GCI070B40A	P9898203F	GCI070B40B	P1106503F
GCI090B30A	P9898204F	GCI090B30B	P1106504F
GCI090B50A	P9898205F	GCI090B50B	P1106505F
GCI115B35A	P9898206F	GCI115B35B	P1106506F
GCI115B50A	P9898207F	GCI115B50B	P1106507F
GCI140B50A	P9898208F	GCI140B50B	P1106508F
GSi045B25A	P9898301F	GCI045C25B	P1106601F
GSi070B30A	P9898302F	GCI070C30B	P1106602F
GSi070B40A	P9898303F	GCI070C40B	P1106603F
GSi090B30A	P9898304F	GCI090C30B	P1106604F
GSi090B50A	P9898305F	GCI090C50B	P1106605F
GSi115B35A	P9898306F	GCI115C35B	P1106606F
GSi115B50A	P9898307F	GCI115C50B	P1106607F
GSi140B50A	P9898308F	GCI140C50B	P1106608F
GUI045C25A	P9898110F	GSi045B25B	P1106701F
GUI070C30A	P9898111F	GSi070B30B	P1106702F
GUI070C40A	P9898112F	GSi070B40B	P1106703F
GUI090C30A	P9898113F	GSi090B30B	P1106704F
GUI090C50A	P9898114F	GSi090B50B	P1106705F
GUI115C35A	P9898115F	GSi115B35B	P1106706F
GUI115C50A	P9898116F	GSi115B35B	P1106706F
GUI140C35A	P9898117F	GSi115B50B	P1106707F
GUI140C50A	P9898118F	GSi140B50B	P1106708F
GCI045C25A	P9898209F		
GCI070C30A	P9898210F		
GCI070C40A	P9898211F		
GCI090C30A	P9898212F		
GCI090C50A	P9898213F		
GCI115C35A	P9898214F		
GCI115C50A	P9898215F		
GCI140C50A	P9898216F		
GUI045B25B	P1106301F		
GUI070B30B	P1106302F		
GUI070B40B	P1106303F		
GUI090B30B	P1106304F		
GUI090B50B	P1106305F		
GUI115B35B	P1106306F		
GUI115B50B	P1106307F		
GUI140B35B	P1106308F		
GUI140B50B	P1106309F		

3 Tested twice

PRODUCT IDENTIFICATION

The Model rating and Serial, Manufacturing number nameplates are located inside the cabinet, affixed to the side panel on the GUI, GCI, and GSI series units. The plates provide the following information.

MODEL RATING NAMEPLATE

Example: GUI115B35

- G = Gas Furnace Hiboy (upflow)
- U = Upflow, C = Counterflow, S = Horizontal
- I = Induced Draft
- 115 = 115,000 BTUH (input)
- B = U.S. Models Only
C = U.S. and Canada Common Vent Models
- 50 = Maximum Add On Capacity, 50 = 5 Tons
- A = Engineering Modifications
A - Standardized control boxes and ignition controls for 80% and 90% furnaces. Wrinkle bend heat exchanger.
B - Added flame rollout limits.

The remainder of the plate contains the unit voltage characteristics, temperature rise, type of gas, external static pressure, input and bonnet BTUH capacity, minimum clearance for installation purposes and lighting procedures.

SERIAL AND MANUFACTURING NUMBER NAMEPLATE (See Figure 1)

The manufacturing number is used for positive identification of component parts used in manufacturing. At which time engineering and manufacturing changes take place where interchangeability of components are affected, this number will change.

It is very important to use this number at all times when requesting service or parts information.

FOR PARTS AND SERVICE GIVE
MODEL, SERIAL, AND MFG NO.

MODEL	GUI 115B35A
MFG NO.	P9898106F
SERIAL	

Amana

A RAYTHEON COMPANY
AMANA REFRIGERATION INC.
AMANA, IOWA, U.S.A.

AGA

TEMPERATURE RISE FROM
[45] °F TO [75] °F
CATEGORY I FORCED AIR FURNACE
FOR OPERATION AT AN EXTERNAL
STATIC PRESSURE UP TO [50] IN. W.C.

ELECTRIC RATING
115 V, 60 HZ, 1 PH,
[15.6] AMPS MAX

TYPE OF
GAS [NATURAL]

INPUT [115,000] BTU / HR
OUTPUT CAP * [92,000] BTU / HR
* AMANA RATINGS BASED
ON D.O.E. PROCEDURES

DESIGNED MAX OUTLET AIR TEMP [170] °F

FOR CLOSET INSTALLATION WITH MINIMUM CLEARANCES TO COMBUST-
IBLE MATERIAL AS SHOWN BELOW.

Δ RT. SIDE	LF. SIDE	REAR	** FRONT	TOP	Δ FLUE PIPE
1"	1"	0"	6"	1"	6"

FOR TYPE B-1 VENT:
Δ MAY BE 1"

** ALLOW 36" MINIMUM SERVICE CLEARANCE

FOR INSTALLATION ON COMBUSTIBLE FLOORING

NOTE: GCI UNITS ARE FOR INSTALLATION ON NONCOMBUSTIBLE FLOORS ONLY.*

* FOR INSTALLATION ON COMBUSTIBLE FLOORING ONLY WHEN INSTALLED ON
SPECIAL PART NO. []

NAT GAS MAX LINE PRESS 10.0 IN. W.C.
NAT GAS MIN LINE PRESS 5.0 IN. W.C.
NAT GAS MANIFOLD PRESS 3.5 IN. W.C.
LPG GAS MAX LINE PRESS 14.0 IN. W.C.
LPG GAS MIN LINE PRESS 11.0 IN. W.C.
LPG GAS MANIFOLD PRESS 10.0 IN. W.C.

FOR INSTALLATION IN BUILDING
CONSTRUCTED ON SITE. FOR INDOOR
INSTALLATION ONLY.

THIS FURNACE MUST BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURES
INSTRUCTIONS AND LOCAL CODES. IN THE ABSENCE OF LOCAL CODES FOLLOW THE
NATURAL FUEL GAS CODE, ANSI Z223.1.

[] CENTRAL FURNACE

FOR PARTS AND SERVICE GIVE
MODEL, SERIAL, AND MFG NO.

MODEL A
MFG NO. B
SERIAL C



CGA

TEMPERATURE RISE FROM ELECTRIC RATING
D °F TO E °F 115 V, 60 HZ, 1 PH, F AMPS MAX
CATEGORY 1 FORCED AIR FURNACE FOR OPERATION AT AN EXTERNAL
STATIC PRESSURE UP TO G IN. W.C.

INPUT OUTPUT CAP* ORIFICE MANIFOLD PRESS
BTU / HR BTU / HR SIZE IN W.C.

0-2000 FT	J	K	CC	DD
0-4500 FT	EE	FF	GG	HH

* AMANA RATINGS BASED ON D.O.E. PROCEDURES

DESIGNED MAX OUTLET AIR TEMP. L °F TYPE OF GAS H

FOR CLOSET INSTALLATION WITH MINIMUM CLEARANCES TO COMBUST-
IBLE MATERIAL AS SHOWN BELOW.

Δ RT.	LF.	REAR	FRONT	TOP	Δ FLUE
SIDE	SIDE				PIPE
U	V	W	X	Y	Z

FOR TYPE B-1 VENT:

Δ MAY BE 1"

** ALLOW 36" MINIMUM SERVICE CLEARANCE

FOR INSTALLATION ON COMBUSTIBLE FLOORING

NOTE: GCI UNITS ARE FOR INSTALLATION ON NONCOMBUSTIBLE FLOORS ONLY.*

* FOR INSTALLATION ON COMBUSTIBLE FLOORING ONLY WHEN INSTALLED ON
SPECIAL PART NO. AA

FOR INSTALLATION IN BUILDING CONSTRUCTED ON SITE. FOR INDOOR
INSTALLATION ONLY.

NAT GAS MAX LINE PRESS 10.0 IN. W.C.

NAT GAS MIN LINE PRESS 5.0 IN. W.C.

LPG GAS MAX LINE PRESS 14.0 IN. W.C.

LPG GAS MIN LINE PRESS 11.0 IN. W.C.

THIS FURNACE MUST BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURES
INSTRUCTIONS AND LOCAL CODES. IN THE ABSENCE OF LOCAL CODES FOLLOW
CAN/CGA B-149.

FOR PARTS AND SERVICE GIVE
MODEL, SERIAL, AND MFG NO.

MODEL A
MFG NO. B
SERIAL C

ELECTRIC RATING
115 V, 60 HZ, 1 PH,
F AMPS MAX

TYPE DE
GAZ H

DIFFERENCE DE TEMPERATURE: DE D °F A E °F

CHAUDIERE A AIR PULSE DE PREMIERE CATEGORIE

CONDITIONS DE FONCTIONNEMENT: JUSQU'A UNE PRESSION

STATIQUE EXTERIEURE DE G MESUREE EN W.C.

CAPACITE* CAPACITE* PRESS DANZ
D'ALIMENTATION DE DEBIT INJECTEUR LECOLECTEUR

0-2000 FT	J	K	CC	DD
0-4500 FT	EE	FF	GG	HH

* EN UNITES THERMALES BRITANNIQUES/HR

TEMP MAX DE L'AIR A LA SORTIE L °F

INSTALLATION DANS UNE ARMOIRE: LES DISTANCES MIN
JUSQU' AUX MATIERES INFLAMMABLES:

Δ COTE	COTE	ARRIERE	AVANT	HALUT	Δ CONDUITE
DROIT	GAUCHE				D'EGARPPEMENT
U	V	W	X	Y	Z

POUR PRISE D'AIR TYPE "B-1"

Δ MAY BE 1"

** ACCORDER UN ESPACE D'AU
MOINS UN METRE POUR LE
DEPANNAGE

POUR L'INSTALLATION SUR SOL INFLAMMABLE

NOTE: GCI UNITS ARE FOR INSTALLATION ON NONCOMBUSTIBLE FLOORS
ONLY.* * FOR INSTALLATION ON COMBUSTIBLE FLOORING ONLY WHEN

INSTALLED ON SPECIAL PART NO. AA

A INSTALLER SEULEMENT DANS LES BATIMENTS NON
-PREFABRIQUES. A UTILISER SEULEMENT A L'INTERIEUR.

PRESS MAX DU GAZ NAT DANS LE TUYAU 10.0 IN. W.C.

PRESS MIN DU GAZ NAT DANS LE TUYAU 5.0 IN. W.C.

PRESS MAX DU GAZ LIO DANS LE TUYAU 14.0 IN. W.C.

PRESS MIN DU GAZ LIO DANS LE TUYAU 11.0 IN. W.C.

CETTE CHAUDIERE A AIR PULSE DOIT ETRE INSTALLEE
CONFORMEMENT AUX SPECIFICATIONS DU FABRICANT ET CELLES
DES CODES EN VIGUEUR AU LIEU DE L'INSTALLATION. EN ABSENCE
DES CODES LOCAUX SUIVRE CAN/CGA B-149.

RATING PLATE "C" MODELS

A - GHI115B35C
B - P6983115F
C - (Blank)
D - 40
E - 70
F - 15.6
G - .50
H - Natural
J - 115,000

K - 92,000
L - 170
U - 1"
V - 1"
W - 0"
X - 6"
Y - 1"
Z - 6"

AA - (Blank)
BB - ANS221.47A - 1985

FOR PARTS AND SERVICE GIVE MODEL, SERIAL, AND MFG NO.

MODEL GUL115B35A
MFG NO. P9898106F
SERIAL



AGA

TEMPERATURE RISE FROM °F TO °F

115 V, 60 HZ, 1 PH, 15.6 AMPS MAX
CATEGORY FORCED AIR FURNACE FOR OPERATION AT AN
EXTERNAL STATIC PRESSURE UP TO IN. W.C.

DESIGNED MAX OUTLET AIR TEMP. °F TYPE OF GAS NATURAL
INPUT BTUH 115,000 OUTPUT CAP. 92,000 MAN PRESS. IN W.C. 3.5

FOR CANADIAN INSTALLATIONS: AMANA RATINGS BASED ON D.O.E. PROCEDURES

INPUT BTUH OUTPUT CAP ORIFICE MAN PRESS. IN W.C.

0-2000 FT	115,000	90,850	44	4.2
0-4500 FT	103,500	81,760	44	3.5

FOR CLOSET INSTALLATION WITH MINIMUM CLEARANCES TO COMBUSTIBLE MATERIAL AS SHOWN BELOW.

FOR TYPE B-1 VENT,
Δ MAY BE 1"

** ALLOW 36" MINIMUM
SERVICE CLEARANCE

Δ RT.	LF.	REAR	FRONT	TOP	Δ FLE
1"	1"	0"	6"	1"	6"

FOR INSTALLATION ON COMBUSTIBLE FLOORING

NOTE: GC UNITS ARE FOR INSTALLATION ON NONCOMBUSTIBLE FLOORS ONLY *
* FOR INSTALLATION ON COMBUSTIBLE FLOORING ONLY WHEN INSTALLED ON
SPECIAL PART NO.

NAT GAS MAX LINE PRESS 10.0 IN. W.C. FOR INSTALLATION IN BUILDING
NAT GAS MIN LINE PRESS 5.0 IN. W.C. Δ CONSTRUCTED ON SITE. FOR INDOOR
LPG GAS MAX LINE PRESS 14.0 IN. W.C. INSTALLATION ONLY.
LPG GAS MIN LINE PRESS 11.0 IN. W.C. Δ

Δ FOR PURPOSES OF INPUT ADJUSTMENT

THIS FURNACE MUST BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S
INSTRUCTIONS AND LOCAL CODES. IN THE ABSENCE OF LOCAL CODES FOLLOW
THE NATIONAL GAS FUEL CODE ANSI Z223.1-1987 OR NATIONAL STANDARDS
OF CANADA CAN/CGA-B149-1.

ANSI Z21.47-1987 CENTRAL FURNACE

TYPE DE

GAZ NATURAL
70 °F

DIFFERENCE DE TEMPERATURE: DE 40 °F A 70 °F
TYPE DE GENERATEUR D'AIR CHAUD CIRCULATION FORCEE
JUSQU'A UNE PRESSION

STATIQUE EXTERIEURE DE .50 MESUREE EN W.C.

CAPACITE* CAPACITE* PRESS DANZ
D'ALIMENTATION DE DEBIT INJECTEUR LECOLECTEUR

0-2000 FT	115,000	90,850	44	4.2
0-4500 FT	103,500	81,760	44	3.5

* EN UNITES THERMALES BRITANNIQUES/HR

TEMP MAX DE L'AIR A LA SORTIE 170 °F

POUR INSTALLATION DANS PLACARDS. LES DISTANCES MIN

JUSQU'AUX MATIERES INFLAMMABLES:

Δ COTE DROIT	COTE GAUCHE	ARRIERE	AVANT	HAUT	Δ CONDUITE D'ECHAPPEMENT**
1"	1"	0"	6"	1"	6"

POUR PRISE D'AIR
TYPE "B-1" Δ MAY BE 1"
ACCORDER UN ESPACE D'AU
MOINS UN METRE POUR LE
DEPANNAGE

POUR L'INSTALLATION SUR SOL INFLAMMABLE

NOTE: GC UNITS ARE FOR INSTALLATION ON NONCOMBUSTIBLE FLOORS
ONLY * * FOR INSTALLATION ON COMBUSTIBLE FLOORING ONLY WHEN
INSTALLED ON SPECIAL PART NO.

A INSTALLER SEULEMENT DANS LES BATIMENTS NON

-PREFABRIQUES. A UTILISER SEULEMENT A L'INTERIEUR

PRESS MAX DU GAZ NAT DANS LE TUYAU 10.0 IN. W.C.

PRESS MIN DU GAZ NAT DANS LE TUYAU 5.0 IN. W.C.

PRESS MAX DU GAZ LIQ DANS LE TUYAU 14.0 IN. W.C.

PRESS MIN DU GAZ LIQ DANS LE TUYAU 11.0 IN. W.C.

CEtte CHAUDIERE A AIR PULSE DOIT ETRE INSTALLEE

CONFORMEMENT AUX SPECIFICATIONS DU FABRICANT ET CELLES

DES CODES EN VIGUEUR AU LIEU DE L'INSTALLATION. EN ABSENCE

DES CODES LOCAUX SUIVRE CAN/CGA B-149.

PRODUCT IDENTIFICATION

FOR YOUR SAFETY READ BEFORE OPERATING



IF YOU DO NOT FOLLOW THESE INSTRUCTIONS EXACTLY, FIRE OR EXPLOSION MAY RESULT WITH PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.

- A. This appliance does not have a pilot. It is equipped with an ignition device which automatically lights the burner. **DO NOT** try to light the burner by hand.
- B. **BEFORE OPERATING** smell all around the appliance area for gas. Be sure to smell next the floor because some gas is heavier than air and will settle on the floor.

WHAT TO DO IF YOU SMELL GAS INDOORS:

If the odor is **FAINT**:

- Open windows and doors.
- Call your gas company immediately.

If the odor is **STRONG**:

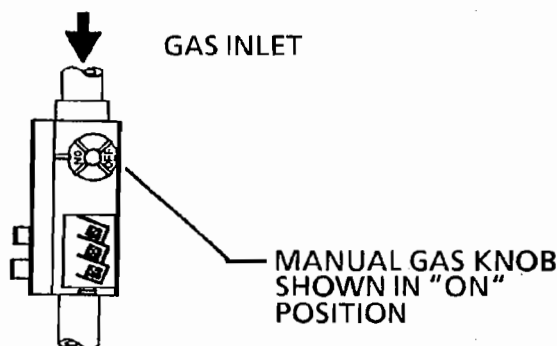
- Do not try to light.
- Do not touch any electric switch, do not use the phone.
- Leave the building immediately, then call your gas company.
- If you cannot reach the gas company, call the fire department.

- C. Use only your hand to push in or turn the gas control knob. Never use tools. If the knob will not push in or turn by hand, don't try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion.
- D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.

OPERATING INSTRUCTIONS

1. **STOP!** Read the safety information above on this label.
2. Set the thermostat to lowest setting.
3. Turn off all electric power to the appliance.

4. This appliance is equipped with an ignition device which automatically lights the burner. Do **NOT** try to light the burner by hand.
5. Turn the gas control knob clockwise to "OFF" position. Do not force.



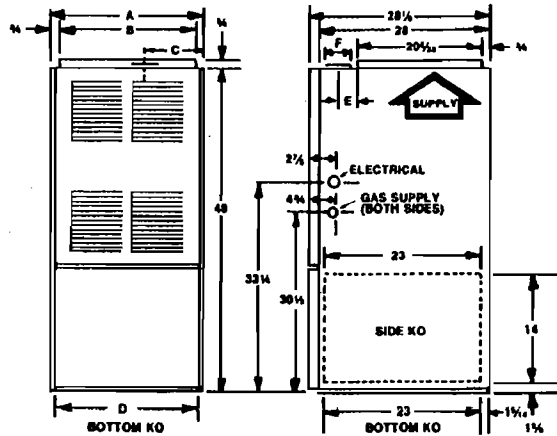
6. Wait five (5) minutes to clear out any gas. If you then smell gas, **STOP!** Follow "B" in the safety information above on this label. If you don't smell gas, go to next step.
7. Turn gas control knob counterclockwise to "ON".
8. Replace control access panel.
9. Turn on all electric power to the appliance.
10. Set thermostat to desired setting.
11. If the appliance will not operate, follow the instructions "To Turn OFF Appliance" and call your service technician or gas company.

TO TURN OFF APPLIANCE

1. Set the thermostat to lowest setting.
2. Turn off all electric power to the appliance if service is to be performed.
3. Turn the gas control knob clockwise to "OFF" position. Do not force.
4. Replace control access panel.

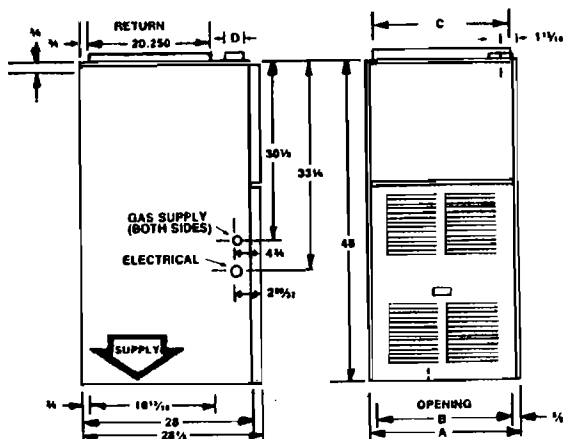
INDUCED DRAFT GAS FURNACE SPECIFICATIONS

UPFLOW



	A	B	C	D	E	F
GUI045	16 1/2	15	6 1/8	10 1/2	2 5/16	3
GUI070	16 1/2	15	6 1/8	10 1/2	2 5/16	3
GUI090	20 1/2	19	8 1/8	14 1/2	2 5/16	3
GUI115	24 1/2	23	10 1/8	18 1/2	2 13/16	4
GUI140	24 1/2	23	10 1/8	18 1/2	2 13/16	4

COUNTERFLOW



	A	B	C	D
GCI045C	16 1/2	15 1/4	14 15/16	3
GCI070C	16 1/2	15 1/4	14 15/16	3
GCI090C	20 1/2	19 1/4	18 15/16	3
GCI115C	24 1/2	23 1/4	22 15/16	4*
GCI140C	24 1/2	23 1/4	22 15/16	4*

*Requires 3" - 4" adapter supplied with furnace.

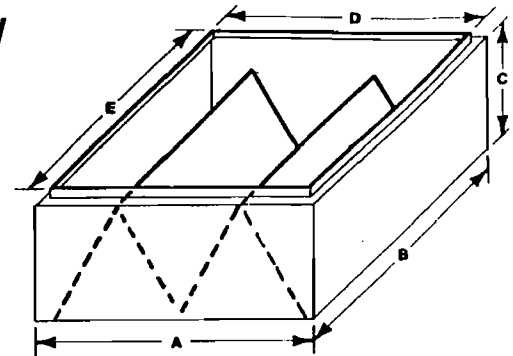
Specifications subject to change without notice.



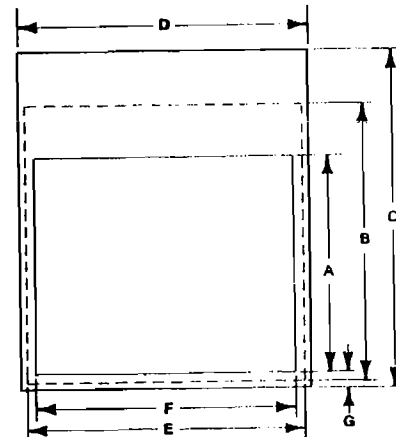
Amana Forced Air Central Furnace Design Complies with Requirements Embodied in the American National Standard Shown Below.
ANSI Z21.47 Central Furnaces

NOTES:

- All furnaces have a redundant gas valve and blower door interlock 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 and 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.



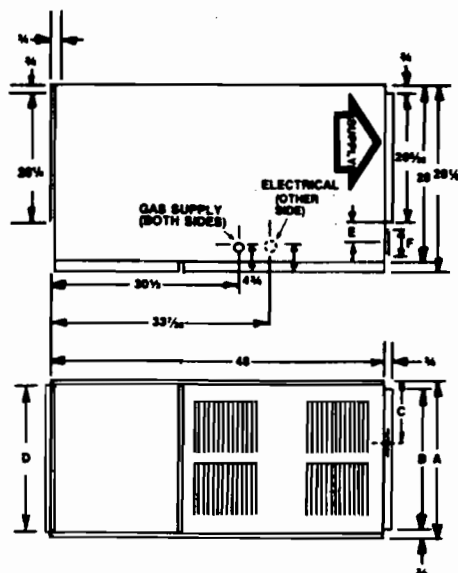
Filter Kit Part No.	Used on Models	Dimensions, Inches				
		A	B	C	D	E
CFC16	GCI045,070	15 1/8	20 1/2	9 1/2	13 5/8	18 15/16
CFC20	GCI090C30	19 1/8	20 1/2	9 1/2	17 5/8	18 15/16
CFC24	GCI115,140	23 1/8	20 1/2	9 1/2	21 5/8	18 15/16
CFC20D	GCI90C50	19 1/8	20 1/2	9 1/2	17 5/8	18 15/16



Subbase Part No.18 9/16	Used on Models	Dimensions, Inches						
		A	B	C	D	E	F	E
CFSB16	GCI045,070	18 9/16	23 3/4	29	17 1/2	16 1/2	15	1 11/32
CFCB20	GCI090	18 9/16	23 3/4	29	21 1/2	20 1/2	19	1 11/32
CFSB24	GCI115,140	18 9/16	23 3/4	29	25 1/2	24 1/2	23	1 11/32

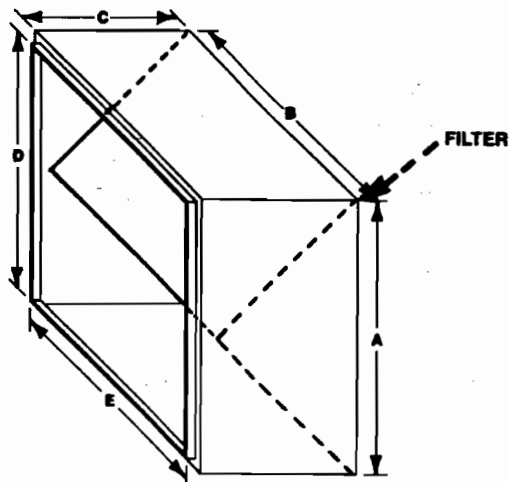
INDUCED DRAFT GAS FURNACE SPECIFICATIONS

HORIZONTAL or ALCOVE-UPFLOW



Top or Bottom View

Front View



	A	B	C	D	E	F
GSI045	16 1/2	15	6 1/8	14 15/16	2 5/16	3
GSI070	16 1/2	15	6 1/8	14 15/16	2 5/16	3
GSI115	24 1/2	23	10 1/8	22 15/16	2 13/16	4
GSI140	24 1/2	23	10 1/8	22 15/16	2 13/16	4

Horizontal furnaces can be installed as shown or with the flue exiting the left side of the unit. This furnace may also be used in the upflow position in alcove only installations.

Horizontal Filter Cabinets

Filter Kit Part No.	Used on Models	Dimensions, Inches				
		A	B	C	D	E
HFC16	GSI045,070	15 1/8	20 3/8	13 1/4	13 5/8	18 15/16
HFC20	GSI090	19 1/8	20 3/8	13 1/4	17 5/8	18 15/16
HCF24	GSI115,140	23 1/8	20 3/8	13 1/4	21 5/8	18 15/16

NOTES:

1. All furnaces have a redundant gas valve and blower door interlock switch.
2. All furnaces are manufactured for use on 120V, 60 Hertz and single phase electrical power supply.
3. **Important:** While the data is presented as a guide it is very important to electrically connect the unit and properly size fuses and wires in accordance with the National Electrical Code and/or all existing local codes.
4. Performance figures are based on Department of Energy information and requirements under continuous operating conditions. Performance will vary with weather conditions and use.

Specifications subject to change without notice



Amana Forced Air Central Furnace Design Complies with Requirements Embodied in the American National Standard Shown Below
ANSI Z21.47 Central Furnaces

FURNACE SPECIFICATIONS

MODEL	GUI045B25 GUI045C25 A/B	GUI070B30 GUI070C30 A/B	GUI070B40 GUI070C40 A/B	GUI090B30 GUI090C30 A/B	GUI090B50 GUI090C50 A/B	GUI115B35 GUI115C35 A/B	GUI115B50 GUI115C50 A/B	GUI140B35 GUI140C35 A/B	GUI140B50 GUI140C50 A/B
BTUH INPUT US	45000	70000	70000	90000	90000	115000	115000	140000	140000
OUTPUT US	36000	55000	55000	71000	71000	91000	90000	110000	111000
INPUT CAN	45000	70000	70000	90000	90000	115000	115000	140000	140000
OUTPUT CAN	36000	55300	55300	70200	70200	90850	90850	111300	111300
HIGH ALT INPUT CAN	40500	63000	63000	71000	81000	103500	103500	126000	126000
OUTPUT CAN	32400	49770	49770	63180	63180	81760	81760	100170	100170
RATED EXT. STATIC WC*	2-.5	2-.5	2-.5	2-.5	2-.5	2-.5	2-.5	2-.5	2-.5
TEMPERATURE RISE	35-65	35-65	35-65	45-75	35-65	40-70	45-75	45-75	45-75
BLOWER WHEEL D x W	9 x 8	10 x 8	10 x 8	10 x 8	10 x 10	10 x 10	10 x 10	10 x 10	10 x 10
BLOWER HORSEPOWER	1/3	1/3	1/2	1/3	3/4	1/2	3/4	3/4	3/4
BLOWER SPEEDS	3	4	4	4	4	4	3	4	3
FULL LOAD AMPS	10.1	13.6	15.6	13.6	17.7	15.6	17.2	15.6	17.2
TRANSFORMER VA	40	40	40	40	40	40	40	40	40
ANTICIPATOR SETTING	.8	.8	.8	.8	.8	.8	.8	.8	.8
LIMIT SETTING	230	200	200	200	200	200	200	200	200
AUX. LIMIT SETTING									
VENT SAFETY SW. (C/CV)	250	250	250	250	250	250	275	275	275
FAN SW. SETTING ON	125	125	125	125	125	125	125	125	125
OFF	110	110	110	110	110	110	110	110	110
GAS SUPPLY PRESS NAT/LP	7" / 11"	7" / 11"	7" / 11"	7" / 11"	7" / 11"	7" / 11"	7" / 11"	7" / 11"	7" / 11"
MANIFOLD PRESS NAT/LP	3.5" / 10"	3.5" / 10"	3.5" / 10"	3.5" / 10"	3.5" / 10"	3.5" / 10"	3.5" / 10"	3.5" / 10"	3.5" / 10"
ORIFICE SIZE NAT/LP	#43 / #54	#43 / #54	#43 / #54	#43 / #54	#43 / #54	#43 / #54	#43 / #54	#43 / #54	#43 / #54
NUMBER OF BURNERS	2	3	3	4	4	5	5	6	6
FILTER SIZE	16 x 25 x 1	16 x 25 x 1	16 x 25 x 1	16 x 25 x 1	16 x 25 x 1	16 x 25 x 1	16 x 25 x 1	16 x 25 x 1	16 x 25 x 1
NUMBER OF FILTERS	1	1	2	1	2	1	2	1	2
NET WEIGHT*	132	148	148	160	160	178	178	186	188

SEE NOTES PAGE 13

FURNACE SPECIFICATIONS

MODEL	GCI045B25 GCI045C25 A/B	GCI070B30 GCI070C30 A/B	GCI070B40 GCI070C40 A/B	GCI090B30 GCI090C30 A/B	GCI090B50 GCI090C50 A/B	GCI115B35 GCI115C35 A/B	GCI115B50 GCI115C50 A/B	GCI140B50 GCI140C50 A/B
BTUH INPUT US	45000	70000	70000	90000	90000	115000	115000	140000
OUTPUT US	36000	56000	56000	72000	72000	92000	92000	112000
INPUT CAN	45000	70000	70000	90000	90000	115000	115000	140000
OUTPUT CAN	37350	58100	58100	74700	74700	95450	95450	116200
HIGH ALT INPUT CAN	40500	63000	63000	81000	81000	103500	103500	126000
OUTPUT CAN	33610	52290	52290	67230	67230	85900	85900	104580
RATED EXT. STATIC WC"	2 - .5	2 - .5	2 - .5	2 - .5	2 - .5	2 - .5	2 - .5	2 - .5
TEMPERATURE RISE	35-65	35-65	35-65	45-75	35-65	40-70	45-75	45-75
BLOWER WHEEL D x W	9 x 8	10 x 8	11 x 8	10 x 8	11 x 10	10 x 10	11 x 10	11 x 10
BLOWER HORSEPOWER	1/4	1/3	1/2	1/3	3/4	1/2	3/4	3-4
BLOWER SPEEDS	3	4	3	4	4	4	4	4
FULL LOAD AMPS	10.1	13.8	14.7	13.8	17.4	14.9	17.4	17.4
TRANSFORMER VA	40	40	40	40	40	40	40	40
ANTICIPATOR SETTING	.8	.8	.8	.8	.8	.8	.8	.8
LIMIT SETTING	250	200	200	180	250	200	200	200
AUX. LIMIT SETTING	160	160	160	160	160	160	160	160
VENT SAFETY SW (C/CV)	200	225	250	250	250	200	200	225
FAN SW. SETTING ON	125	125	125	125	125	125	125	125
OFF	110	110	110	110	110	110	110	110
GAS SUPPLY PRESS NAT/LP	7" / 11"	7" / 11"	7" / 11"	7" / 11"	7" / 11"	7" / 11"	7" / 11"	7" / 11"
MANIFOLD PRESS NAT/LP	3.5" / 10"	3.5" / 10"	3.5" / 10"	3.5" / 10"	3.5" / 10"	3.5" / 10"	3.5" / 10"	3.5" / 10"
ORIFICE SIZE NAT/LP	#43 / #54	#43 / #54	#43 / #54	#43 / #54	#43 / #54	#43 / #54	#43 / #54	#43 / #54
NUMBER OF BURNERS	2	3	3	4	4	5	5	6
NET WEIGHT	131	147	147	159	159	177	177	206

SEE NOTES PAGE 13

FURNACE SPECIFICATIONS

MODEL	GS1045B25 A/B	GS1070B30 A/B	GS1070B40 A/B	GS1090B30 A/B	GS1090B50 A/B	GS115B35 A/B	GS115B50 A/B	GS1140B50 A/B
BTUH INPUT US	45000	70000	70000	90000	90000	115000	115000	140000
OUTPUT US	37000	55000	55000	72000	71000	92000	91000	111000
RATED EXT. STATIC WC*	.2 - .5	.2 - .5	.2 - .5	.2 - .5	.2 - .5	.2 - .5	.2 - .5	.2 - .5
TEMPERATURE RISE	35-65	35-65	35-55	45-75	35-65	40-70	45-75	45-75
BLOWER WHEEL D x W	9 x 8	10 x 8	11 x 8	10 x 8	11 x 10	10 x 10	11 x 10	11 x 10
BLOWER HORSEPOWER	1/4	1/3	1/2	1/3	3/4	1/2	3/4	3/4
BLOWER SPEEDS	3	4	3	4	4	4	4	4
FULL LOAD AMPS	10.1	13.8	14.7	13.8	17.4	14.9	17.4	17.4
TRANSFORMER VA	40	40	40	40	40	40	40	40
ANTICIPATOR SETTING	.8	.8	.8	.8	.8	.8	.8	.8
LIMIT SETTING	230	200	200	180	230	200	250	200
AUX. LIMIT SETTING	160	160	160	160	160	160	160	160
FAN SW. SETTING ON	125	125	125	125	125	125	125	125
OFF	110	110	110	110	110	110	110	110
GAS SUPPLY PRESS NAT/LP	7" / 11"	7" / 11"	7" / 11"	7" / 11"	7" / 11"	7" / 11"	7" / 11"	7" / 11"
MANIFOLD PRESS NAT/LP	3.5" / 10"	3.5" / 10"	3.5" / 10"	3.5" / 10"	3.5" / 10"	3.5" / 10"	3.5" / 10"	3.5" / 10"
ORIFICE SIZE NAT/LP	#43 / #54	#43 / #54	#43 / #54	#43 / #54	#43 / #54	#43 / #54	#43 / #54	#43 / #54
NUMBER OF BURNERS	2	3	3	4	4	5	5	6
NET WEIGHT	132	147	147	159	159	177	177	187

- 1 These furnaces are manufactured for natural gas operation. Optional LP conversion kits are available to convert to propane gas.
- 2 For elevations above 2000 ft. the rating should be reduced by 4% for each 1000 ft. above sea level. The furnace must not be derated, orifice changes should only be made if necessary for altitude.
- 3 The total heat loss from the structure as expressed in TOTAL BTU/HR must be calculated by the manufacturers method or in accordance with the "A.S.H.R.A.E. GUIDE" or "MANUAL J-LOAD CALCULATIONS" published by the AIR CONDITIONING CONTRACTORS OF AMERICA. The total heat loss calculated should be equal to or less than the heating capacity. Output based on D.O.E. test procedures, steady state efficiency times input.
- 4 Maximum full load amps include 5 amps drawn by the ignitor during 45 second preheat cycle.

BLOWER PERFORMANCE SPECIFICATIONS

MODEL	MOTOR SPEED TAP	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
GUI045B25A/B GUI045C25A/B	LOW	690	48	675	49	660	51	640	52	590	54	530	60	450	-
	MED	965	-	950	-	915	36	875	38	820	39	760	42	675	47
	HI	1240	-	1170	-	1100	-	1050	-	950	-	870	37	780	41
GUI070B30A/B GUI070C30A/B	LOW	725	-	720	-	700	-	675	-	580	-	515	-	420	-
	MED-LO	935	55	920	56	900	58	865	60	820	61	770	-	690	-
	MED	1190	44	1150	45	1115	47	1065	49	1010	49	945	53	860	58
GUI070B40A/B GUI070C40A/B	LOW	1135	46	1135	46	1130	46	1125	46	1095	46	1070	47	1035	48
	MED-LO	1340	39	1335	39	1325	39	1300	40	1270	39	1235	40	1180	42
	MED	1570	-	1560	-	1525	-	1485	-	1450	-	1400	36	1330	37
GUI090B30A/B GUI090C30A/B	LOW	850	-	830	-	800	-	775	-	730	-	680	-	610	-
	MED-LO	910	73	900	74	870	-	840	-	800	-	750	-	690	-
	MED	1120	60	1080	62	1050	63	1010	66	960	67	900	72	820	-
GUI090B50A/B GUI090C50A/B	LOW	1230	54	1220	55	1210	55	1200	56	1170	55	1135	57	1090	59
	MED-LO	1530	44	1525	44	1520	44	1515	44	1485	44	1455	44	1410	46
	MED	1770	38	1770	38	1755	38	1725	39	1700	38	1660	39	1600	40
GUI115B35A/B GUI115C35A/B	LOW	1180	-	1175	-	1150	-	1125	-	1090	-	1050	-	995	-
	MED-LO	1410	60	1400	61	1375	62	1350	63	1310	64	1265	66	1200	69
	MED	1655	51	1645	52	1620	53	1575	54	1480	56	1410	59	1310	64
GUI115B50A/B GUI115C50A/B	LOW	2000	43	1950	44	1875	45	1800	47	1725	48	1630	51	1520	55
	LOW	1530	56	1520	56	1500	57	1475	58	1430	58	1370	61	1280	65
	MED	1730	49	1720	50	1700	50	1675	51	1620	51	1560	53	1470	57
GUI115B50A/B GUI115C50A/B	LOW	2375	-	2275	-	2200	-	2125	-	2030	-	1920	-	1760	47
	LOW	1160	-	1150	-	1135	-	1125	-	1090	-	1040	-	980	-
	MED-LO	1330	-	1315	-	1295	-	1275	-	1230	-	1175	-	1100	-
GUI140B50A/B GUI140C50A/B	LOW	1585	65	1560	66	1525	68	1475	70	1425	71	1340	-	1230	-
	MED	1930	54	1875	55	1835	57	1750	59	1680	60	1600	63	1480	68
	LOW	1490	70	1470	71	1450	72	1425	73	1380	73	1330	-	1260	-
GUI140B50A/B GUI140C50A/B	MED	1660	62	1650	63	1635	63	1625	64	1590	64	1550	65	1490	68
	HI	2290	-	2230	47	2130	49	2050	51	1960	52	1850	55	1700	59

BLOWER PERFORMANCE SPECIFICATIONS

- 1 CFM in 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 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 allowed 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.

BLOWER PERFORMANCE SPECIFICATIONS

MODEL	MOTOR SPEED TAP	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
GCI045B25A/B	LOW	730	46	730	46	700	48	675	49	610	53	535	60	390	-
GCI045C25A/B	MED	915	36	900	37	870	38	825	40	760	43	680	48	500	-
	HI	1220	-	1160	-	1090	-	1015	-	930	-	825	39	680	48
GCI070B30A/B	LOW	740	-	730	-	700	-	675	-	610	-	540	-	430	-
GCI070C30A/B	MED-LO	970	53	950	55	920	56	890	58	840	59	770	-	670	-
	MED	1265	41	1220	43	1175	44	1125	46	1050	47	970	51	835	60
	HI	1530	-	1465	-	1400	37	1330	39	1240	40	1155	43	1030	48
GCI070B40A/B	LOW	1050	49	1040	50	1025	51	1000	52	970	51	925	54	860	58
GCI070C40A/B	MED	1525	-	1490	35	1455	36	1410	37	1350	37	1280	39	1170	43
	HI	1845	-	1790	-	1715	-	1660	-	1580	-	1490	-	1350	37
GCI090B30A/B	LOW	740	-	730	-	700	-	675	-	620	-	560	-	460	-
GCI090C30A/B	MED-LO	960	69	940	71	900	74	865	-	815	-	750	-	660	-
	MED	1220	55	1170	57	1120	60	1065	63	1000	65	910	72	800	-
	HI	1420	47	1350	49	1285	52	1225	54	1140	57	1040	63	900	72
GCI090B50A/B	LOW	1525	44	1475	45	1400	48	1350	49	1270	51	1180	55	1035	63
GCI090C50A/B	MED-LO	1745	38	1690	39	1625	41	1565	43	1490	44	1400	46	1270	51
	MED	1955	-	1900	-	1820	37	1760	38	1680	39	1580	41	1430	45
	HI	2210	-	2150	-	2070	-	2000	-	1910	-	1810	36	1650	39
GCI115B35A/B	LOW	1060	-	1050	-	1040	-	1000	-	955	-	880	-	790	-
GCI115C35A/B	MED-LO	1260	68	1250	68	1220	-	1200	-	1145	-	1080	-	990	-
	MED	1580	54	1560	55	1510	56	1460	58	1395	60	1300	64	1150	-
	HI	1920	44	1835	46	1760	48	1670	51	1570	53	1460	57	1320	63
GCI115B50A/B	LOW	1380	62	1360	63	1335	64	1300	66	1250	67	1180	71	1080	-
GCI115C50A/B	MED-LO	1610	53	1570	54	1540	55	1490	57	1425	59	1340	63	1200	70
	MED	1890	-	1860	46	1800	47	1750	49	1680	50	1600	52	1480	57
	HI	2260	-	2200	-	2125	-	2050	-	1950	-	1850	-	1710	49
GCI140B50A/B	LOW	1315	-	1280	-	1240	-	1200	-	1140	-	1060	-	950	-
GCI140C50A/B	MED-LO	1560	66	1515	68	1475	70	1425	73	1360	-	1260	-	1090	-
	MED	1815	57	1770	59	1715	60	1660	62	1580	64	1475	69	1300	-
	HI	2340	-	2265	46	2200	47	2100	49	1995	51	1860	55	1620	63

BLOWER PERFORMANCE SPECIFICATIONS

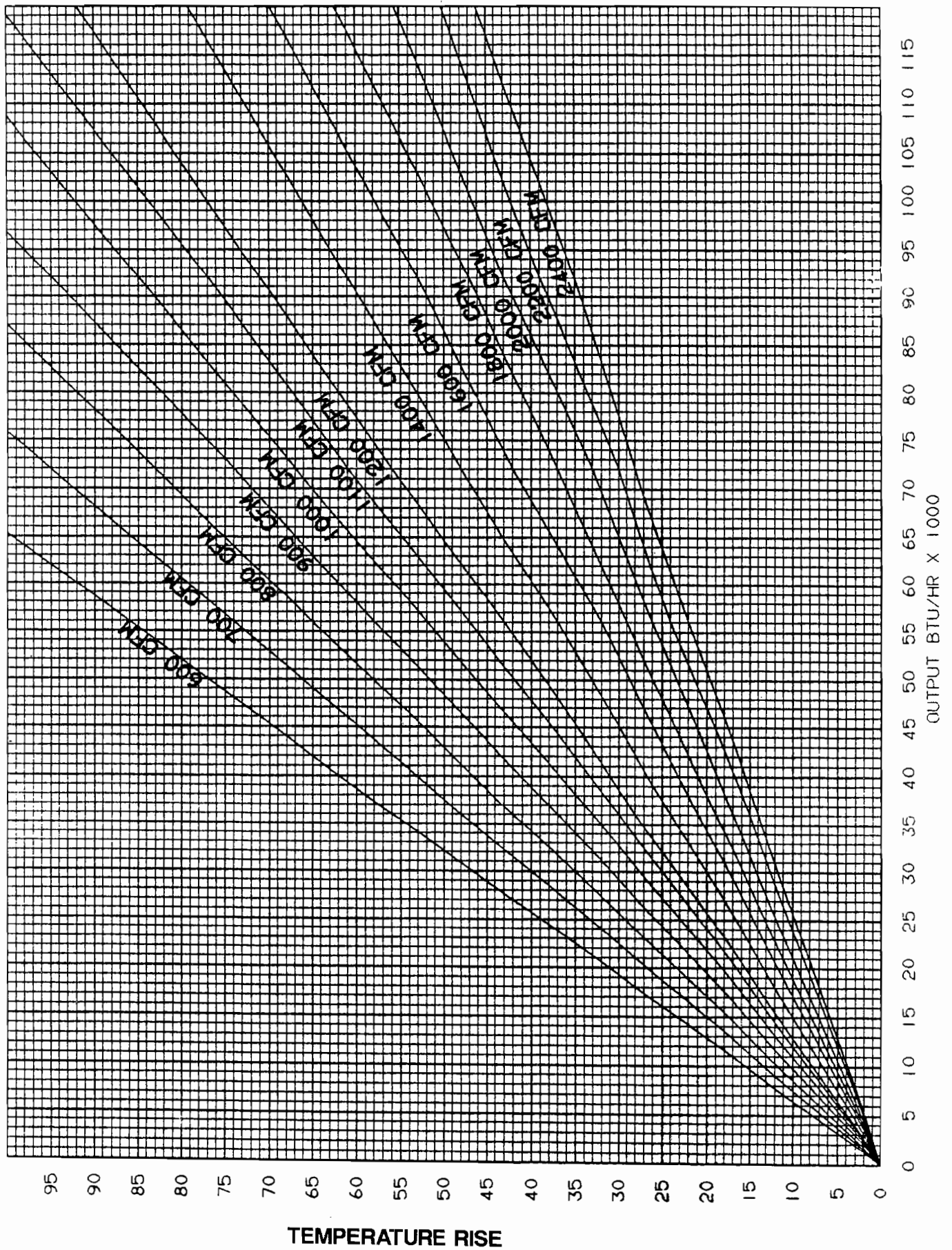
- 1 CFM in chart is with filter(s) as shipped with furnace. If furnace is shipped with two side return filters, this chart assumes both filters are used.
- 2 INSTALLATION IS TO BE ADJUSTED TO OBTAIN TEMPERATURE RISE WITHIN THE RANGE SPECIFIED ON THE RATING PLATE.
- 3 The chart is for information only. 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 allowed 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.

BLOWER PERFORMANCE SPECIFICATIONS

MODEL	MOTOR SPEED TAP	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
GSI045B25A/B	LOW	730	46	730	46	700	48	675	49	640	53	535	60	390	-
	MED	915	36	900	37	870	38	825	40	760	43	680	48	500	-
	HI	1220	-	1160	-	1090	-	1015	-	930	-	825	39	680	48
GSI070B30A/B	LOW	740	-	730	-	700	-	675	-	640	-	540	-	430	-
	MED-LO	970	53	950	55	920	56	890	58	840	59	770	-	670	-
	MED	1265	41	1220	43	1175	44	1125	46	1050	47	970	51	835	60
	HI	1530	-	1465	-	1400	37	1330	39	1240	40	1155	43	1030	48
GSI070B40A/B	LOW	1050	49	1040	50	1025	51	1000	52	970	51	925	54	860	58
	MED	1525	-	1490	35	1455	36	1410	37	1350	37	1280	39	1170	43
	HI	1845	-	1790	-	1715	-	1660	-	1580	-	1490	-	1350	37
GSI090B30A/B	LOW	740	-	730	-	700	-	675	-	620	-	560	-	460	-
	MED-LO	960	69	940	71	900	74	865	-	815	-	750	-	660	-
	MED	1220	55	1170	57	1120	60	1065	63	1000	65	910	72	800	-
	HI	1420	47	1350	49	1285	52	1225	54	1140	57	1040	63	900	72
GSI090B50A/B	LOW	1525	44	1475	45	1400	48	1350	49	1270	51	1180	55	1035	63
	MED-LO	1745	38	1690	39	1625	41	1565	43	1490	44	1400	46	1270	51
	MED	1955	-	1900	-	1820	37	1760	38	1680	39	1580	41	1430	45
	HI	2210	-	2150	-	2070	-	2000	-	1910	-	1810	36	1650	39
GSI115B35A/B	LOW	1060	-	1050	-	1040	-	1000	-	955	-	880	-	790	-
	MED-LO	1260	68	1250	68	1220	-	1200	-	1145	-	1080	-	990	-
	MED	1580	54	1560	55	1510	56	1460	58	1395	60	1300	64	1150	-
	HI	1920	44	1835	46	1760	48	1670	51	1570	53	1460	57	1320	63
GSI115B50A/B	LOW	1380	62	1360	63	1335	64	1300	66	1250	67	1180	71	1080	-
	MED-LO	1610	53	1570	54	1540	55	1490	57	1425	59	1340	63	1200	70
	MED	1890	-	1860	46	1800	47	1750	49	1680	50	1600	52	1480	57
	HI	2260	-	2200	-	2125	-	2050	-	1950	-	1850	-	1710	49
GSI140B50A/B	LOW	1315	-	1280	-	1240	-	1200	-	1140	-	1060	-	950	-
	MED-LO	1560	66	1515	68	1475	70	1425	73	1360	-	1260	-	1090	-
	MED	1815	57	1770	59	1715	60	1660	62	1580	64	1475	69	1300	-
	HI	2340	-	2265	46	2200	47	2100	49	1995	51	1860	55	1620	63

BLOWER PERFORMANCE SPECIFICATIONS

- 1 CFM in 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 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 allowed 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.



PRODUCT DESIGN

The gas furnaces listed in this manual are designed for indoor application only, and depending on the type of installation required, will determine whether an up-flow, counterflow or horizontal furnace would be used.

In all instances only line and low voltage electrical connections, gas piping, venting and duct work connections are required for operation.

ELECTRICAL WIRING

The wiring harness on this unit is furnished as an integral part of the furnace. Field alteration to comply with electrical codes should not be required.

Power supply to the furnace must be N.E.C. Class 1, and must comply with all applicable codes. The furnace must be **ELECTRICALLY GROUNDED** in accordance with the "National Electrical Code, ANSI/NFPA No. 70-1984 or current edition. (Canadian Current National Electric Code C22.1, Part 1.) A fused disconnect should be provided and sized in accordance with the unit minimum circuit ampacity data shown on Pages 9 - 14. Units designed for heating-cooling application have an auxiliary fan relay built into the furnace.

TYPICAL FIELD WIRING

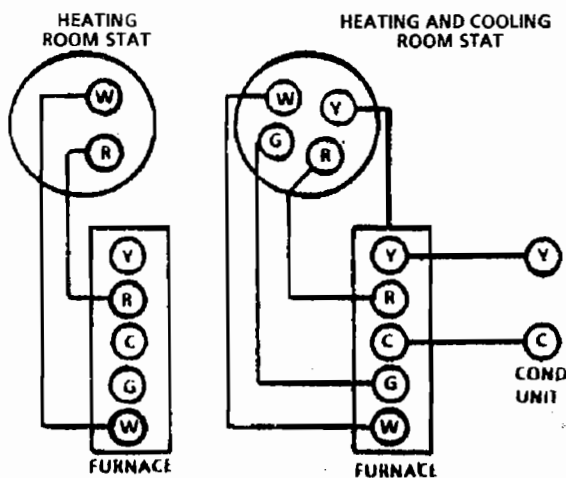


FIGURE 2



IF ANY OF THE ORIGINAL WIRE AS SUPPLIED WITH THE FURNACE MUST BE REPLACED, IT MUST BE REPLACED WITH TYPE AMW, 105°C., 4/64 THICK INSULATION OF THE SAME GAUGE OR ITS EQUIVALENT.

GAS CONNECTIONS

Local codes and the National Fire Protection Associate code (NFPA54) must be followed in installing the gas piping.

Proper sizing of gas piping depends on the cubic feet per hour of gas flow required, specific gravity of the gas and the length of the run. "ANSI Installation of Gas Appliances and Gas Piping" (Z21.30) should be followed in all cases unless superseded by local or gas company requirements. (Canadian - CAN/COA B149 Installation Codes.)

The gas piping to the unit must include manual service shut-off valve and a drip leg. A union of the ground joint or flange type must be installed between the manual shut-off valve and the unit gas valve for proper servicing. (Gas valve has a female 1/2" I.P.T. connection.)

The furnaces are manufactured for use with natural gas, however, they may be field converted for use with Propane Gas.

Propane conversions are made by securing the proper propane conversion kit, which consists of a proper number of propane burner orifices and a gas valve blankoff plate or spring.



DO NOT ATTEMPT TO PEEN OVER THE NATURAL GAS ORIFICE AND REDRILL IN THE FIELD. ALWAYS OBTAIN AND REPLACE WITH THE PROPER ORIFICES.

HIGH ALTITUDE APPLICATION (USA)

See Page 90 for those necessary changes when operating at altitudes above 3500 feet.

PRODUCT DESIGN

NATURAL GAS

MAXIMUM PIPE CAPACITY

Cubic feet of gas per hour for gas pressures of 0.5 PSIG or less - pressure drop 0.3" water-specific gravity 0.60.

LENGTH OF PIPE, FEET	1/2"	3/4"	1	1 1/4"	1 1/2"
10	132	278	520	1050	1600
20	92	190	350	730	1100
30	73	152	285	590	890
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

PRODUCT DESIGN

L.P. 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"	1/2"	3/4"
10	780	1,700	3,200	5,300	8,300	3,200	7,500
20	500	1,100	2,220	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	800	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	930	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.

TYPICAL PROPANE PIPING

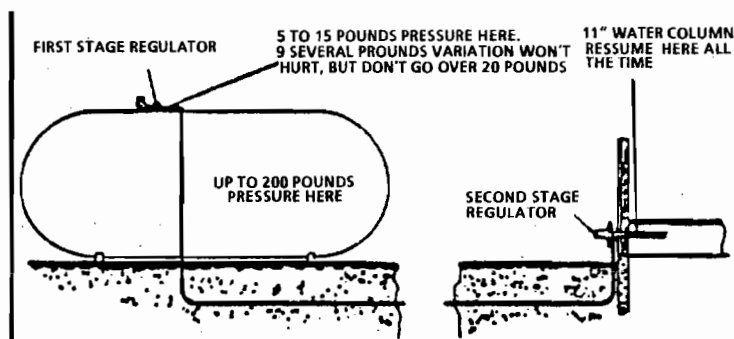


FIGURE 3

PRODUCT DESIGN

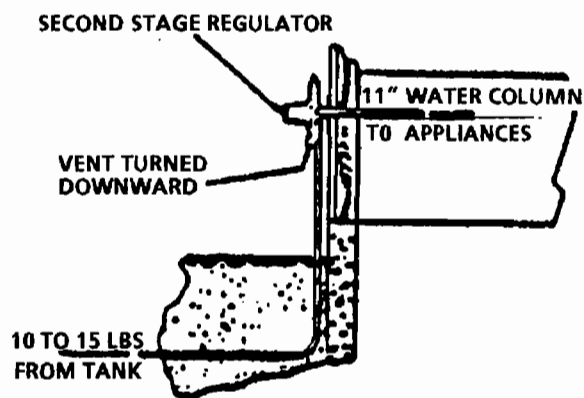


FIGURE 4

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"	1-1/8"	1/2"	3/4"	1"	1-1/4"	1-1/2"
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

*DATA IN ACCORDANCE WITH NFPA PAMPHLET NO. 54

PRODUCT DESIGN

MAXIMUM GAS NEEDED TO VAPORIZE*	TANK SIZE REQUIRED IF LOWEST OUTDOOR TEMPERATURE (AVERAGE FOR 24 HOURS) REACHES --						
	32°F.	20°F.	10°F.	0°F.	-10°F.	-20°F.	-30°F.
125,000 BTU/HR (50 CFH)	115 Gal.	115 Gal.	115 Gal.	250 Gal.	250 Gal.	400 Gal.	600 Gal.
250,000 BTU/HR (100 CFH)	250 Gal.	250 Gal.	250 Gal.	400 Gal.	500 Gal.	1000 Gal.	1500 Gal.
375,000 BTU/HR (150 CFH)	300 Gal.	400 Gal.	500 Gal.	500 Gal.	1000 Gal.	1500 Gal.	2500 Gal.
500,000 BTU/HR (200 CFH)	400 Gal.	500 Gal.	750 Gal.	1000 Gal.	1200 Gal.	2000 Gal.	3500 Gal.
750,000 BTU/HR (300 CFH)	750 Gal.	1000 Gal.	1500 Gal.	2000 Gal.	2500 Gal.	4000 Gal.	5000 Gal.

*AVERAGE RATE OF WITHDRAWAL IN 8 HOUR PERIOD.

	VAPOR PRESSURE, PSIG														
	OUTSIDE TEMPERATURE, DEGREES FAHRENHEIT														
	-30	-20	-10	0	10	20	30	40	50	60	70	80	90	100	110
100% Propane	6.8	11.5	17.5	24.5	34	42	53	65	78	93	110	128	150	177	204
70% Propane 30% Butane	---	4.7	9	15	20.5	28	35.6	46	56	68	82	96	114	134	158
50% Propane 50% Butane	---	---	3.5	7.6	12.3	17.8	24.5	32.4	41	50	61	74	88	104	122
70% Butane 30% Propane	---	---	---	2.3	5.9	10.2	15.4	21.5	28.5	36.5	45	54	66	79	93
100% Butane	---	---	---	---	---	---	---	3.1	6.9	11.5	17	23	30	38	47

PRESSURE EQUIVALENTS

1" Water Column	.....	equals	.....	.58 oz./sq. in.
11" Water Column	.....	equals	.....	6.35 oz./sq. in.
11" Water Column	.....	equals	.....	.4 lb./sq. in.
1 lb/sq. in.	.....	equals	.....	27.71" Water Column
1" Mercury	.....	equals	.....	.49 lb/sq. in.
1 Std. Atmosphere	.....	equals	.....	14.73 lb./sq. in.

PRODUCT DESIGN

AIR FOR COMBUSTION AND VENTILATION



OUTSIDE AIR MUST BE INTRODUCED INTO A BUILDING THAT HAS BEEN DETERMINED NOT TO ADEQUATELY SUPPORT PROPER COMBUSTION. COMBUSTION AIR OPENINGS MUST NOT BE RESTRICTED IN ANY MANNER. THE FURNACE AREA MUST NOT BE USED AS A STORAGE AREA.

The following information has been reproduced, with permission from National Fuel Gas Code NFPA54 AN-SIZ223.1 - 1984 and Z223.19 - 1987 (throughout).

5.3 AIR FOR COMBUSTION AND VENTILATION

5.3.1 GENERAL:

- a. The provisions of 5.3 apply to gas utilization equipment installed in buildings and which require air for combustion, ventilation and dilution of flue gases from within the building. They do not apply to (1) direct vent equipment which is constructed and installed so that all air for combustion is obtained from the outside atmosphere and all flue gases are discharged to the outside atmosphere, or (2) enclosed furnaces which incorporate an integral total enclosure and use only outside air for combustion and dilution of flue gases.
- b. Equipment shall be installed in a location in which the facilities for ventilation permit satisfactory combustion of gas, proper venting and the maintenance of ambient temperature at safe limits under normal conditions of use. Equipment shall be located so as not to interfere with proper circulation of air. When normal infiltration does not provide the necessary air, outside air shall be introduced.
- c. In addition to air needed for combustion, process air shall be provided as required for: cooling of equipment or material, controlling dew point, heating, drying, oxidation or dilution, safety exhaust, odor control, and air for compressors.
- d. In addition to air needed for combustion, air shall be supplied for ventilation, including all air required for comfort and proper working conditions for personnel.
- e. A draft hood or a barometric draft regulator shall be installed in the same room or enclosure as the equipment in such a manner as to prevent any difference in pressure between the hood or regulator and the combustion air supply.

- f. While all forms of building construction cannot be covered in detail, air for combustion, ventilation and dilution of flue gases for gas utilization equipment vented by natural draft normally may be obtained by application of one of the methods covered in 5.3.3 and 5.3.4.
- g. Air requirements for the operation of exhaust fans, kitchen ventilation systems, clothes dryers and fireplaces shall be considered in determining the adequacy of a space to provide combustion air requirements. See Appendix H for one method of determining adequate air for equipment operation.

5.3.2 EQUIPMENT LOCATED IN UNCONFINED SPACES:

In unconfined spaces (See definition below) in buildings, infiltration may be adequate to provide air for combustion, ventilation and dilution of flue gases. However, in buildings of tight construction (for example, weather stripping, heavy insulated, caulked, vapor barrier, etc.), additional air may need to be provided using the methods described in 5.3.3-b or 5.3.4.

SPACE, UNCONFINED. For purposes of this Code, a space whose volume is not less than 50 cubic feet per 1,000 BTU per hour of the aggregate input rating of all appliances installed in that space. Rooms communicating directly with the space in which the appliances are installed, through openings not furnished with doors, are considered a part of the unconfined space.

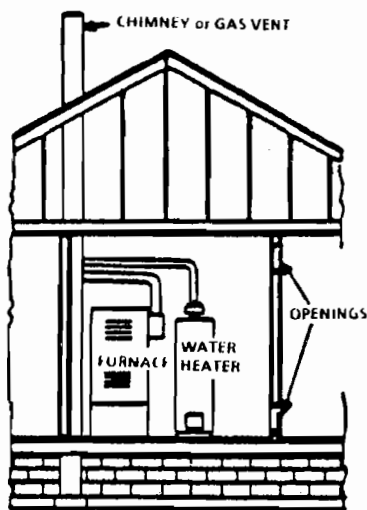
5.3.3 EQUIPMENT LOCATED IN CONFINED SPACES:

- a. **All Air From Inside The Building:** The confined space shall be provided with the two permanent openings communicating directly with an additional room(s) of sufficient volume so that the combined volume of all spaces meets the criteria for an unconfined space. The total input of all gas utilization equipment installed in the combined space shall be considered in making this determination. Each opening shall have a minimum free area of 1 square inch per 1,000 BTU per hour of the total input rating of all gas utilization equipment in the confined space, but not less than 100 square inches. One opening shall be within 12 inches of the top and one within 12 inches of the bottom of the enclosure. (See Figure 1.)
- b. **All Air From Outdoors:** The confined space shall be provided with two permanent openings, one commencing within 12 inches of the top and one commencing within 12 inches of the bottom of the enclosure. The openings shall communicate directly, or by ducts, with the outdoors or spaces

PRODUCT DESIGN

(crawl or attic) that freely communicate with the outdoors.

1. When directly communicating with the outdoors, each opening shall have a minimum free area of 1 square inch per 4,000 BTU per hour of total input rating of all equipment in the enclosure. (See Figure 2.)
2. When communicating with the outdoors through vertical ducts, each opening shall have a minimum free area of 1 square inch per 4,000 BTU per hour of total input rating of all equipment in the enclosure. (See Figure 3.)
3. When communicating with the outdoors through horizontal ducts, each opening shall have a minimum free area of 1 square inch per 2,000 BTU per hour of total input rating of all equipment in the enclosure. (See Figure 4.)
4. When ducts are used, they shall be of the same cross-sectional area as the free area of the openings to which they connect. The minimum dimension of rectangular air ducts shall be not less than 3 inches.



Note: Each opening shall have a free area of not less than one square inch per 1,000 Btu per hour of the total input rating of all equipment in the enclosure, but not less than 100 square inches

FIGURE 1 - Equipment Located in Confined Spaces: All Air from Inside the Building. See 5.3.3-a.

5.3.4 SPECIALLY ENGINEERED INSTALLATIONS:

The requirements of 5.3.3 shall not necessarily govern when special engineering, approved by the authority having jurisdiction, provides an adequate supply of air for combustion, ventilation, and dilution of flue gases.

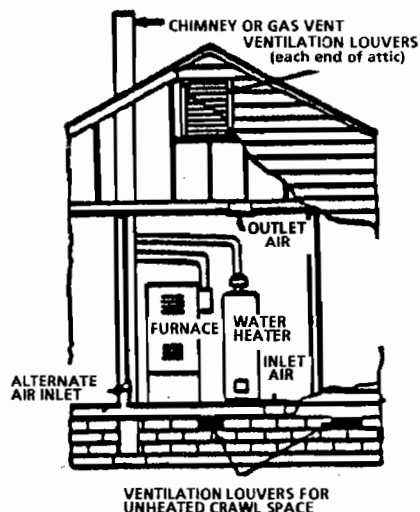
5.3.5 LOUVERS AND GRILLES:

In calculating free area in 5.3.3, consideration shall be given to the blocking effect of louvers, grilles or screens protecting openings. Screens used shall not be smaller than 1/4 inch mesh. If the free area through a design of louver or grille is known, it should be used in calculating the size opening required to provide the free area specified.

If the design and free area is not known, it may be assumed that wood louvers will have 20-25 percent free area and metal louvers and grilles will have 60-75 percent free area. Louvers and grilles shall be fixed in the open position or interlocked with the equipment so that they are opened automatically during equipment operation.

5.3.6 SPECIAL CONDITIONS CREATED BY MECHANICAL EXHAUSTING OR FIREPLACES:

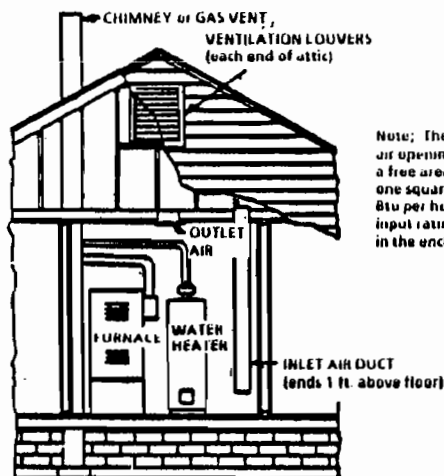
Operation of exhaust fans, ventilation systems, clothes dryers or fireplaces may create conditions requiring special attention to avoid unsatisfactory operation of installed gas utilization equipment.



NOTE: The inlet and outlet air openings shall each have square inch per 4,000 Btu per hour of the total input rating of all equipment in the enclosure.

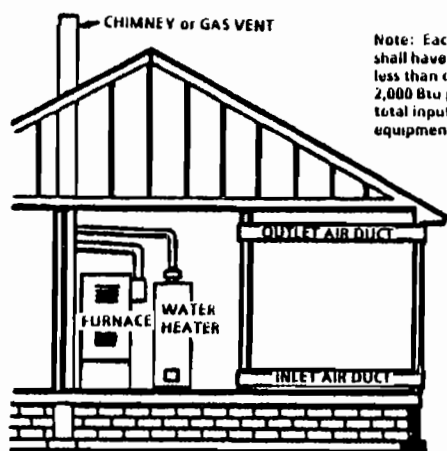
FIGURE 2 - Equipment Located in Confined Spaces: All Air from Outdoors - Inlet Air from Ventilated Crawl Space and Outlet Air to Ventilated Attic. See 5.3.3-5b.

PRODUCT DESIGN



Note: The inlet and outlet air openings shall each have a free area of not less than one square inch per 4,000 Btu per hour of the total input rating of all equipment in the enclosure.

FIGURE 3. Equipment Located in Confined Spaces: All Air from Outdoors through Ventilated Attic. See 5.3.3-b.



Note: Each air duct opening shall have a free area of not less than one square inch per 2,000 Btu per hour of the total input rating of all equipment in the enclosure.

*IF THE APPLIANCE ROOM IS LOCATED AGAINST AN OUTSIDE WALL AND THE AIR OPENINGS COMMUNICATE DIRECTLY WITH THE OUTDOORS, EACH OPENING SHALL HAVE A FREE AREA OF NOT LESS THAN ONE SQUARE INCH PER 4,000 BTU PER HOUR OF THE TOTAL INPUT RATING OF ALL APPLIANCES IN THE ENCLOSURE.

FIGURE 4. Equipment Located in Confined Spaces: All Air from Outdoors. See 5.3.3-b.

LOCATION AND MINIMUM CLEARANCES

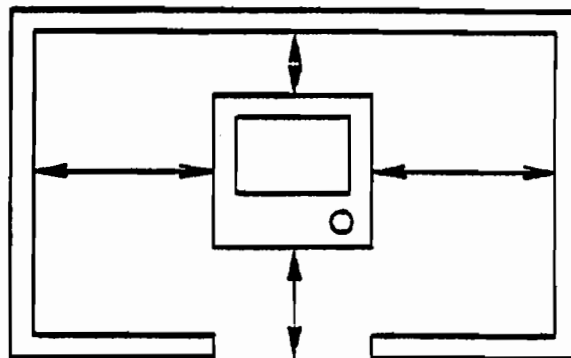
If the furnace is installed in a residential garage the burner and ignition source must be at least 18 inches above the floor and be located or protected from physical damage by the vehicle.



WARNING

THESE FURNACES ARE FOR INSTALLATION IN BUILDINGS CONSTRUCTED ON SITE, NOT FOR USE IN A MOBILE HOME, TRAILER, OR RECREATIONAL VEHICLE. FOR INDOOR INSTALLATION ONLY.

Listed below are the minimum clearance required to combustible material.



FURNACE INSTALLATION IN UTILITY ROOM OR CLOSET
FIGURE 9

FOR CLOSET INSTALLATION WITH MINIMUM CLEARANCES TO COMBUSTIBLE MATERIAL AS SHOWN BELOW.

MODEL	Δ RT SIDE	LF SIDE	REAR	∞ FRONT	TOP	Δ FLUE PIPE
GUI45 & 70	2"	1"	0"	6"	1"	6"
GUI90; 115; 140	1"	1"	0"	6"	1"	6"
All GCI Models	6"	1"	0"	6"	0"	6"

Δ For Type B-1 Vent may be 1".

∞ Allow 36" Minimum Service Clearance.

GUI FOR INSTALLATION ON COMBUSTIBLE FLOORING.
GCI FOR INSTALLATION ON NON-COMBUSTIBLE FLOORING ONLY, UNLESS USED WITH SPECIAL PART NUMBER SUB-BASE.

PRODUCT DESIGN

When planning an installation which will use Type B vent, please refer to GAMA "Venting Tables for Category I Central Furnaces" (next section). This includes rules, definitions, and tables to be followed when Category I appliances are to be vertically vented using Type B vent. All Air Command 80 furnaces are Category I appliances.

Section I includes definitions of commonly used terms. These definitions are adapted from the National Fuel Gas Code.

Section II should be referenced when two or more induced draft appliances are connected to the same vent.

Section II includes examples of Air Command 80 furnaces vented in accordance with Appendix A. Excerpts from the Appendix A tables are included.

LEGAL NOTICE

Amana Refrigeration, Inc. does not make any warranty or representation, expressed or implied, with respect to the accuracy, completeness or usefulness of the information contained in the following section. Amana has prepared this manual in order to provide general information and guidelines regarding venting. This manual does not and cannot address every possible condition of application which may arise. Individual applications remain the sole responsibility of the installer.

I. DEFINITIONS AND TERMS

I. DEFINITIONS

(Additional Definitions Located in Appendix A - Venting Tables)

Ambient Temperature. The temperature of the surrounding medium, usually used to refer to the temperature of the air in which a structure is situated or a device operates.

Appliance (Equipment). Any device which utilizes gas as a fuel or raw material to produce light, heat, power, refrigeration or air conditioning.

Chimney. (See also "Gas Vent," "Vent" and "Venting System.")

One or more passageways, vertical or nearly so, for conveying flue or vent gases to the outside atmosphere.

- a. **Factory-Built Chimney.** A chimney composed of listed factory-built components assembled in accordance with the terms of their listing to form the completed chimney.
- b. **Masonry Chimney.** A field-constructed chimney of solid masonry units, bricks, stones, listed masonry chimney units or reinforced portland cement concrete, lined with suitable chimney flue liners.
- c. **Metal Chimney.** A field-constructed chimney of metal.

Combustible Material. As pertaining to materials adjacent to or in contact with heat producing appliances, vent connectors, gas vents, chimneys, steam and hot water pipes, and warm air ducts, shall mean materials made of or surfaced with wood, compressed paper, plant fibers, or other materials that are capable of being ignited and burned. Such material shall be considered combustible even though flame-proofed, fire-retardant treated, or plastered.

Combustion Products. Constituents resulting from the combustion of a fuel with the oxygen of the air, including the inerts but excluding excess air.

Condensate (Condensation). The liquid which separates from a gas (including flue gas) due to a reduction in temperature or increase in pressure.

Dilution Air. Air which enters a draft hood or draft regulator and mixes with the flue gases.

Draft. The flow of gases or air through chimney, flue or equipment caused by pressure differences.

- a. **Mechanical or Induced.** The draft developed by fan or air or steam jet or other mechanical means.
- b. **Natural.** The draft developed by the difference in temperature of hot gases and outside atmosphere.

Draft Hood. A device built into an appliance, or made a part of the vent connector from an appliance, which is designed to (1) provide for the ready escape of the flue gases from the appliance in the event of no draft, backdraft, or stoppage beyond the draft hood, (2) prevent a backdraft from entering the appliance, and (3) neutralize the effect of stack action of the chimney or gas vent upon the operation of the appliance.

Excess Air. Air which passes through the combustion chamber and the appliance flues in excess of that which is theoretically required for complete combustion.

Flue, Appliance. The passage(s) within an appliance through which combustion products pass from the combustion chamber of the appliance to the draft hood inlet opening on an appliance equipped with a draft hood or to the outlet of the appliance on an appliance not equipped with a draft hood.

Flue, Chimney. The passage(s) in a chimney for conveying the flue or vent gases to the outside atmosphere.

Flue Collar. That portion of an appliance designed for the attachment of the draft hood or vent connector.

Flue Exhauster. A device installed in and made a part of the vent which will provide a positive induced draft.

Flue Gases. Products of combustion plus excess air in appliance flues or heat exchangers.

Gas Vent. A passageway composed of listed factory-built components assembled in accordance with the terms of listing for conveying vent gases from gas appliances or their vent connectors to the outside atmosphere.

- a. **Type B Gas Vent.** A gas vent for venting listed gas appliances with draft hoods and other Category I gas appliances listed for use with Type B gas vents.

Mechanical Exhaust System. Equipment installed in and made a part of the vent, which will provide a positive induced draft.

Noncombustible Material. For the purpose of this Code, noncombustible material shall mean material which is not capable of being ignited and burned, such as materials consisting entirely of, or a combination of, steel, iron, brick, tile, concrete, slate, asbestos, glass and plaster.

Pressure. Unless otherwise stated, is expressed in pounds per square inch above atmospheric pressure, i.e., gage pressure (psig).

Relief Opening. The opening provided in a draft hood to permit the ready escape to the atmosphere of the flue products from the draft hood in the event of no draft, backdraft or stoppage beyond the draft hood, and to permit inspiration of air into the draft hood in the event of a strong chimney updraft.

Shall. Indicates a mandatory requirement.

Vent. A passageway, vertical or nearly so, used to convey flue or vent gases from gas utilization equipment, or their vent connectors, to the outside atmosphere. (Also see Gas Vent and Venting System.)

Vent Connector. The pipe or duct which connects a fuel-gas burning appliance to a vent or chimney.

Vent Gases. Products of combustion from fuel-gas burning appliances plus excess air, plus dilution air in the venting system above the draft hood or draft regulator.

I. DEFINITIONS AND TERMS

Venting. Removal of combustion products as well as process fumes to the outer air.

Venting System. A continuous open passageway from the flue collar or draft hood of a gas-burning appliance to the outside atmosphere for the purpose of removing flue or vent gases.

Note: A venting system is usually composed of a vent or a chimney and vent connector(s), if used, assembled to form the open passageway.

Vented Appliance Categories.

a. Category I. An appliance which operates with a non-positive vent pressure and with a vent gas temperature at least 140°F above its dewpoint, measured as specified in the appropriate nationally recognized appliance standard.

b. Category II. An appliance which operates with a non-positive vent pressure and with a vent gas temperature less than 140°F above its dewpoint, measured at the entrance to the venting system.

c. Category III. An appliance which operates with a positive vent pressure and with a vent gas temperature at least 140°F above its dewpoint, measured at the entrance to the venting system.

d. Category IV. An appliance which operates with a positive vent pressure and with a vent gas temperature less than 140°F above its dewpoint, measured at the entrance to the venting system.

Water Heater. An appliance for supplying hot water for domestic or commercial purposes.

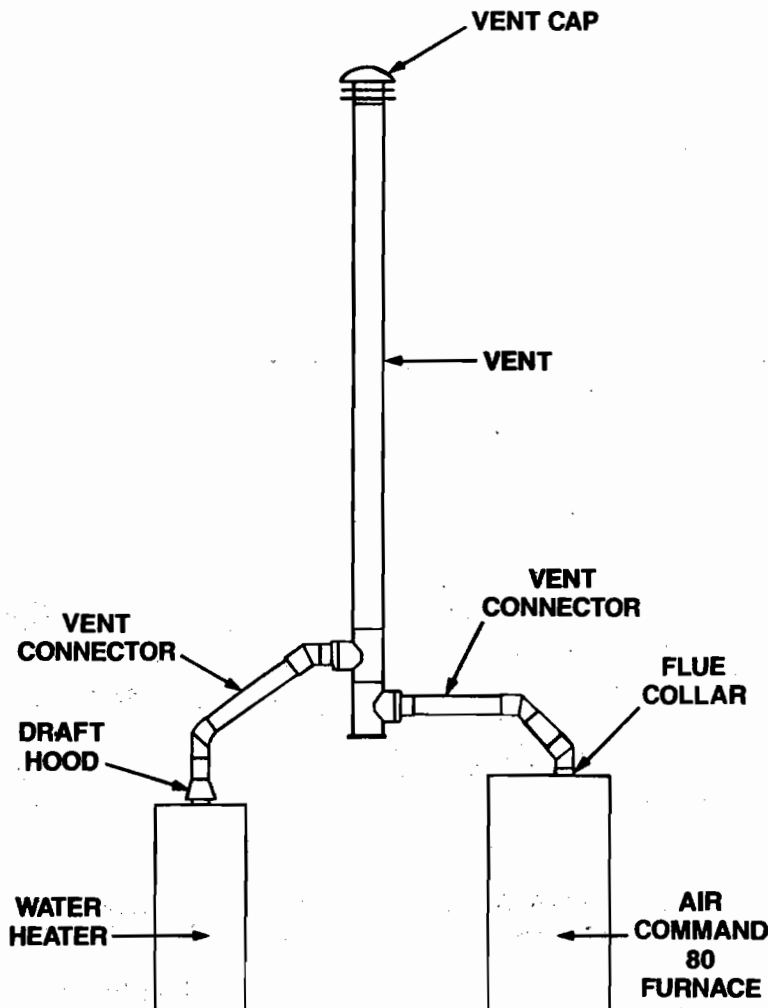


Fig. 1: Location of Definitions as described on pg. 3 and 4.

II. FURNACE LISTINGS

ALL Air Command 80 Furnaces may be vented in common with appliance(s) equipped with a draft hood and listed for use with Type B vent, such as a water heater. If two or more induced draft appliances, controlled by separate thermostats or a two stage thermostat, are connected to the same vent, **ONLY** the following Air Command 80 Furnaces may be used:

U.S. or Canada

UPFLOW

GUI045C25
GUI070C30
GUI070C40
GUI090C30
GUI090C50
GUI115C35
GUI115C50
GUI140C35
GUI140C50

COUNTERFLOW

GCI045C25
GCI070C30
GCI070C40
GCI090C30
GCI090C50
GCI115C35
GCI115C50
GCI140C50

NOTE: Only current production models which include a blocked vent switch are listed above.

These furnaces include a thermally activated, manual reset blocked vent switch. This will open if positive pressure develops at the entrance to the venting system. This switch can only be reset once. If it should open a second time, the cause of its opening must be determined and corrected by an Amana authorized servicer.



WARNING

PERSONAL INJURY HAZARD

Failure to identify the cause of the blocked vent switch opening can result in severe personal injury or death from asphyxiation.

DO NOT BY-PASS THIS SWITCH.

III. VENT SIZING EXAMPLES

Example 1

In this first example, we will have a GUI090 vented alone in the following application:

—The installation calls for the furnace to be vented by going up 5 feet, horizontally 10 feet, and vertically again 15 more feet.

—We need to determine if these lengths will be acceptable and what size of vent can be used.

—We will be using Table 2 in the new GAMA venting tables for this example.

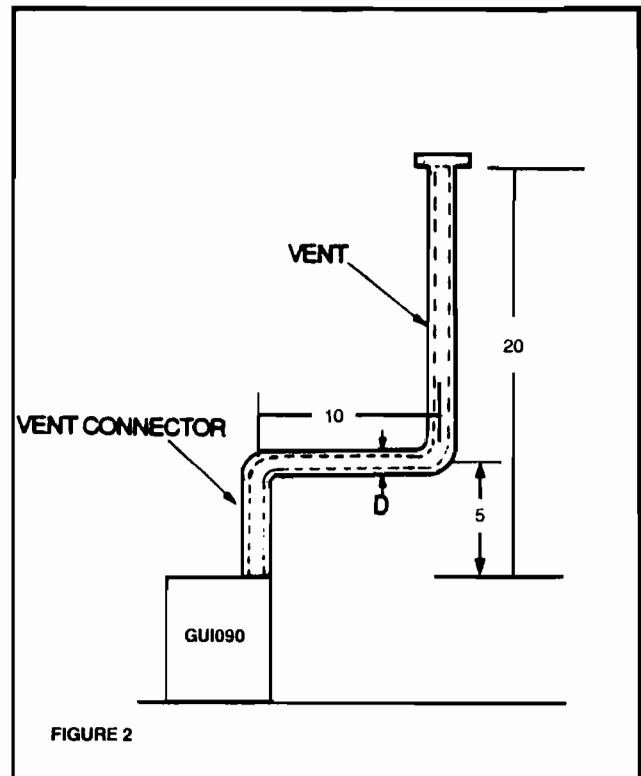


FIGURE 2

When installing a GUI090 in a typical installation, the installer would probably prefer to use 3" single wall metal vent connector and type B vent. Let's see if that would be acceptable by looking at Table 2. By following the left hand column marked "height" to the 20' category and then finding the proper lateral length of 10', we can read across to the FAN Minimum and Maximum capacities. We see that using a 3" single wall metal vent connector is not recommended (NR).

TABLE 2

Height H (ft)	Lateral L (ft)	3"			4"		
		FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max
6	0	38	77	45	59	151	85
	2	39	51	36	60	96	66
	4	NR	NR	33	74	92	63
	6	NR	NR	31	83	89	60
8	0	37	83	50	58	164	93
	2	39	56	39	59	108	75
	5	NR	NR	37	77	102	69
	8	NR	NR	33	90	95	64
10	0	37	87	53	57	174	99
	2	39	61	41	59	117	80
	5	52	56	39	76	111	76
	10	NR	NR	34	97	100	68
15	0	36	93	57	56	190	111
	2	38	69	47	57	136	93
	5	51	63	44	75	128	86
	10	NR	NR	39	95	116	79
	15	NR	NR	NR	NR	NR	72
20	0	35	96	60	54	200	118
	2	37	74	50	56	148	99
	5	50	68	47	73	140	94
	10	NR	NR	41	93	129	86
	15	NR	NR	NR	NR	NR	80
	20	NR	NR	NR	NR	NR	NR

Even if we jump up to a 4" single wall metal vent connector, the FAN Minimum is 93,000 BTUH. Comparing this to our 90,000 BTUH input, we cannot do this installation with a 4" single-wall vent connector either.

The solution here would be to do one of two options:

1. Reduce the lateral run of the single wall vent connector to 5' from 10'. Looking at Table 2, we can see the range here is from 73,000 BTUH (FAN-Min) to 140,000 BTUH (FAN-Max).

or

2. Use 4" type B vent connector with a type B vent. Looking at Table 1 and following the proper columns, we can see using 4" will work because the FAN Minimum is 38,000 BTUH and the FAN Maximum is 133,000 BTUH. Comparing this to our 90,000 BTUH input, we fall within this range and it would be acceptable.

A 3" to 4" adapter will be required at the furnace flue collar.

TABLE 1

Height Lateral H L (ft) (ft)		Appl					
		3"			4"		
		FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max
6	0	0	78	46	0	152	86
	2	13	51	36	18	97	67
	4	21	49	34	30	94	64
	6	25	46	32	36	91	61
8	0	0	84	50	0	165	94
	2	12	57	40	16	109	75
	5	23	53	38	32	103	71
	8	28	49	35	39	98	66
10	0	0	88	53	0	175	100
	2	12	61	42	17	118	81
	5	23	57	40	32	113	77
	10	30	51	36	41	104	70
15	0	0	94	58	0	191	112
	2	11	69	48	15	136	93
	5	22	65	45	30	130	87
	10	29	59	41	40	121	82
	15	35	53	37	48	112	76
20	0	0	97	61	0	202	119
	2	10	75	51	14	149	100
	5	21	71	48	29	143	96
	10	28	64	44	38	133	89
	15	34	58	40	46	124	84
	20	48	52	35	55	116	78

Example 2

In this example, the application calls for a GUI070 installed with a 35,000 BTUH water heater. See figure below.

Schematic Diagram showing offset in the common vent section of the vertical vent.

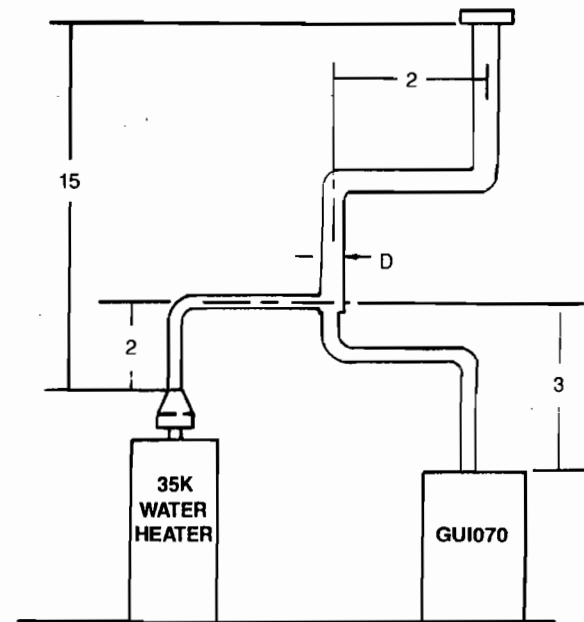


FIGURE 3

Note that, when common venting two appliances, the smaller appliances vent connector enters higher than the larger. If the two are the same size, the water heater should enter higher.

For this example we will need to look at Tables 3 and 4.

We must first determine the proper vent connector size for each appliance based on the above information.

Let's assume the installer will want to use a single wall vent connector and Type B vent. For this, we will refer to Table 4. Using this table, read down the total vent height to 15' and read across the 2' connector rise to the NAT maximum column. This value must be equal to or greater than the input of the water heater. In this application, the NAT maximum is 34,000 BTUH. The 35,000 BTUH water heater we have cannot use the 3" connector.

TABLE 4

Vent Connector Capacity

Vent Height H (ft)	Connector Rise R (ft)	3"			4"		
		Appl					
		FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max
6	1	NR	NR	26	NR	NR	46
	2	NR	NR	31	NR	NR	55
	3	NR	NR	34	NR	NR	62
15	1	NR	NR	29	79	87	52
	2	NR	NR	34	83	94	62
	3	NR	NR	39	87	100	70

The alternatives here would be to increase the connector rise to 3 feet, at which the NAT maximum is 39,000 BTUH, or increase the vent connector diameter to 4" at which the NAT maximum is 62,000 BTUH.

Please note that the horizontal vent connector length cannot exceed 6 feet (1½ feet per inch of connector diameter). See note 3 on page 2 of appendix.

Now, we must determine the furnace vent connector diameter. Let's assume that the installer would like to use a single wall vent connector and Type B vent. Again, Table 4 would be used. Read down the vent height column (H) to a 15' and then across the 3' connector rise row. Table 4 tells us that a single wall vent connector can't be used. It is not recommended for 3", and a 70,000 BTUH furnace is too small when compared to the FAN minimum column of 87,000 BTUH at 4". The alternative for us is to refer to Table 3 for Type B connectors, and read down the connector height (H) column and across the 3' connector use (R) row. Read down the connector diameter column to the cross-point where the FAN maximum is greater than the BTUH input of the furnace. In this case this is under the 4" column where the FAN maximum is 102,000 and the FAN minimum is 36,000. A 4" diameter vent connector must be used.

A 3" to 4" adapter will be required at the furnace's flue collar.

TABLE 3

Vent Connector Capacity

Vent Height H (ft)	Connector Rise R (ft)	3"			4"		
		FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max
6	1	22	37	26	35	66	46
	2	23	41	31	37	75	55
	3	24	44	35	38	81	62
8	1	22	40	27	35	72	48
	2	23	44	32	36	80	57
	3	24	47	36	37	87	64
10	1	22	43	28	34	78	50
	2	23	47	33	36	86	59
	3	24	50	37	37	92	67
15	1	21	50	30	33	89	53
	2	22	53	35	35	96	63
	3	24	55	40	36	102	71

Finally, we must determine the common vent diameter. If both single wall and double wall vent connectors are used, such as in this example, the common vent capacity from Table 4 will be used. The combined input rating is used to size the common vent, in this case 35 + 70 = 105 MBh. Table 4 shows a 4" common vent with a 15 foot height has a capacity of 108 MBh. However, with two 90° elbows in the common vent the maximum capacity must be reduced by 10% for each 90° elbow, or a total of 20%. Therefore the 4" common vent is too small and a 5" diameter will be checked. 159 MBh x .80 = 127 MBh maximum capacity. Since 127 MBh is greater than 105 MBh, a 5" common vent will be adequate.

Common Vent Capacity

Vent Height H (ft)	4"			5"		
	Combined					
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT
6	89	78	64	136	113	100
8	98	87	71	151	126	112
10	106	94	76	163	137	120
15	121	108	88	189	159	140

As a final check the upper portion of Table 3 or 4 is used to confirm that the common vent isn't too big for the furnace. The upper portion of Table 3 shows that FAN Min. is 51 MBh. Therefore a 70 MBh furnace with a 5 inch vent will be acceptable.

TABLE 3

Vent Connector Capacity

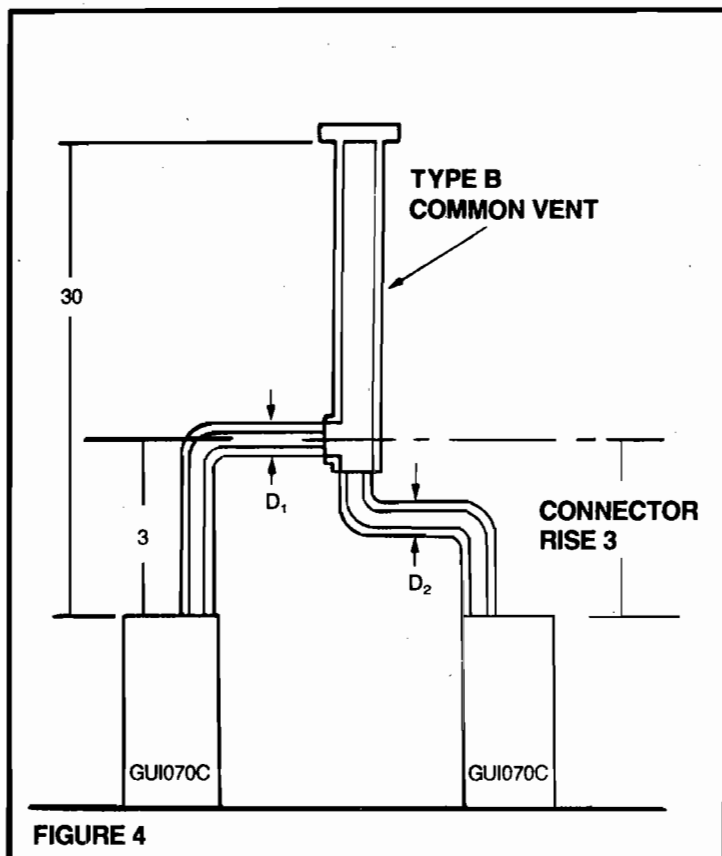
Vent Height H (ft)		Connector Rise R (ft)	3"			4"			5"		
			Appliance Input								
			FAN		NAT	FAN		NAT	FAN		NAT
			Min	Max	Max	Min	Max	Max	Min	Max	Max
6	1		22	37	26	35	66	46	46	106	72
	2		23	41	31	37	75	55	48	121	86
	3		24	44	35	38	81	62	49	132	96
8	1		22	40	27	35	72	48	49	114	76
	2		23	44	32	36	80	57	51	128	90
	3		24	47	36	37	87	64	53	139	101
10	1		22	43	28	34	78	50	49	123	78
	2		23	47	33	36	86	59	51	136	93
	3		24	50	37	37	92	67	52	146	104
15	1		21	50	30	33	89	53	47	142	83
	2		22	53	35	35	96	63	49	153	99
	3		24	55	40	36	102	71	51	163	111

Summary:

In this application, the single-wall vent connector diameter for the water heater is 4". The furnace should use a 4" Type B vent connector. A 3" to 4" adapter must be used at the furnace flue collar, and (if necessary), at the draft hood of the water heater. The common vent should be a 5" Type B vent.

Example 3

This example has a large house requiring two GUI070C30 furnaces common vented. See the figure below. Please note that furnaces having a blocked vent switch are required for this application. For details, see page 5.



First of all, we must determine if a 3" single wall vent connector will be adequate for this application. To do this, we must look at the upper portion of Table 4. Read down the vent height column (H) until 30' is reached and then across the connector use (R) row at 3'. Find the column where the furnace input rating falls between the FAN minimum and FAN maximum numbers. Looking at this table, we can see that a 70,000 BTUH furnace in this application cannot be vented with single wall vent connector.

TABLE 4

Vent Connector Capacity

Vent Height H (ft)	Connector Rise R (ft)	3"		4"	
		FAN	NAT	FAN	NAT
		Min	Max	Min	Max
6	1	NR	NR	26	NR
	2	NR	NR	31	NR
	3	NR	NR	34	NR
15	1	NR	NR	29	79
	2	NR	NR	34	83
	3	NR	NR	39	87
30	1	47	60	31	77
	2	50	62	37	81
	3	54	64	42	85

We must now look to Table 3 to determine if a Type B vent connector can be used. By reading the table at 30' height and a 3' rise the table shows that a 4" Type B vent connector is the best choice. A 3" to 4" adapter will be required at the flue collar of each furnace.

TABLE 3

Vent Connector Capacity

Vent Height H (ft)	Connector Rise R (ft)	3"		4"	
		FAN	NAT	FAN	NAT
		Min	Max	Min	Max
6	1	22	37	26	35
	2	23	41	31	37
	3	24	44	35	38
8	1	22	40	27	35
	2	23	44	32	36
	3	24	47	36	37
10	1	22	43	28	34
	2	23	47	33	36
	3	24	50	37	37
15	1	21	50	30	33
	2	22	53	35	35
	3	24	55	40	36
20	1	21	54	31	33
	2	22	57	37	34
	3	23	60	42	35
30	1	20	62	33	31
	2	21	64	39	33
	3	22	66	44	34

To find the Type B common vent size we must look at common vent capacity on the lower portion of Table 3. Again, follow the vent height (H) to 30'. When the input ratings of the two furnaces are added together, we get 140,000 BTUH. Read across the 30' row to find where the FAN + FAN rating is greater than the combined input of the two furnaces being common vented. In this case, a 4" Type B vent has a common vent capacity of 152 MBh. Since this is greater than our actual input of 140 MBh, a 4" Type B vent may be used. The upper portion of Table 3 confirms that the 4 inch common vent is not too large for a single 70 MBh furnace.

Common Vent Capacity

Vent Height H (ft)	4"		
	FAN	FAN	NAT
	+FAN	+NAT	+NAT
6	92	81	65
8	101	90	73
10	110	97	79
15	125	112	91
20	136	123	102
30	152	138	118

For new construction, a 4" Type B vent would be used. But what if this is a retrofit job, and an existing Type B vent of greater than 4 inch diameter is present? Can the existing vent be reused?

The answer can be found in the upper portion of Table 3. Here we find "FAN Min." number of 34 MBh for a 4" vent, 48 MBh for 5", 64 MBh for a 6", and 88 MBh for a 7". Therefore, these 70 MBh furnaces could be successfully vented into Type B common vents of 4", 5", or 6" diameter. Any vent of 7" or more in diameter would be too big.

Vent Connector Diameter - D											
4"			5"			6"			7"		
Appliance Input Rating Limits in Thousands of											
FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
35	66	46	46	106	72	58	164	104	77	225	142
37	75	55	48	121	86	60	183	124	79	253	168
38	81	62	49	132	96	62	199	139	82	275	189
35	72	48	49	114	76	64	176	109	84	243	148
36	80	57	51	128	90	66	195	129	86	269	175
37	87	64	53	139	101	67	210	145	88	290	198
34	78	50	49	123	78	65	189	113	89	257	154
36	86	59	51	136	93	67	206	134	91	282	182
37	92	67	52	146	104	69	220	150	94	303	205
33	89	53	47	142	83	64	220	120	88	298	163
35	96	63	49	153	99	66	235	142	91	320	193
36	102	71	51	163	111	68	248	160	93	339	218
33	99	56	46	157	87	62	246	125	86	334	171
34	105	66	48	167	104	64	259	149	89	354	202
35	110	74	50	176	116	66	271	168	91	371	228
31	113	59	45	181	93	60	288	134	83	391	182
33	118	70	47	190	110	62	299	158	85	408	215
34	123	79	48	198	124	64	309	178	88	423	242

In summary, 4" Type B vent connectors must be used to run from each GUL070 furnace to the common vent. A 3" to 4" adapter will be required at the flue collar of each furnace.

The common vent must be Type B, and may be 4", 5", or 6" in nominal diameter. If this is a new construction installation, a 4 inch diameter Type B common vent is the best choice.* If this is a replacement job, an existing 5 inch or 6 inch diameter Type B vent would be acceptable.

* Assuming there are no vertical offsets in the common vent.

IV. MASONRY CHIMNEYS

A. General Information

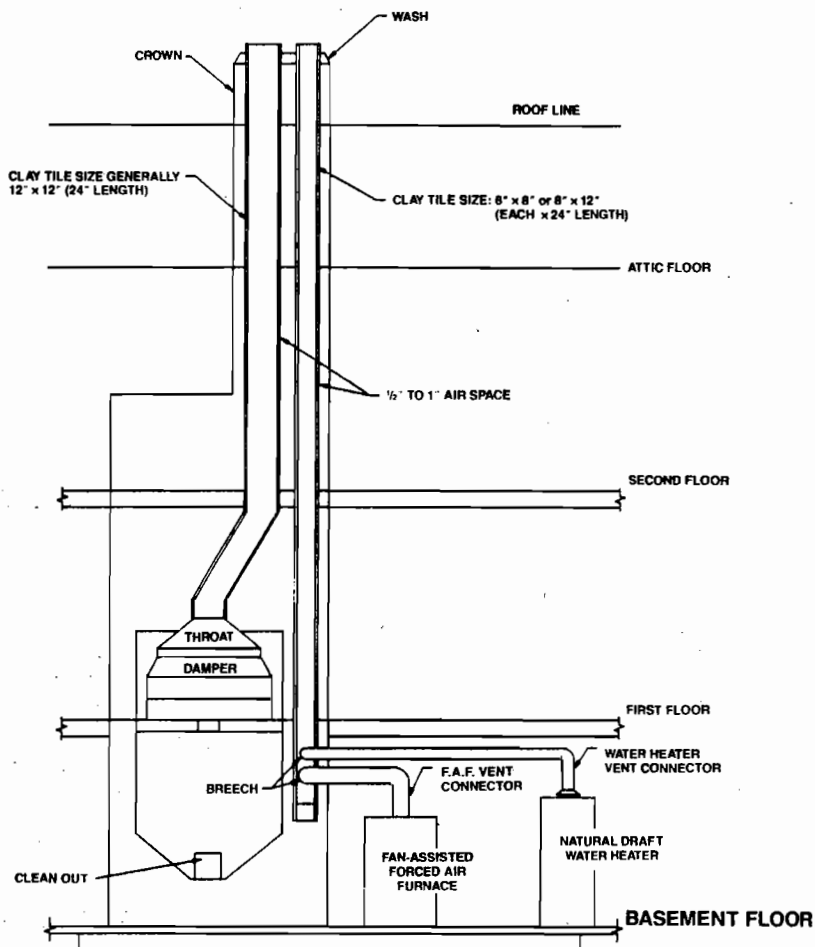


WARNING

Possibility of property damage, personal injury, or death — A draft topical report by the American Gas Association Laboratories for the Gas Research Institute has documented that damaging condensation can occur inside masonry chimneys when a single fan assisted Category I appliance (80% AFUE furnace) is vented without adequate dilution air. Due to this durability risk, do not connect an 80% furnace to a masonry chimney unless the furnace is common vented with a draft hood equipped appliance, or the

chimney is lined with a metal liner sized per these instructions, or Type B-1 metal vent per the Appendix A Venting Tables.

If an 80% furnace is common vented with a draft hood equipped appliance, the potential for condensation damage may still exist with extreme cold, long vent connectors and/or chimneys, exterior chimneys, or any combination of these conditions. The risk of condensation damage is best avoided by using the masonry chimney as a pathway for properly sized metal liner or Type B-1 metal vent.



BASEMENT FLOOR

Figure 5: Typical Multiple Flue Clay Tile Chimney

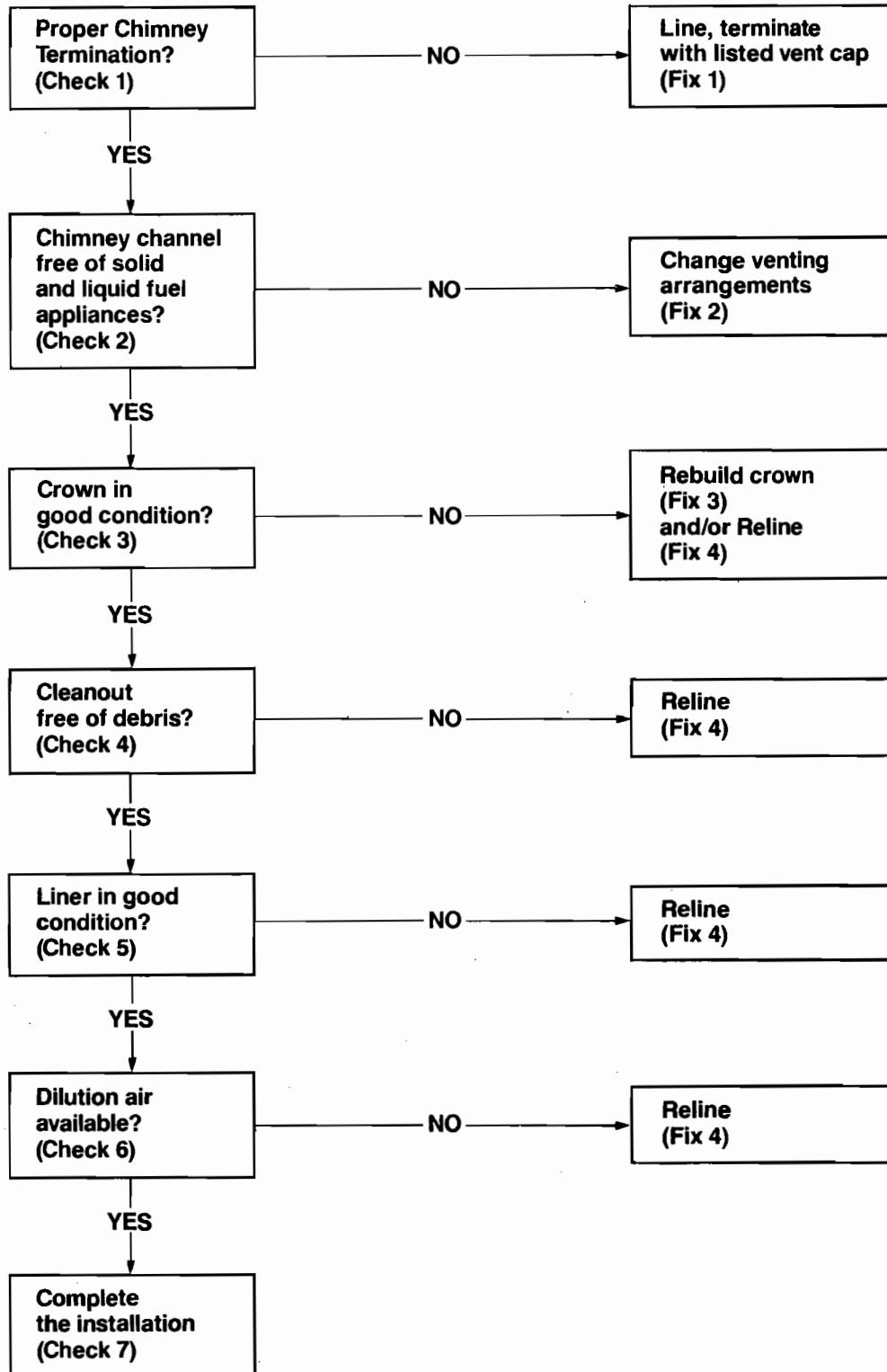
IV. MASONRY CHIMNEYS (cont.)

B. Checklist Summary

This checklist serves as a summary of the items to be checked before venting an Air Command 80 furnace into a masonry chimney. In addition, we recommend that a qualified serviceman use this checklist to perform a yearly inspection of the furnace venting system.

This checklist is only a summary. For detailed information on each of the procedures mentioned, see the paragraph referenced with each item.

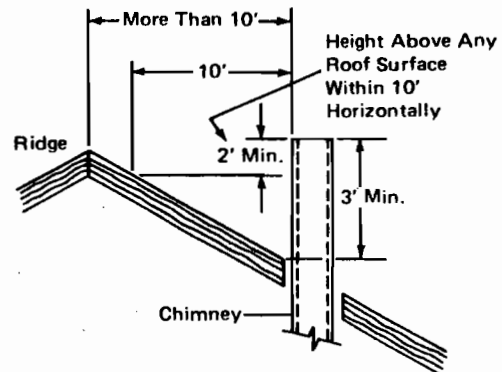
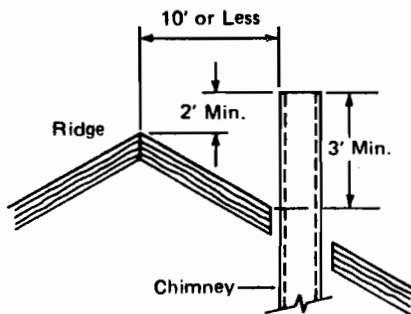
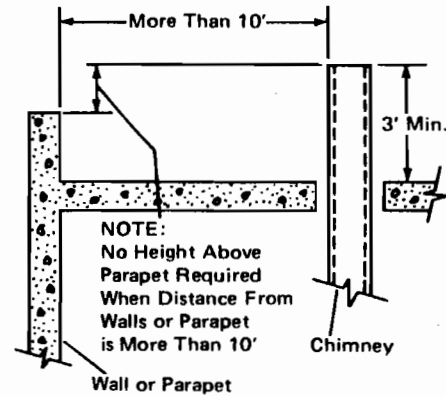
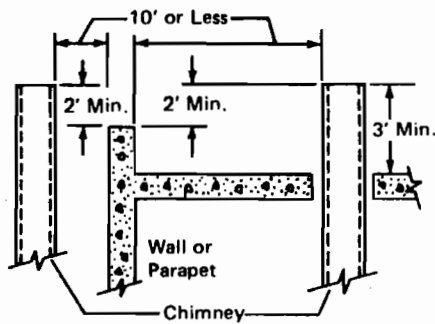
This inspection is based upon a draft topical report, "Masonry Chimney Inspection and Relining", issued by the Gas Research Institute. While not yet finalized, we believe this report represents the best information on this subject which is currently available.



Check 1 — Proper chimney termination. A masonry chimney used as a vent for gas fired equipment must extend at least three feet above the highest point where it passes through the roof. It must extend at least two feet higher than any portion of a building within a horizontal distance of 10 feet. In addition, the chimney must terminate at least 3 feet above any forced air inlet located within 10 feet. The chimney

must extend at least five feet above the highest connected equipment draft hood outlet or flue collar.

If the chimney does not meet these termination requirements, but all other requirements in the checklist can be met, it may be possible for a mason to extend the chimney. If this will not be practical, see Fix 1.



A. Termination 10 Feet or Less From Ridge, Wall or Parapet

B. Termination More Than 10 Feet From Ridge, Wall or Parapet

Figure 6. Typical Termination Locations for Chimneys

Check 2 — Any solid or liquid fuel appliances vented into this chimney channel?

Solid fuel appliances include fireplaces, wood stoves, coal furnaces, and incinerators.

Liquid fuel appliances include oil furnaces, oil-fired boilers, and oil-fired water heaters.

Appliances which burn propane (sometimes referred to as LP (liquified petroleum)) gas are considered gas-fired appliances.

Check 3 — Chimney Crown Condition. Damage from condensate usually shows up first in the crown. If any of the following trouble signs are present, the condition of the crown is not satisfactory:

- Crown leaning
- Bricks missing
- Mortar missing
- Tile liner cracked
- No tile liner
- Salt staining at mortar joints. (White stains, and mortar becomes sandy and/or erodes.)

For problems a, b, or c, see Fix 3. If problems d, e, or f are present; see Fix 4. **IMPORTANT:** It may be necessary to follow both Fix 3 and Fix 4.

Check 4 — Debris in Cleanout. A cleanout (dropleg) must be present such that the upper edge of the cleanout cover is at least 12 inches below the lower edge of the lowest chimney inlet opening.

A chimney without a cleanout could become partially blocked by debris. If no cleanout is present, the chimney must be relined (see Fix 4.)

Remove the cleanout cover, and examine the cleanout for debris. If significant amounts of any of the following are found:

- Fuel oil residue
- Bricks
- Mortar or sand
- Pieces of the tile liner
- Rusted pieces of the metallic liner
- Then the chimney must be relined (See Fix 4.)

Check 5 — Liner condition. If a metal liner is present, it must be checked. It cannot be assumed that all existing metal liners are correctly installed and in good condition.

Remove the lowest existing vent connector, and examine the inside of the elbow or tee at the base of the liner. A small amount of soot may be considered acceptable, provided the installer vacuums it away. If rusted pieces of the liner have collected here, the metal liner must be removed and replaced. (Fix 4).

Next, gently tap the inside of the liner with a phillips screwdriver. If the screwdriver perforates the liner, or if the tapping does not sound like metal hitting metal, the liner must be removed and replaced (Fix 4).

Remember that all appliances must be vented **inside** the liner. Venting one appliance inside the liner and another appliance outside the liner is not acceptable.

Next, use a flashlight and small mirror to sight up the liner. B vent must be supported so as to not come into direct contact with the chimney walls or tile liner. If it is not, it can probably be rehung so as to be acceptable. A thimble or fire stop may be helpful here.

Flexible liners should be hung straight or nearly straight. If it is spiralled in the chimney and in good condition, it should be rehung. To do this, break the top seal; pull up and cut off the excess liner length, and refit the top seal. Use caution when doing this, as the cut edges of flexible liners may be sharp.

The surfaces of the liner must be physically sound. If gaps or holes are present, the metal liner must be removed and replaced (Fix 4).

Finally, confirm that the metallic liner is the correct size for the appliances to be installed. For B vent, use the GAMA tables in the appendix of this manual. For flexible liners, size as directed in Fix 4.

If a metal liner is not present, a clay tile liner must be present, or the chimney must be lined (Fix 4).

Use a flashlight and small mirror at the cleanout or vent connector to inspect the clay tile liner. If any of the following problems are present:

- Tile sections misaligned
- Tile sections missing
- Gaps between tile sections
- Signs of condensate drainage at the cleanout or vent connectors
- Mortar protruding from between tile sections
- Use of sewer pipe or drainage pipe rather than an approved fire clay tile liner
- Then the chimney must be relined (Fix 4).

Next, measure the size of the liner. It may be possible to do this from the cleanout. The liner must be at least as large as the minimum size established by the tables below. If the liner is too small, or if it is larger than a nominal 12 x 12, then the chimney must be relined (Fix 4).

Table G-7
Masonry Chimney Liner Dimensions
with Circular Equivalents

Nominal Liner Size Inches	Inside Dimensions of Liner in Inches	Inside Diameter or Equivalent Diameter Inches	Equivalent Area Square Inches
4 x 8	2½ x 6½	4	12.2
		5	19.6
		6	28.3
		7	38.3
8 x 8	6¾ x 6¾	7.4	42.7
		8	50.3
8 x 12	6½ x 10½	9	63.6
		10	78.5
12 x 12	9¾ x 9¾	10.4	83.3

Table G-6

Capacity of a Masonry Chimney and Single-Wall Vent
Connectors Serving Two or More Appliances

Single-Wall Vent Connector Capacity

Total Vent Height "H"	Rise Connector "R"	Vent Connector Diameter — D					
		3"	4"	5"	6"	7"	8"
		Maximum Appliance Input Rating in Thousands of Btu Per Hour					
6'-8'	1'	21	39	66	100	140	200
	2'	28	52	84	123	172	231
	3'	34	61	97	142	202	269
15'	1'	23	43	73	112	171	225
	2'	30	54	88	132	189	256
	3'	34	63	101	151	213	289
30' and up	1'	24	47	80	124	183	250
	2'	31	57	93	142	205	282
	3'	35	65	105	160	229	312

Note: The above table is only for appliances equipped with draft hoods. Air Command 80s vented into clay tile liners must use Type B vent connectors, sized in accordance with Table Three in the appendix of this manual.

Common Chimney Capacity

Total Vent Height "H"	Minimum Internal Area of Chimney — "A"					
	Square Inches					
	19	28	38	50	78	113
Combined Appliance Input Rating in Thousands of Btu Per Hour						
6'	45	71	102	142	245	NR
8'	52	81	118	162	277	405
10'	56	89	129	175	300	450
15'	66	105	150	210	360	540
20'	74	120	170	240	415	640
30'	NR	135	195	275	490	740
50'	NR	NR	NR	325	600	910

Note: The above table was developed as a NAT + NAT (Max) table. It may also be used as a FAN + NAT (Max) table for Air Command 80s vented with natural draft appliances into an approved fire clay tile liner.

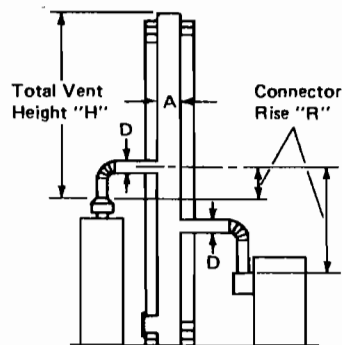


Figure 7.

Masonry Chimney Serving
Two or More Appliances.
(See Table G-6.)

Notes for Multiple Appliance Vents.

1. Maximum Vent Connector Length: 1½ feet for every inch of connector diameter. Greater lengths require increase in size, rise, or total vent height, to obtain full capacity.
2. Each 90-degree turn in excess of the first two reduces the connector capacity by 10 percent.
3. Each 90-degree turn in the common vent reduces capacity by 10 percent.
4. Where possible, locate vent close to or directly over smaller appliance connector.
5. Connectors must be equal to or larger than draft hood outlets.
6. If both connectors are same size, common vent must be at least one size larger, regardless of tabulated capacity.
7. Common vent must be equal to or larger than largest connector.
8. Interconnection fittings must be same size as common vent.
9. Use sea level input rating when calculating vent size for high altitude installation.
10. Designation "NR" in Table G-6 indicates not recommended.
11. For multiple units of gas utilization equipment all located on one floor, available total height "H" is measured from the highest draft hood outlet or flue collar up to the level of the cap or terminal. (Not applicable to multistory.)
12. When masonry chimneys are used as vents for Air Command 80s, all appliances vented into the chimney must be located on the same floor. Multi-story venting into masonry chimneys is not permitted.

Check 6 - Dilution Air. If gas-fired appliances are to be vented into a clay tile liner, a source of dilution air is required.

Dilution air cannot be obtained through:

- Induced draft appliances
- Natural draft appliances with vent dampers.

Sufficient dilution air can ordinarily be obtained through the draft hood of a natural draft appliance *only if* the appliance's vent connector does not include a vent damper.

If dilution air will not be available, the chimney must be relined (Fix 4).

Check 7 — Complete the Installation. If Checks 1 through 6 have been satisfactory, the clay tile liner can probably be used as a vent for the gas appliances. However, the installer must keep in mind the following factors which may render the tile liner unsuitable for use as a vent:

- Tall chimneys
- Extremely cold weather
- Long vent connectors
- Vent connectors with an excessive number of elbows
- Masonry chimneys with no air gap between the liner and the bricks. (In practice, this can be difficult to detect.)
- Exterior chimneys

If, in the installer's judgement, one or more of the above factors is likely to present a problem, the chimney must be relined (Fix 4).

In any case, only Type B vent connectors are to be used with Air Command 80 furnaces which are vented into clay tile liners. If signs of corrosion are present in its existing single-wall vent connector, a natural draft appliance should also use a Type B vent connector. If the vent is a B vent or a masonry chimney, size the vent connectors by Table One or Table Three in the first section of this manual. If the vent is a flexible liner, size the vent connectors by the Table in Fix 4.

Fix 1 — Liner termination. Any cap or roof assembly used with a liner must be approved by the liner manufacturer for such use. The liner and cap/roof assembly must then terminate above the roof in accordance with the manufacturer's instructions.

In some cases, a shorter extension above the roof may be possible with a liner than would be required with a masonry chimney.

For further information on relining, see Fix 4.

Fix 2 — Change venting arrangements

If the masonry chimney has more than one channel, it may be possible to vent the gas appliances into one channel and vent the solid or liquid fuel appliance(s) into another channel(s). Do not vent an Air Command 80 inside of a metal liner with other appliances vented outside the liner.

Alternatively, the homeowner may agree to discontinue use of the fireplace (solid fuel appliance). If so, the tile liner must be cleaned to remove creosote buildup. The fireplace opening must then be permanently sealed.

If oil-fired appliance(s) are being replaced by gas-fired appliance(s), the tile liner must first be cleaned to remove the fuel oil residue.

If none of the above options is practical, the Air Command 80 may need to be vented vertically with a B Vent. Consult Appendix A of this manual for further information on use of B Vents. Under certain conditions, it may be possible to vent some Air Command 80's horizontally, but *only if* the listed Amana accessory is correctly used.

Alternatively, under some conditions an Air Command 90 could be installed rather than an Air Command 80. The Air Command 90 can be vented horizontally or vertically through PVC pipe.

Fix 3 — Rebuild the crown. If the chimney crown is damaged, a qualified mason must repair it in accordance with nationally recognized building codes or standards. One such standard which may be referenced is the *Standard for Chimneys, Fireplaces, Vents, and Solid Fuel Burning Appliances*, ANSI/NFPA 211.

Fix 4 — Relining. Relining options include B vent and flexible liners.

If the chimney has diagonal offsets, B vent probably cannot be used.

If B vent is to be used, it must be supported adequately. Supports (such as fire stops or thimbles) must be used to prevent the B vent from coming into direct contact with the tile liner or chimney walls. Direct contact would result in higher heat loss, with an increased possibility of poor venting system performance.

It is not acceptable to vent one appliance inside the B vent and other appliances outside. The excess space between the B vent and the chimney walls must be covered at the top of the chimney by a weatherproof, corrosion resistant flashing.

The B vent shall then be topped with a listed vent cap or listed roof assembly. The listed vent cap will, when installed per the manufacturer's instructions, prevent problems due to rain, birds, or wind effects.

B vent installed as described above is considered to be an enclosed vent system, and the sizing tables in the appendix of this manual may be used.

If a flexible liner is to be used, it must be made of the proper materials:

-For most residential applications, an aluminum liner should be acceptable.

-If the combustion air supplied to the furnace will be contaminated with compounds containing chlorine or fluorine, a liner of AL29-4C stainless steel should be used. Common sources of chlorine and fluorine compounds include indoor swimming pools and chlorine bleaches, paint strippers, adhesives, paints, varnishes, sealers, waxes (which are not yet dried) and solvents used during construction and remodeling. Various commercial and industrial processes may also be sources of chlorine/fluorine compounds.

-Heavier gauge 300 and 400 series stainless steel liners were developed for use with oil or solid fuel appliances. They are not suitable for use with gas-fired appliances. Flexible liners specifically intended and tested for gas applications are listed in the UL "Gas and Oil Equipment Directory".

To size a flexible liner which serves one appliance, use Table 1A. EXAMPLE: A GUI090B30 is to be vented into a flexible liner which will terminate 20 feet above the flue collar of the furnace. The furnace will be located 5 feet away from the chimney liner.

Table 1A, on page 18 of this manual, indicates that with a height of 20 feet and a lateral of 5 feet, FAN Min is 33 MBh, and FAN Max is 111 MBh for a 4 inch diameter liner. Our furnace input (90 MBh) is greater than 33 and less than 111. Therefore, a 4 inch Type B vent connector and 4 inch flexible aluminum liner should be used.

To size a liner serving more than one appliance, follow the liner manufacturer's instructions. If the manufacturer has no instructions regarding liner sizing, use Table 3 or Table 4 from the Appendix of this manual - and multiply the Max ratings by .75. This compensates for the fact that flexible liners have a corrugated inner surface rather than a smooth surface as B vent does.

To install the liner, read and follow the liner manufacturer's instructions and your local codes. Excess liner length should be pulled out of the chimney and cut off. Use caution when doing this, as the cut edges of flexible liners may be sharp. Do not spiral excess liner inside of the chimney. Support the liner as recommended by the liner manufacturer.

Insulation will need to be poured around the flexible liner if:

- It is required by the liner manufacturer's instructions, or
- The previous liner was properly sized and installed, and suffered from condensation damage, or
- It is required by your local building codes.

Even if none of those three conditions exist which require additional liner insulation, the installer may wish to consider it if:

- The local climate is very cold, or
- The chimney is very tall, or
- The vent connectors used are very long or have a large number of elbows, or
- Local experience indicates that flexible liners installed without poured insulation are likely to have condensation problems.

Insulation must be selected and installed in accordance with the liner manufacturer's instructions.

Finally, cap the chimney and terminate the liner in accordance with the liner manufacturer's instructions.

V. Suggested Checkout Procedure

A. Appliances Equipped with Draft Hoods.

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 and in accordance with the National Fuel Gas Code, ANSI Z223.1-1984 and Addenda, Z223.1a-1987.

If resizing any portion of the common venting system, use the appropriate table in Appendix G in the National Fuel Gas Code, ANSI Z223.1 and Addenda, Z223.1a-1987.

B. Air Command 80 Furnaces

To check for proper venting of an Air Command 80 Furnace, begin with steps (a) through (c) as listed above for appliances equipped with draft hoods. Then proceed as follows:

- d) Attach a pressure tap at a point on the vent/vent connector six to nine inches downstream from the flue collar of the furnace. Using a flexible hose, connect this pressure tap to an inclined manometer. Make certain the manometer is level, and is zeroed correctly.
- e) Following the instructions shipped with the furnace, place the furnace in operation. Adjust the room thermostat so the furnace will operate continuously.
- f) Wait five minutes after the gas valve opens, then examine the inclined manometer. It should indicate a static pressure of $-.02''$ W.C. or less (i.e., farther away from zero.) After confirming this, the burners may be shut down by moving the room thermostat to its coldest setting.
- g) Examine the venting system to make certain no condensation of flue gases has occurred.

- h) Repeat steps a) through g) for each Air Command 80 Furnace attached to the venting system being tested. To reduce the chances of personal injury, it may be necessary to let the venting system cool for a few minutes before moving from one furnace to the next.
- i) After completing the test on the final furnace, leave the pressure tap and manometer attached. Shut down the burners by moving the room thermostat to its coolest setting. To reduce the chances of personal injury, it may be necessary to let the venting system cool for a few minutes.
- j) After the venting system has cooled adequately, open all vent connectors in the venting system. Place all appliances in the area in operation. Wait five minutes after the last gas valve opens, then examine the inclined manometer again. With all appliances operating properly, it should indicate a static pressure of $-.02''$ or less.
- k) Retest for spillage at all draft hood relief openings. Use the flame of a match or candle, or smoke from a cigarette, cigar, or pipe.
- l) After it has been determined that each appliance vents properly; return doors, windows, exhaust fans, fireplace dampers, and all gas-burning appliances to their previous conditions of use.

C. Troubleshooting Procedure

If the venting system(s) of the Air Command 80 furnace(s) do not operate satisfactorily when tested as outlined above, one or more of the following items may prove helpful:

- Confirm that the gas appliances have an adequate supply of combustion air. For details, see the furnace installation manual or Section 5.3 of the National Fuel Gas Code.
- Check the temperature of the air entering the furnace. Entering air which is too cool could result in lower flue gas temperatures, loss of draft, and condensation.

To correct this, it may be necessary to increase the entering air temperature to the furnace. This may mean handling less outside air, using a higher room thermostat setting, or instructing construction workers to use other heat sources until the building is enclosed.

- Confirm that the furnace is being fired at or slightly below the rated input for your altitude. The installation manual tells how to do this.
- Check the temperature rise across the furnace. If it is smaller than that listed on the furnace nameplate, cooler flue gas temperatures, loss of draft, and condensation could result. To correct this, it may be necessary to decrease the blower speed.
- If using a masonry chimney, run a Type B vent or flexible liner through it
- If using a flexible metal liner through an otherwise unused masonry chimney or exterior wooden framework, pour vermiculite or similar insulation to fill the excess space, in accordance with liner manufacturer's instructions.
- Reexamine the venting system layout, simplifying it where practical. For example, could 2 45s replace 2 90s in a horizontal offset?
- Increase the height of the vent. There are practical limits to this, and this may prove counterproductive if these limits are exceeded.
- If winds or local downdrafts are a problem, consider what type of vent cap/chimney cap is being used. Some have better resistance to wind effects than others.

VI. Table 1A

Capacity of Flexible Aluminum Liners in Masonry Chimneys with Type B
Double-Wall Connectors Serving a Single Category I Appliance

Height H (ft)		Lateral L (ft)		Vent and Connector Diameter - D																	
				3"			4"			5"			6"			7"			8"		
				Appliance Input Rating in Thousands of Btu Per Hour																	
				FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	
6	2	19	41	34	25	79	65	32	129	104	40	191	152	49	266	210	59	352	276		
	4	26	39	33	36	77	63	47	127	102	59	188	150	72	262	208	86	348	275		
	6	32	38	32	42	75	62	55	125	101	69	185	149	85	259	206	101	344	273		
8	2	29	45	38	24	88	72	31	145	117	38	215	172	47	300	238	56	398	315		
	5	38	42	36	37	85	71	48	140	114	60	210	170	73	294	235	87	392	312		
	8	NR	NR	35	46	81	68	59	136	112	74	205	167	90	288	232	107	386	308		
10	2	31	48	41	23	95	79	30	157	128	37	235	190	45	329	263	53	438	348		
	5	41	45	39	36	91	76	47	153	125	58	230	186	71	322	259	85	431	344		
	10	NR	NR	36	49	85	73	63	145	121	78	221	181	95	311	254	112	419	338		
15	2	17	53	46	22	107	91	28	180	150	35	272	223	42	384	312	49	514	414		
	5	45	50	44	34	103	88	44	175	147	55	266	220	67	377	307	79	506	410		
	10	NR	NR	41	47	96	84	60	167	141	74	257	214	90	366	301	106	494	402		
	15	NR	NR	37	65	90	79	71	159	136	87	247	208	104	355	294	122	481	395		
20	2	16	55	50	21	115	99	26	196	165	33	299	249	40	424	349	46	572	466		
	5	52	52	48	33	111	96	43	191	162	53	293	245	64	417	344	76	563	461		
	10	NR	NR	44	45	104	92	58	183	157	72	283	238	86	405	337	102	550	453		
	15	NR	NR	40	68	97	87	68	175	151	84	273	232	100	394	330	117	536	444		
	20	NR	NR	NR	NR	NR	81	81	166	146	98	264	225	116	382	322	135	523	436		
30	2	15	58	53	18	124	110	22	216	187	28	335	285	34	481	404	41	654	543		
	5	NR	NR	51	32	119	108	41	211	184	50	329	281	61	473	399	71	645	537		
	10	NR	NR	47	43	113	102	55	203	178	68	319	274	82	461	391	96	631	528		
	15	NR	NR	NR	85	106	96	65	193	172	80	309	267	95	450	383	111	617	520		
	20	NR	NR	NR	NR	NR	NR	78	185	166	93	299	260	110	438	375	127	603	510		
	30	NR	NR	NR	NR	NR	NR	126	168	NR	123	277	246	141	414	359	160	576	492		
50	2	NR	NR	55	16	130	121	19	236	212	23	374	329	27	546	472	32	752	642		
	5	NR	NR	53	31	127	116	39	231	209	47	368	325	57	539	468	67	743	637		
	10	NR	NR	NR	109	120	111	52	221	202	64	358	318	77	529	459	91	729	627		
	15	NR	NR	NR	NR	NR	NR	62	213	196	75	348	311	89	515	451	105	715	618		
	20	NR	NR	NR	NR	NR	NR	74	205	186	89	335	303	103	503	443	120	701	608		
	30	NR	NR	NR	NR	NR	NR	173	189	NR	116	315	286	132	478	425	151	674	589		
10	2	NR	NR	NR	14	130	125	16	246	228	19	401	376	22	609	553	25	857	766		
	5	NR	NR	NR	NR	NR	122	36	242	225	44	396	371	53	602	549	62	848	761		
	10	NR	NR	NR	NR	NR	NR	49	234	219	60	387	363	72	583	540	85	835	751		
	15	NR	NR	NR	NR	NR	NR	58	223	212	71	378	348	84	572	531	98	822	742		
	20	NR	NR	NR	NR	NR	NR	NR	NR	NR	86	368	340	97	561	522	112	808	732		
	30	NR	NR	NR	NR	NR	NR	NR	NR	NR	108	343	NR	123	538	491	140	772	710		
	50	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	197	486	NR	215	717	NR		

NOTE: This Table is based upon Vent II simulations of venting system performance as performed by AGA Labs.

If a 5½ inch diameter liner is used, use Min and Max numbers which are halfway between the 5" and 6" Min and Max numbers shown above.

If the appropriate vent tables indicate that a 5" diameter vent or vent connector is too small and a 5½" flexible liner will be appropriate, then it is acceptable to attach a 6" Type B pipe to a 5½" diameter flexible liner.

VENTING TABLES

CATEGORY I CENTRAL FURNACES



**COPYRIGHT © 1990
GAS APPLIANCE MANUFACTURERS ASSOCIATION**

GAMA VENTING TABLES FOR CATEGORY I CENTRAL FURNACES

This booklet contains new venting tables designed specifically for use with Category I central furnaces. These tables are unique, in that, for the first time, venting tables now exist for fan-assisted combustion system central furnaces. Previously, venting tables for these types of appliances did not exist.

All requirements contained in this booklet apply to both Category I draft-hood equipped central furnaces as well as fan-assisted combustion system central furnaces. At no time should a venting system for a listed Category II, III, or IV central furnace be sized with these tables. The National Fuel Gas Code (NFPA 54/ANSI Z223.1-1988) may also be used to size venting systems for draft-hood equipped central furnaces. However, at this time, the National Fuel Gas Code does not include alternate sizing methods for fan-assisted combustion systems. Therefore, until engineering data is developed to allow alternate sizing methods for Category I fan-assisted central furnaces, the enclosed venting tables must be used for fan-assisted combustion system central furnaces. These tables apply to venting single appliances and common venting multiple appliances.

The new venting tables were developed by Battelle under contract (GRI-5088-245-1728) to the Gas Research Institute (GRI). The computer program (VENT-II) developed by Battelle Columbus generated the venting tables in this booklet and this procedure has been accepted by the American Gas Association Laboratories as an appropriate engineering methodology for determining venting requirements of Category I central furnaces.

For your information, the general venting requirements listed in this booklet are not intended to be used as complete installation instructions and represent only a partial list of venting considerations.

For venting applications that fall outside the parameters of the new venting tables, refer to the furnace manufacturer's complete installation instructions, the specific vent manufacturer's complete installation instructions and state and local codes.

GRI DISCLAIMER

LEGAL NOTICE: This information is, in part, a result of work performed by Battelle under the sponsorship of the Gas Research Institute (GRI). Neither GRI, members of GRI, nor any person acting on behalf of either:

- a. Makes any warranty or representation, express or implied, with respect to the accuracy, completeness, or usefulness of this information, or that the use of any apparatus, method, or process disclosed may not infringe privately owned rights; or
- b. Assumes any liability with respect to the use of, or for damages resulting from the use of, any information, apparatus, method, or process disclosed.

VENTING REQUIREMENTS FOR CATEGORY I CENTRAL FURNACES

I. INTRODUCTION

This booklet contains the current definitions, instructions, and tables necessary to vent today's modern Category I Gas Fired Appliance. A variety of definitions of new terms describing today's gas appliances are included to supplement the actual venting tables which have been generated to correctly vent various combinations of Category I Appliances using Type B or single-wall metal vent connectors attached to Type B vents. Tables are also included covering similar venting material combinations when applied to common venting arrangements of two appliances.

Finally, a series of examples are presented demonstrating how the vent tables are used to size the vent connector and the vertical vent for a variety of typical applications.

II. DEFINITION OF TERMS

"Fan Assisted Combustion System"

An appliance equipped with an integral mechanical means to either draw or force products of combustion through the combustion chamber and/or heat exchanger.

"FAN Min"

refers to the minimum appliance input rating of a Category I appliance with a fan-assisted combustion system that could be attached to the vent.

"FAN Max"

refers to the maximum appliance input rating of a Category I appliance with a fan-assisted combustion system that could be attached to the vent.

"NAT Max"

refers to the maximum appliance input rating of a Category I appliance equipped with a draft hood that could be attached to the vent. There are no minimum appliance input ratings for draft-hood-equipped appliances.

"FAN+FAN"

refers to the maximum combined input rating of two fan-assisted appliances attached to the common vent.

"FAN+NAT"

refers to the maximum combined input rating of one fan-assisted appliance and one draft-hood-equipped appliance attached to the common vent.

"NAT+NAT"

refers to the maximum combined input rating of two draft-hood-equipped appliances attached to the common vent.

"NR"

means not recommended due to potential for condensate formation and/or pressurization of the venting system.

"NA"

means not applicable due to physical or geometric constraints.

Draft Hood

A device built into an appliance, or made a part of the vent connector from an appliance, which is designed to (1) provide for the ready escape of the flue gases from the appliance in the event of no draft, backdraft, or stoppage beyond the draft hood, (2) prevent a backdraft from entering the appliance, and (3) neutralize the effect of stack action of the chimney or gas vent upon the operation of the appliance.

Vent

A passageway used to convey flue gases from gas utilization equipment, or their vent connectors, to the outside atmosphere.

Vent Connector

The pipe or duct which connects a fuel-gas burning appliance to a vent or chimney.

Flue Collar

That portion of an appliance designed for the attachment of a draft hood, vent connector, or venting system.

III. GENERAL VENTING REQUIREMENTS

All requirements contained in this document apply to both Category I draft hood equipped and fan-assisted combustion appliances. At no time should a venting system for a listed Category II, III, or IV appliance be sized with these Tables. The alternate sizing methods described in the National Fuel Gas Code (NFPA54/ANSI Z223.1-1988) may also be used to size the venting system for a draft hood equipped appliance. At this time, alternate sizing methods have not been developed for fan-assisted appliances. Therefore, until engineering data is developed to allow alternate sizing methods for Category I fan-assisted appliances, the vent tables must be used.

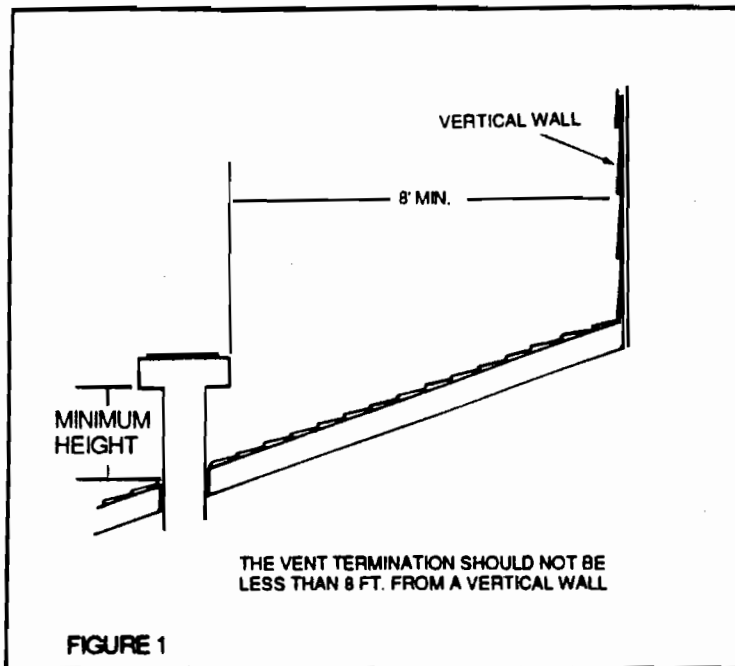
1. If the vent size determined from the tables is smaller than the appliance draft hood outlet or flue collar, the smaller size may be used provided:
 - a) The total vent height "H" is at least 10 feet.
 - b) Vents for appliance draft hood outlets or flue collars 12 inches in diameter or smaller are not reduced more than one size (e.g. 12 inches to 10 inches is a one size reduction).
 - c) Vents for appliance draft hood or flue collars above 12 inches in diameter are not reduced more than two sizes (e.g. 24 inches to 20 inches is a two size reduction).
 - d) The maximum capacity listed in the tables for a fan-assisted appliance is reduced by 10% (0.90 x maximum capacity).
 - e) The draft hood outlet is greater than 4 inches in diameter. Do not connect a 3 inch diameter vent to a 4 inch diameter draft hood outlet. This provision does not apply to fan-assisted appliances.
- 2) Single appliance venting configurations with zero lateral lengths, Tables 1 & 2, are assumed to have no elbows in the vent system. For all other vent configurations with indicated lateral lengths, the vent system is assumed to have two 90° elbows. For each additional 90° elbow, or equivalent* beyond two, the maximum capacity listed in the venting table should be reduced by 10 percent (0.90 x maximum listed capacity).
- 3) The common venting Tables 3 & 4 were generated using a maximum vent connector length of 1 1/2 feet (18 inches) for each inch of connector diameter as follows:

* Two 45° Elbows are equivalent to one 90° Elbow.

CONNECTOR DIAMETER (INCHES)	MAXIMUM CONNECTOR LENGTH (FEET)
3	4 1/2
4	6
5	7 1/2
6	9
7	10 1/2
8	12
9	13 1/2
10	15
12	18
14	21
16	24
18	27
20	30
22	33
24	36

The vent connector should be routed to the vent utilizing the shortest possible route. Longer connectors than these listed are possible but require an increase in size, rise, or total vent height to compensate for the additional length. Consult the appliance manufacturer for specific recommendations concerning long vent connectors.

- 4) If vent connectors are combined prior to entering the common vent, the maximum common vent capacity listed in the common venting tables must be reduced by 10% (0.90 x maximum common vent capacity). See Figure 7. The length of the common vent connector offset (Lo) should not exceed 1-1/2 feet (18 inches) for each inch of common vent connector diameter.
- 5) If the common vertical vent is offset as shown in Figure 8, the maximum common vent capacity listed in the common venting tables should be reduced by 20% (0.80 x maximum common vent capacity).
- 6) The flow area in the common vent should be greater than or equal to 80 percent of the sum of the flow areas of the individual vent connectors. However, the common vent diameter must always be at least as large as the largest vent connector diameter. All interconnection fittings must also be the same size as the common vent.
- 7) Type B gas vents shall terminate above the roof surface with a listed cap or a listed roof assembly in accordance with the terms of their respective listings and the manufacturer's instructions. See Figures 1 and 2.



WIND-TESTED CAPS - (12" and Smaller)

Listed gas venting systems using listed vent caps 12" and smaller in size may terminate in accordance with the VENT TERMINATION TABLE.

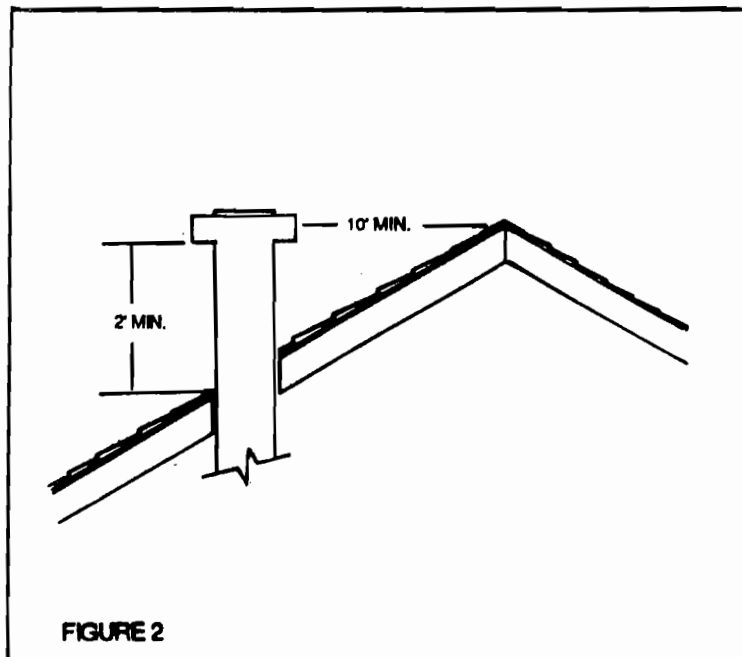
GAS VENT TERMINATION TABLE

ROOF PITCH	MINIMUM HEIGHT
FLAT TO 7/12	1.0 FEET *
OVER 7/12 TO 8/12	1.5 FEET
OVER 8/12 TO 9/12	2.0 FEET
OVER 9/12 TO 10/12	2.5 FEET
OVER 10/12 TO 11/12	3.25 FEET
OVER 11/12 TO 12/12	4.0 FEET
OVER 12/12 TO 14/12	5.0 FEET
OVER 14/12 TO 16/12	6.0 FEET
OVER 16/12 TO 18/12	7.0 FEET
OVER 18/12 TO 20/12	7.5 FEET
OVER 20/12 TO 21/12	8.0 FEET

* THIS REQUIREMENT COVERS MOST INSTALLATIONS

VENT CAPS LARGER THAN 12"

Listed vent caps larger than 12" must be located at least 2 feet above the highest point and at least 2 feet higher than any portion of a building within a horizontal distance of 10 feet.



- 8) No portion of the venting system can extend into, or pass through any circulating air duct or plenum.
- 9) All vent pipe passing through floors, walls, and ceilings must be installed with the listed clearance to combustible materials and be fire stopped according to local codes. In the absence of local codes, refer to NFPA.
- 10) Vent connectors serving Category I appliances shall not be connected to any portion of mechanical draft systems operating under positive pressure such as Category III or IV Venting Systems.
- 11) A Category I appliance must never be connected to a chimney that is servicing a solid fuel appliance. If a fireplace chimney, lined with a metal liner, is used to vent this appliance, the fireplace opening must be permanently sealed.
- 12) These tables are not applicable to outside chimneys or vents unless enclosed in a chase. A Type B vent passing through an unused masonry chimney is considered to be an enclosed vent system and these tables may be used.

- 13) A vent connector shall be supported without any dips or sags and shall slope a minimum of 1/4 inch per lineal foot of connector, back towards the appliance.
- 14) When two or more vent connectors enter a common gas vent, chimney flue, or single-wall metal pipe, the smaller connector shall enter at the highest level consistent with the available headroom or clearance to combustible material.
- 15) Vent connectors shall be firmly attached to draft hood outlets or flue collars by sheet-metal screws or other approved means, except vent connectors of listed Type B vent material which shall be assembled in accordance with the manufacturer's instructions. Joints between sections of single wall connector piping shall be fastened by sheet-metal screws or other approved means.
- 16) When the vent connector used for Category I appliances must be located in or pass through a crawl space or other area which may be cold, that portion of the vent connector shall be of listed double-wall Type B vent material or material having equivalent insulation qualities.
- 17) The entire length of a vent connector shall be readily accessible for inspection, cleaning, and replacement.
- 18) When more than two appliances are connected to a common vent, and at least one of the common vented appliances is a fan assisted type, the common vent must be sized to accommodate:
 - 1) The capacity of all the common vented appliances.
 - 2) Have a minimum capacity lower than that of the smallest fan assisted appliance. Minimum capacity should be determined using Tables 1 and 2.

TYPICAL VENTING APPLICATIONS

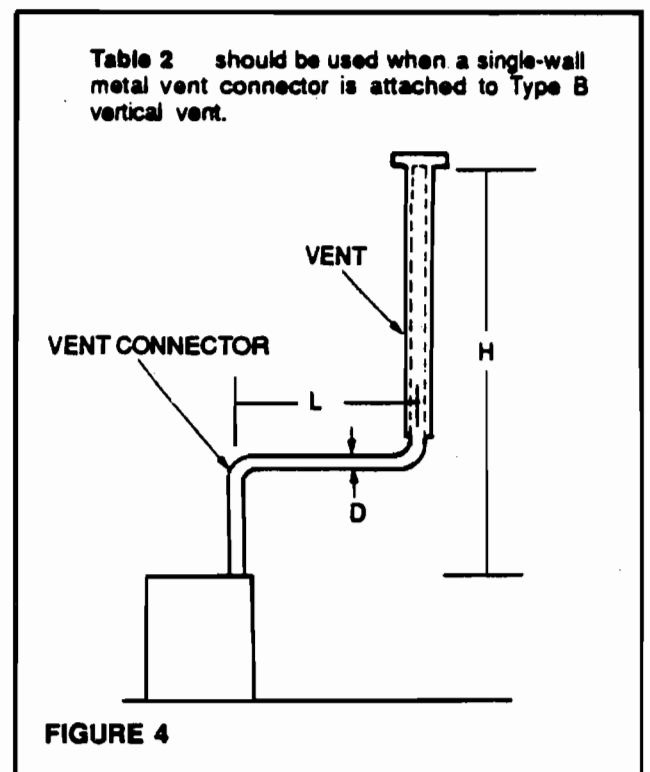
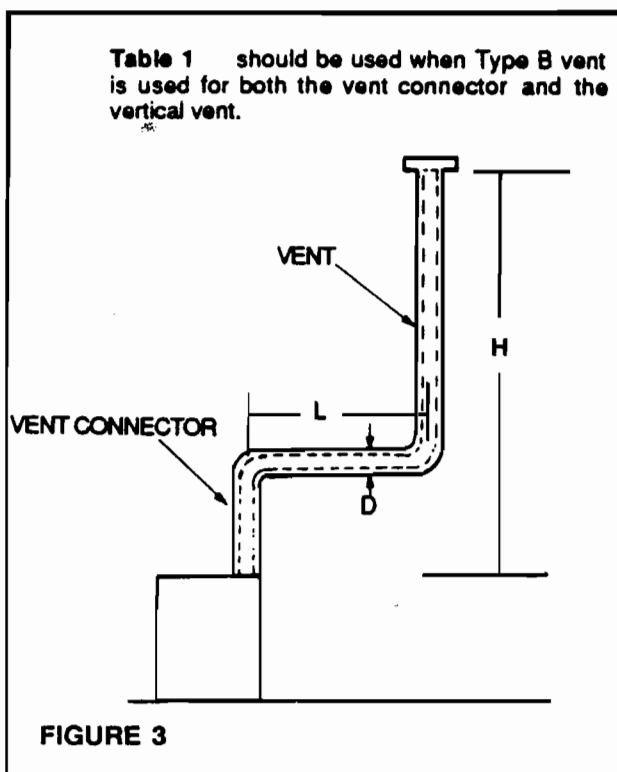


Table 3 should be used when Type B vent connectors are attached to a Type B common vent.

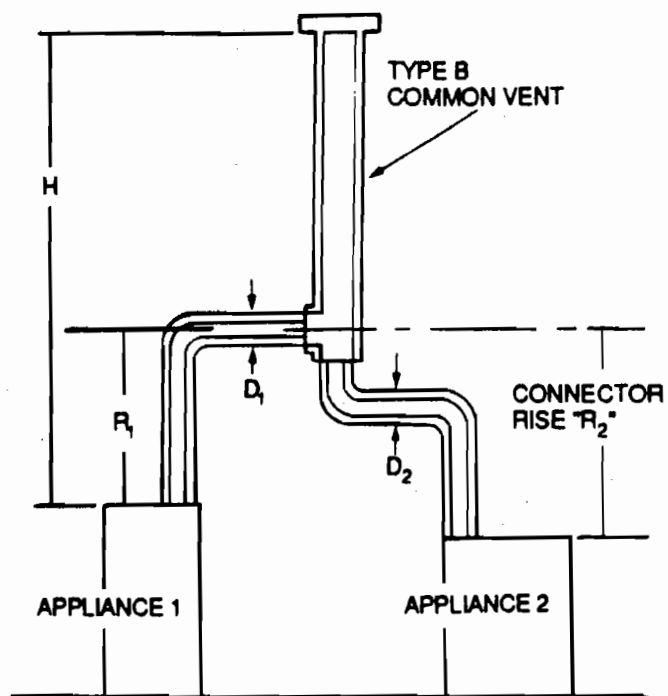


FIGURE 5

Table 4 should be used when single-wall metal vents are attached to a Type B common vent.

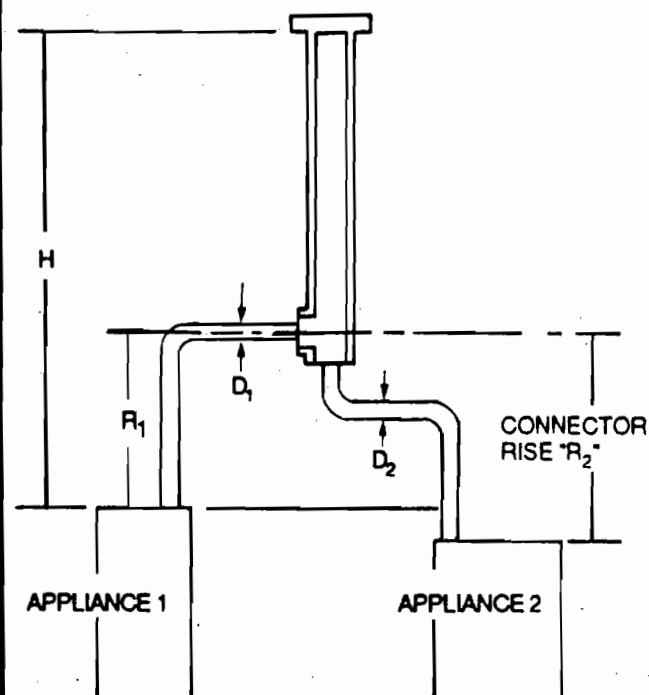


FIGURE 6

Schematic Diagram showing offset in the common vent section "L", of the vent connector.

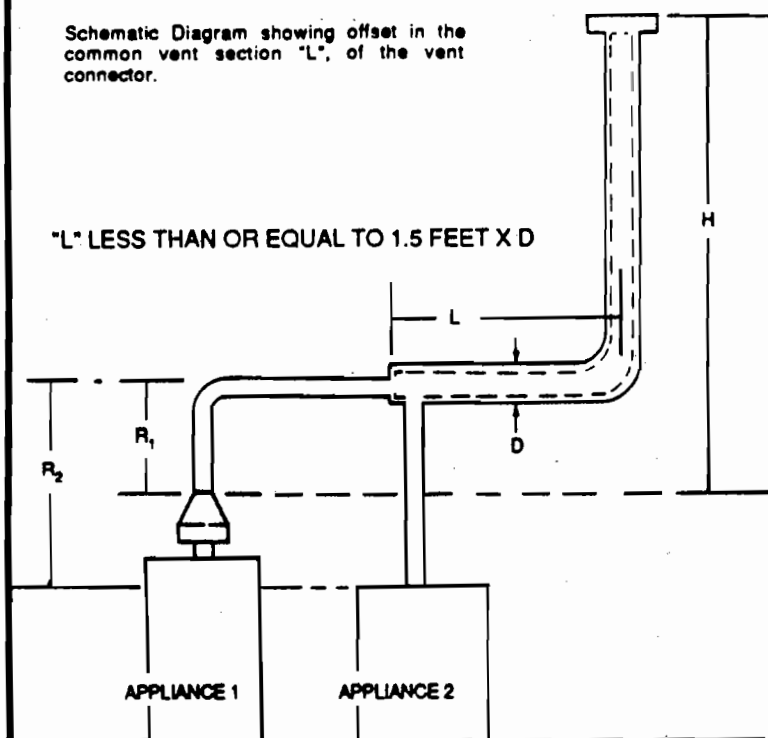


FIGURE 7

Schematic Diagram showing offset in the common vent section of the vertical vent.

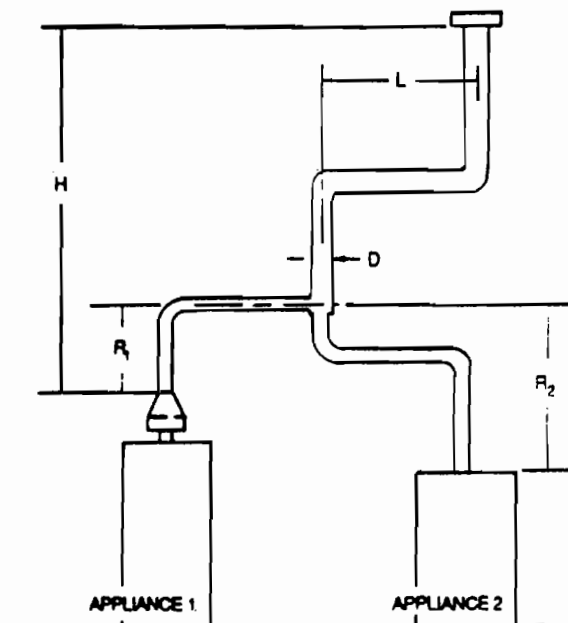


FIGURE 8

VENT TABLES

Capacity of Type B Double-Wall Vents with Type B Double-Wall Connectors
Serving a Single Category I Appliance

TABLE 1

Height Lateral H L (ft) (ft)		Vent and Connector Diameter - D																					
		3"			4"			5"			6"			7"			8"			9"			
		Appliance Input Rating in Thousands of Btu Per Hour																					
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	
6	0	0	78	46	0	152	86	0	251	141	0	375	205	0	524	285	0	698	370	0	897	470	
	2	13	51	36	18	97	67	27	157	105	32	232	157	44	321	217	53	425	285	63	543	370	
	4	21	49	34	30	94	64	39	153	103	50	227	153	66	316	211	79	419	279	93	536	362	
	6	25	46	32	36	91	61	47	149	100	59	223	149	78	310	205	93	413	273	110	530	354	
8	0	0	84	50	0	165	94	0	276	155	0	415	235	0	583	320	0	780	415	0	1006	537	
	2	12	57	40	16	109	75	25	178	120	28	263	180	42	365	247	50	483	322	60	619	418	
	5	23	53	38	32	103	71	42	171	115	53	255	173	70	356	237	83	473	313	99	607	407	
	8	28	49	35	39	98	66	51	164	109	64	247	165	84	347	227	99	463	303	117	596	396	
10	0	0	88	53	0	175	100	0	295	166	0	447	255	0	631	345	0	847	450	0	1096	585	
	2	12	61	42	17	118	81	23	194	129	26	289	195	40	402	273	48	533	355	57	684	457	
	5	23	57	40	32	113	77	41	187	124	52	280	188	68	392	263	81	522	346	95	671	446	
	10	30	51	36	41	104	70	54	176	115	67	267	175	88	376	245	104	504	330	122	651	427	
15	0	0	94	58	0	191	112	0	327	187	0	502	285	0	716	390	0	970	525	0	1263	682	
	2	11	69	48	15	136	93	20	226	150	22	339	225	38	475	316	45	633	414	53	815	544	
	5	22	65	45	30	130	87	39	219	142	49	330	217	64	463	300	76	620	403	90	800	529	
	10	29	59	41	40	121	82	51	206	135	64	315	208	84	445	288	99	600	386	116	777	507	
15	35	53	37	48	112	76	61	195	128	76	301	198	98	429	275	115	580	373	134	755	491		
20	0	0	97	61	0	202	119	0	349	202	0	540	307	0	776	430	0	1057	575	0	1384	752	
	2	10	75	51	14	149	100	18	250	166	20	377	249	33	531	346	41	711	470	50	917	612	
	5	21	71	48	29	143	96	38	242	160	47	367	241	62	519	337	73	697	460	86	902	599	
	10	28	64	44	38	133	89	50	229	150	62	351	228	81	499	321	95	675	443	112	877	576	
20	15	34	58	40	46	124	84	59	217	142	73	337	217	94	481	308	111	654	427	129	853	557	
	20	48	52	35	55	116	78	69	206	134	84	322	206	107	464	295	125	634	410	145	830	537	
	30	0	0	100	64	0	213	128	0	374	220	0	587	336	0	853	475	0	1173	650	0	1548	855
		2	9	81	56	13	166	112	14	283	185	18	432	280	27	613	394	33	826	535	42	1072	700
5		21	77	54	28	160	108	36	275	176	45	421	273	58	600	385	69	811	524	82	1055	688	
10		27	70	50	37	150	102	48	262	171	59	405	261	77	580	371	91	788	507	107	1028	668	
30	15	33	64	NR	44	141	96	57	249	163	70	389	249	90	560	357	105	765	490	124	1002	648	
	20	56	58	NR	53	132	90	66	237	154	80	374	237	102	542	343	119	743	473	139	977	628	
	30	NR	NR	NR	73	113	NR	88	214	NR	104	346	219	131	507	321	149	702	444	171	929	594	
	50	0	0	101	67	0	216	134	0	397	232	0	633	363	0	932	518	0	1297	708	0	1730	952
2		8	86	61	11	183	122	14	320	206	15	497	314	22	715	445	26	975	615	33	1276	813	
5		20	82	NR	27	177	119	35	312	200	43	487	308	55	702	438	65	960	605	77	1259	798	
10		26	76	NR	35	168	114	45	299	190	56	471	298	73	681	426	86	935	589	101	1230	773	
50	15	59	70	NR	42	158	NR	54	287	180	66	455	288	85	662	413	100	911	572	117	1203	747	
	20	NR	NR	NR	50	149	NR	63	275	169	76	440	278	97	642	401	113	888	556	131	1176	722	
	30	NR	NR	NR	69	131	NR	84	250	NR	99	410	259	123	605	376	141	844	522	161	1125	670	
	100	0	NR	NR	NR	0	218	NR	0	407	NR	0	665	400	0	997	560	0	1411	770	0	1908	1040
2		NR	NR	NR	10	194	NR	12	354	NR	13	566	375	18	831	510	21	1155	700	25	1536	935	
5		NR	NR	NR	26	189	NR	33	347	NR	40	557	369	52	820	504	60	1141	692	71	1519	926	
10		NR	NR	NR	33	182	NR	43	335	NR	53	542	361	68	801	493	80	1118	679	94	1492	910	
100	15	NR	NR	NR	40	174	NR	50	321	NR	62	528	353	80	782	482	93	1095	666	109	1465	895	
	20	NR	NR	NR	47	166	NR	59	311	NR	71	513	344	90	763	471	105	1073	653	122	1438	880	
	30	NR	NR	NR	NR	NR	NR	78	290	NR	92	483	NR	115	726	449	131	1029	627	149	1387	849	
	50	NR	NR	NR	NR	NR	NR	NR	NR	NR	147	428	NR	180	651	405	197	944	575	217	1288	787	

VENT TABLES

Capacity of Type B Double-Wall Vents with Type B Double-Wall Connectors
Serving a Single Category I Appliance

TABLE 1 (Cont'd)

Height H (ft)		Lateral L (ft)		Vent and Connector Diameter - D																											
				10"		12"		14"		16"		18"		20"		22"		24"													
				Appliance Input Rating in Thousands of Btu Per Hour																											
		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT			
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
6	0	0	1121	570	0	1645	850	0	2267	1170	0	2983	1530	0	3802	1960	0	4721	2430	0	5737	2950	0	6853	3520	0	8070	4090	0	9287	4640
	2	75	675	455	103	982	650	138	1346	890	178	1769	1170	225	2250	1480	296	2782	1850	360	3377	2220	426	4030	2670	535	4023	2660	618	4017	2650
	4	110	668	445	147	975	640	191	1338	880	242	1761	1160	300	2242	1475	390	2774	1835	469	3370	2215	555	4023	2660	618	4017	2650	685	4011	2640
	6	128	661	435	171	967	630	219	1330	870	276	1753	1150	341	2235	1470	437	2767	1820	523	3363	2210	618	4017	2650	685	4011	2640	752	4005	2630
8	0	0	1261	660	0	1858	970	0	2571	1320	0	3399	1740	0	4333	2220	0	5387	2750	0	6555	3360	0	7838	4010	0	9121	4010	0	10393	5300
	2	71	770	515	98	1124	745	130	1543	1020	168	2030	1340	212	2584	1700	278	3196	2110	336	3882	2560	401	4634	3050	562	4612	3040	630	4602	3030
	4	115	758	505	154	1110	733	199	1528	1010	251	2013	1330	311	2563	1685	398	3180	2090	476	3863	2545	562	4612	3040	630	4602	3030	698	4596	3020
	6	137	746	490	180	1097	720	231	1514	1000	289	2000	1320	354	2552	1670	450	3163	2070	537	3850	2530	630	4602	3030	698	4596	3020	752	4005	2630
10	0	0	1377	720	0	2036	1060	0	2825	1450	0	3742	1925	0	4782	2450	0	5955	3050	0	7254	3710	0	8682	4450	0	10193	5300	0	11753	6000
	2	68	852	560	93	1244	850	124	1713	1130	161	2256	1480	202	2868	1890	264	3556	2340	319	4322	2840	378	5153	3390	540	5132	3371	618	5126	3360
	4	112	839	547	149	1229	829	192	1696	1105	243	2238	1461	300	2849	1871	382	3536	2318	458	4301	2818	540	5132	3371	618	5126	3360	685	5120	3350
	6	142	817	525	187	1204	795	238	1669	1080	298	2209	1450	364	2818	1840	459	3504	2280	546	4268	2780	618	5126	3360	685	5120	3350	752	4005	2630
15	0	0	1596	840	0	2380	1240	0	3323	1720	0	4423	2270	0	5678	2900	0	7099	3620	0	8665	4410	0	10393	5300	0	12193	5300	0	14193	6000
	2	63	1019	675	86	1495	985	114	2062	1350	147	2719	1770	186	3467	2260	239	4304	2800	290	5232	3410	346	6231	4080	501	6222	4057	569	6175	4019
	4	105	1003	660	140	1476	967	182	2041	1327	229	2696	1748	283	3442	2235	355	4278	2777	426	5204	3385	501	6222	4057	569	6175	4019	630	6169	3980
	6	135	977	635	177	1446	936	227	2009	1289	283	2659	1712	346	3402	2193	432	4234	2739	510	5159	3343	599	6175	4019	630	6169	3980	698	6169	3980
	15	155	953	610	202	1418	905	257	1976	1250	318	2623	1675	385	3363	2150	479	4192	2700	564	5115	3300	665	6129	3980	698	6169	3980	752	4005	2630
20	0	0	1756	930	0	2637	1350	0	3701	1900	0	4948	2520	0	6376	3250	0	7988	4060	0	9785	4980	0	11753	6000	0	13848	7060	0	16094	8430
	2	59	1150	755	81	1694	1100	107	2343	1520	139	3097	2000	175	3955	2570	220	4916	3200	269	5983	3910	321	7154	4700	475	7119	4662	543	7113	4652
	4	101	1133	738	135	1674	1079	174	2320	1498	219	3071	1978	270	3926	2544	337	4885	3174	403	5950	3880	475	7119	4662	543	7113	4652	618	7107	4647
	6	130	1105	710	172	1641	1045	220	2282	1460	273	3029	1940	334	3880	2500	413	4835	3130	489	5896	3830	573	7063	4600	641	7057	4575	698	7057	4575
	15	150	1078	688	195	1609	1018	248	2245	1425	306	2988	1910	372	3835	2465	459	4786	3090	541	5844	3795	631	7007	4575	698	7057	4575	752	4005	2630
	20	167	1052	665	217	1578	990	273	2210	1390	335	2948	1880	404	3791	2450	495	4737	3050	585	5792	3760	689	6953	4550	698	7057	4575	752	4005	2630
30	0	0	1977	1060	0	3004	1550	0	4252	2170	0	5725	2920	0	7420	3770	0	9341	4750	0	11483	5850	0	13848	7060	0	16094	8430	0	18694	9430
	2	54	1351	865	74	2004	1310	98	2786	1800	127	3696	2380	159	4734	3050	199	5900	3810	241	7194	4650	285	8617	5600	439	8574	5552	501	8568	5542
	4	96	1332	851	127	1981	1289	164	2759	1775	206	3666	2350	252	4701	3020	312	5863	3783	373	7155	4622	439	8574	5552	501	8568	5542	569	8568	5542
	6	125	1301	829	164	1944	1254	209	2716	1733	259	3617	2300	316	4647	2970	386	5803	3739	456	7090	4574	535	8505	5471	599	8437	5391	618	8437	5391
	15	143	1272	807	187	1908	1220	237	2674	1692	292	3570	2250	354	4594	2920	431	5744	3695	507	7026	4527	590	8437	5391	618	8437	5391	685	8437	5391
	20	160	1243	784	207	1873	1185	260	2633	1650	319	3523	2200	384	4542	2870	467	5686	3650	548	6964	4480	639	8370	5310	698	8370	5310	752	4005	2630
	30	195	1189	745	246	1807	1130	305	2555	1585	369	3433	2130	440	4442	2785	540	5574	3565	635	6842	4375	739	8239	5225	739	8239	5225	752	4005	2630
50	0	0	2231	1195	0	3441	1825	0	4934	2550	0	6711	3440	0	8774	4460	0	11129	5635	0	13767	6940	0	16694	8430	0	19778	8860	0	22978	9430
	2	41	1620	1010	66	2431	1513	86	3409	2125	113	4554	2840	141	5864	3670	171	7339	4630	209	8980	5695	251	10788	6860	394	10737	6818	475	10652	6749
	4	90	1600	996	118	2406	1495	151	3380	2102	191	4520	2813	234	5826	3639	283	7295	4597	336	8933	5654	394	10737	6818	475	10652	6749	569	10652	6749
	6	118	1567	972	154	2366	1466	196	3332	2064	243	4464	2767	295	5763	3585	355	7224	4542	419	8855	5585	491	10652	6749	569	10652	6749	630	10652	6749
	15	136	1536	948	177	2327	1437	222	3285	2026	274	4409	2721	330	5701	3534	396	7155	4511	465	8779	5546	542	10570	6710	569	10570	6710	630	10570	6710
	20	151	1505	924	195	2288	1408	244	3239	1987	300	4356	2675	361	5641	3481	433	7086	4479	506	8704	5506	586	10488	6670	569	10488	6670	630	10488	6670
	30	183	1446	876	232	2214	1349	287	3150	1910	347	4253	2631	412	5523	3431	494	6953	4421	577	8557	5444	672	10328	6603	672	10328	6603	752	4005	2630
100	0	0	2491	1310	0	3925	2050	0	5729	2950	0	7914	4050	0	10485	5300	0	13454	6700	0	16817	8600	0	20578	10300	0	24264	11000	0	28464	12000
	2	30	1975	1170	44	3027	1820	72	4313	2550	95	5834	3500	120	7591	4600	138	9577	5800	169	11803	7200	204	14264	8800	341	14204	8756	436	14105	8683
	4	82	1955	1159	107	3002	1800	136	4282	2531	172	5797	3475	208	7548	4564	245	9528	5769	293	11748	7162	341	14204	8756	436	14105	8683	501	14007	8610
	6	108	1923	1142	142	2961	1775	180	4231	2500	223	5737	3434	268	7478	4509	318	9447	5717	374	11658	7100	436	14105	8683	501	14007	8610	569	14007	8610
	15	126	1892	1124	163	2920	1747	208	4182	2449	252	5678	3392	304	7409	4451	358	9367	5665	418	11569	7037	487	14007	8610	569	14007	8610	630	13910	8537
	20	141	1861	1071	181	2880	1719	226	4133	2438	277	5619	3351	330	7341	4394	387	9289	5613	452	11482	6975	523	13910	8537	523	13910	8537	569	13910	8537
	30	170	1802	1071	215	2803	1663	265	4037	2375	319	5505	3267	378	7209	4279	446	9136	5509	514	11310	6850	592	13720	8391	592	13720	8391	6		

VENT TABLES

Capacity of Type B Double-Wall Vents with Single-Wall Metal Connectors
Serving a Single Category I Appliance

TABLE 2

Height Lateral H (ft)		Vent and Connector Diameter - D																													
		3"		4"		5"		6"		7"		8"		9"		10"		12"													
		Appliance Input Rating in Thousands of Btu Per Hour																													
H (ft)	L (ft)	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	0	38	77	45	59	151	85	85	249	140	126	373	204	165	522	284	211	695	369	267	894	469	371	1118	569	537	1639	849			
	2	39	51	36	60	96	66	85	156	104	123	231	156	159	320	213	201	423	284	251	541	368	347	673	453	498	979	648			
	4	NR	NR	33	74	92	63	102	152	102	146	225	152	187	313	208	237	416	277	295	533	360	409	664	443	584	971	638			
	6	NR	NR	31	83	89	60	114	147	99	163	220	148	207	307	203	263	409	271	327	526	352	449	656	433	638	962	627			
8	0	37	83	50	58	164	93	83	273	154	123	412	234	161	580	319	206	777	414	258	1002	536	360	1257	658	521	1852	967			
	2	39	56	39	59	108	75	83	176	119	121	261	179	155	363	246	197	482	321	246	617	417	339	768	513	486	1120	743			
	5	NR	NR	37	77	102	69	107	168	114	151	252	171	193	352	235	245	470	311	305	604	404	418	754	500	598	1104	730			
	8	NR	NR	33	90	95	64	122	161	107	175	243	163	223	342	225	280	458	300	344	591	392	470	740	486	665	1089	715			
10	0	37	87	53	57	174	99	82	293	165	120	444	254	158	628	344	202	844	449	253	1093	584	351	1373	718	507	2031	1057			
	2	39	61	41	59	117	80	82	193	128	119	287	194	153	400	272	193	531	354	242	681	456	332	849	559	475	1242	848			
	5	52	56	39	76	111	76	105	185	122	148	277	186	190	388	261	241	518	344	299	667	443	409	834	544	584	1224	825			
	10	NR	NR	34	97	100	68	132	171	112	188	261	171	237	369	241	296	497	325	363	643	423	492	808	520	688	1194	788			
15	0	36	93	57	56	190	111	80	325	186	116	499	283	153	713	388	195	966	523	244	1259	681	336	1591	838	488	2374	1237			
	2	38	69	47	57	136	93	80	225	149	115	337	224	148	473	314	187	631	413	232	812	543	319	1015	673	457	1491	983			
	5	51	63	44	75	128	86	102	216	140	144	326	217	182	459	298	231	616	400	287	795	526	392	997	657	562	1469	963			
	10	NR	NR	39	95	116	79	128	201	131	182	308	203	228	438	284	284	592	381	349	768	501	470	966	628	664	1433	928			
20	15	NR	NR	NR	NR	NR	72	158	186	124	220	290	192	272	418	269	334	568	367	404	742	484	540	937	601	750	1399	894			
	0	35	96	60	54	200	118	78	346	201	114	537	306	149	772	428	190	1053	573	238	1379	750	326	1751	927	473	2631	1346			
	2	37	74	50	56	148	99	78	248	165	113	375	248	144	528	344	182	708	468	227	914	611	309	1146	754	443	1689	1098			
	5	50	68	47	73	140	94	100	239	158	141	363	239	178	514	334	224	692	457	279	896	596	381	1126	734	547	1665	1074			
30	10	NR	NR	41	93	129	86	125	223	146	177	344	224	222	491	316	277	666	437	339	866	570	457	1092	702	646	1626	1037			
	15	NR	NR	NR	NR	NR	80	155	208	136	216	325	210	264	469	301	325	640	419	393	838	549	526	1060	677	730	1587	1005			
	20	NR	NR	NR	NR	NR	NR	186	192	126	254	306	196	309	448	285	374	616	400	448	810	526	592	1028	651	808	1550	973			
	30	0	34	99	63	53	211	127	76	372	219	110	584	334	144	849	472	184	1168	647	229	1542	852	312	1971	1056	454	2996	1545		
50	2	37	80	56	55	164	111	76	281	183	109	429	279	139	610	392	175	823	533	219	1069	698	296	1346	863	424	1999	1308			
	5	49	74	52	72	157	106	98	271	173	136	417	271	171	595	382	215	806	521	269	1049	684	366	1324	846	524	1971	1283			
	10	NR	NR	NR	91	144	98	122	255	168	171	397	257	213	570	367	265	777	501	327	1017	662	440	1287	821	620	1927	1243			
	15	NR	NR	NR	115	131	NR	151	239	157	208	377	242	255	547	349	312	750	481	379	985	638	507	1251	794	702	1884	1205			
100	20	NR	NR	NR	NR	NR	NR	181	223	NR	246	357	228	298	524	333	360	723	461	433	955	615	570	1216	768	780	1841	1166			
	30	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	389	477	305	461	670	426	541	895	574	704	1147	720	937	1759	1101			
	0	33	99	66	51	213	133	73	394	230	105	629	361	138	928	515	176	1292	704	220	1724	948	295	2223	1189	428	3432	1818			
	2	36	84	61	53	181	121	73	318	205	104	495	312	133	712	443	168	971	613	209	1273	811	280	1615	1007	401	2426	1509			
500	5	48	80	NR	70	174	117	94	308	198	131	482	305	164	696	435	204	953	602	257	1252	795	347	1591	991	496	2396	1490			
	10	NR	NR	NR	89	160	NR	118	292	186	162	461	292	203	671	420	253	923	583	313	1217	765	418	1551	963	589	2347	1455			
	15	NR	NR	NR	112	148	NR	145	275	174	199	441	280	244	646	405	299	894	562	363	1183	736	481	1512	934	668	2299	1421			
	20	NR	NR	NR	NR	NR	NR	176	257	NR	236	420	267	285	622	389	345	866	543	415	1150	708	544	1473	906	741	2251	1387			
1000	30	NR	NR	NR	NR	NR	NR	NR	NR	NR	315	376	NR	373	573	NR	442	809	502	521	1086	649	674	1399	848	892	2159	1318			
	0	NR	NR	NR	49	214	NR	69	403	NR	100	639	395	131	991	555	166	1404	765	207	1900	1033	273	2479	1300	395	3912	2042			
	2	NR	NR	NR	51	192	NR	70	351	NR	98	563	373	125	828	508	158	1152	698	196	1532	933	259	1970	1168	371	3021	1817			
	5	NR	NR	NR	67	186	NR	90	342	NR	125	551	366	156	813	501	194	1134	688	240	1511	921	322	1945	1153	460	2990	1796			
5000	10	NR	NR	NR	85	175	NR	113	324	NR	153	532	354	191	789	486	238	1104	672	293	1477	902	389	1905	1133	547	2938	1763			
	15	NR	NR	NR	132	162	NR	138	310	NR	188	511	343	230	764	473	281	1075	656	342	1443	884	447	1865	1110	618	2888	1730			
	20	NR	NR	NR	NR	NR	NR	168	295	NR	224	487	NR	270	739	458	325	1046	639	391	1410	864	507	1825	1087	690	2838	1696			
	30	NR	NR	NR	NR	NR	NR	231	264	NR	301	448	NR	355	685	NR	418	988	NR	491	1343	824	631	1747	1041	834	2739	1627			
5000	50	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	540	584	NR	617	866	NR	711	1205	NR	895	1591	NR	1138	2547	1489			

VENT TABLES

Capacity of Type B Double-Wall Vents with Type B Double-Wall Connectors
Serving Two or more Category I Appliances

TABLE 3

Vent Connector Capacity

Vent Height H (ft)		Connector Rise R (ft)		Vent Connector Diameter - D																							
				3"		4"		5"		6"		7"		8"		9"		10"									
				Appliance Input Rating Limits in Thousands of Btu Per Hour																							
				FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	
6	1	22	37	26	35	66	46	46	106	72	58	164	104	77	225	142	92	296	185	109	376	237	128	466	289		
	2	23	41	31	37	75	55	48	121	86	60	183	124	79	253	168	95	333	220	112	424	282	131	526	345		
	3	24	44	35	38	81	62	49	132	96	62	199	139	82	275	189	97	363	248	114	463	317	134	575	386		
8	1	22	40	27	35	72	48	49	114	76	64	176	109	84	243	148	100	320	194	118	408	248	138	507	303		
	2	23	44	32	36	80	57	51	128	90	66	195	129	86	269	175	103	356	230	121	454	294	141	564	358		
	3	24	47	36	37	87	64	53	139	101	67	210	145	88	290	198	105	384	258	123	492	330	143	612	402		
10	1	22	43	28	34	78	50	49	123	78	65	189	113	89	257	154	106	341	200	125	436	257	146	542	314		
	2	23	47	33	36	86	59	51	136	93	67	206	134	91	282	182	109	374	238	128	479	305	149	596	372		
	3	24	50	37	37	92	67	52	146	104	69	220	150	94	303	205	111	402	268	131	515	342	152	642	417		
15	1	21	50	30	33	89	53	47	142	83	64	220	120	88	298	163	110	389	214	134	493	273	162	609	333		
	2	22	53	35	35	96	63	49	153	99	66	235	142	91	320	193	112	419	253	137	532	323	165	658	394		
	3	24	55	40	36	102	71	51	163	111	68	248	160	93	339	218	115	445	286	140	565	365	167	700	444		
20	1	21	54	31	33	99	56	46	157	87	62	246	125	86	334	171	107	436	224	131	552	285	158	681	347		
	2	22	57	37	34	105	66	48	167	104	64	259	149	89	354	202	110	463	265	134	587	339	161	725	414		
	3	23	60	42	35	110	74	50	176	116	66	271	168	91	371	228	113	486	300	137	618	518	164	764	466		
30	1	20	62	33	31	113	59	45	181	93	60	288	134	83	391	182	103	512	238	125	649	305	151	802	372		
	2	21	64	39	33	118	70	47	190	110	62	299	158	85	408	215	105	535	282	129	679	360	155	840	439		
	3	22	66	44	34	123	79	48	198	124	64	309	178	88	423	242	108	555	317	132	706	405	158	874	45		
50	1	19	71	36	30	133	64	43	216	101	57	349	145	78	477	197	97	627	257	120	797	330	144	984	403		
	2	21	73	43	32	137	76	45	223	119	59	358	172	81	490	234	100	645	306	123	820	392	148	1014	478		
	3	22	75	48	33	141	86	46	229	134	61	366	194	83	502	263	103	661	343	126	842	441	151	1043	538		
100	1	18	82	37	28	158	66	40	262	104	53	442	150	73	611	204	91	810	266	112	1038	341	135	1285	417		
	2	19	83	44	30	161	79	42	267	123	55	447	178	75	619	242	94	822	316	115	1054	405	139	1306	494		
	3	20	84	50	31	163	89	44	272	138	57	452	200	78	627	272	97	834	355	118	1069	455	142	1327	555		

Common Vent Capacity

Vent Height H (ft)	Common Vent Diameter - D																							
	4"			5"			6"			7"			8"			9"			10"					
	Combined Appliance Input Rating in Thousands of Btu Per Hour																							
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT
6	92	81	65	140	116	103	204	161	147	309	248	200	404	314	260	547	434	335	672	520	410			
8	101	90	73	155	129	114	224	178	163	339	275	223	444	348	290	602	480	378	740	577	465			
10	110	97	79	169	141	124	243	194	178	367	299	242	477	377	315	649	522	405	800	627	495			
15	125	112	91	195	164	144	283	228	206	427	352	280	556	444	365	753	612	465	924	733	565			
20	136	123	102	215	183	160	314	255	229	475	394	310	621	499	405	842	688	523	1035	826	640			
30	152	138	118	244	210	185	361	297	266	547	459	360	720	585	470	979	808	605	1209	975	740			
50	167	153	134	279	244	214	421	353	310	641	547	423	854	706	550	1164	977	705	1451	1188	860			
100	175	163	NR	311	277	NR	489	421	NR	751	658	479	1025	873	625	1408	1215	800	1784	1502	975			

© 1990 by Gas Research Institute

VENT TABLES

Capacity of Type B Double-Wall Vents with Type B Double-Wall Connectors
Serving Two or more Category I Appliances

TABLE 3 (Cont'd)

Vent Connector Capacity

Vent Height H (ft)		Connector Rise R (ft)	Vent Connector Diameter - D																				
			12"			14"			16"			18"			20"			22"			24"		
			Appliance Input Rating Limits in Thousands of Btu Per Hour																				
			FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	2	174	764	496	223	1046	653	281	1371	853	346	1772	1080	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	4	180	897	616	230	1231	827	287	1617	1081	352	2069	1370	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
8	2	186	822	516	238	1126	696	298	1478	910	365	1920	1150	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	4	192	952	644	244	1307	884	305	1719	1150	372	2211	1460	471	2737	1800	560	3319	2180	662	3957	2590	
	6	198	1050	772	252	1445	1072	313	1902	1390	380	2434	1770	478	3018	2180	568	3665	2640	669	4373	3130	
10	2	196	870	536	249	1195	730	311	1570	955	379	2049	1205	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	4	201	997	664	256	1371	924	318	1804	1205	387	2332	1535	486	2887	1890	581	3502	2280	686	4175	2710	
	6	207	1095	792	263	1509	1118	325	1989	1455	395	2556	1865	494	3169	2290	589	3849	2760	694	4593	3270	
15	2	214	967	568	272	1334	790	336	1760	1030	408	2317	1305	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	4	221	1085	712	279	1499	1006	344	1978	1320	416	2579	1665	523	3197	2060	624	3881	2490	734	4631	2960	
	6	228	1181	856	286	1632	1222	351	2157	1610	424	2796	2025	533	3470	2510	634	4216	3030	743	5035	3600	
20	2	223	1051	596	291	1443	840	357	1911	1095	430	2533	1385	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	4	230	1162	748	298	1597	1064	365	2116	1395	438	2778	1765	554	3447	2180	661	4190	2630	772	5005	3130	
	6	237	1253	900	307	1726	1288	373	2287	1695	450	2984	2145	567	3708	2650	671	4511	3190	785	5392	3790	
30	2	216	1217	632	286	1664	910	367	2183	1190	461	2891	1540	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	4	223	1316	792	294	1802	1160	376	2366	1510	474	3110	1920	619	3840	2365	728	4681	2860	847	5606	3410	
	6	231	1400	952	303	1920	1410	384	2524	1830	485	3299	2340	632	4080	2875	741	4976	3480	860	5961	4150	
50	2	206	1479	689	273	2023	1007	350	2659	1315	435	3548	1665	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	4	213	1561	860	281	2139	1291	359	2814	1685	447	3730	2135	580	4601	2633	709	5569	3185	851	6633	3790	
	6	221	1631	1031	290	2242	1575	369	2951	2055	461	3893	2605	594	4808	3208	724	5826	3885	867	6943	4620	
100	2	192	1923	712	254	2644	1050	326	3490	1370	402	4707	1740	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	4	200	1984	888	263	2731	1346	336	3606	1760	414	4842	2220	523	5982	2750	639	7254	3330	769	8650	3950	
	6	208	2035	1064	272	2811	1642	346	3714	2150	426	4968	2700	539	6143	3350	654	7453	4070	786	8892	4810	

Common Vent Capacity

Vent Height H (ft)	Common Vent Diameter - D																				
	12"			14"			16"			18"			20"			22"			24"		
	Combined Appliance Input Rating in Thousands of Btu Per Hour																				
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT
6	900	696	588	1284	990	815	1735	1336	1065	2253	1732	1345	2838	2180	1660	3488	2677	1970	4206	3226	2390
8	994	773	652	1423	1103	912	1927	1491	1190	2507	1936	1510	3162	2439	1860	3890	2998	2200	4695	3616	2680
10	1076	841	712	1542	1200	995	2093	1625	1300	2727	2113	1645	3444	2665	2030	4241	3278	2400	5123	3957	2920
15	1247	986	825	1794	1410	1158	2440	1910	1510	3184	2484	1910	4026	3133	2360	4971	3862	2790	6016	4670	3400
20	1405	1116	916	2006	1588	1290	2722	2147	1690	3561	2798	2140	4548	3552	2640	5573	4352	3120	6749	5261	3800
30	1658	1327	1025	2373	1892	1525	3220	2558	1990	4197	3326	2520	5303	4193	3110	6539	5157	3680	7940	6247	4480
50	2024	1640	1280	2911	2347	1863	3964	3183	2430	5184	4149	3075	6567	5240	3800	8116	6458	4500	9837	7813	5475
100	2569	2131	1670	3732	3076	2450	5125	4202	3200	6749	5509	4050	8597	6986	5000	10681	8648	5920	13004	10499	7200

© 1990 by Gas Research Institute

VENT TABLES

Capacity of Type B Double-Wall Vent with Single-Wall Connectors
Serving Two or more Category I Appliances

TABLE 4

Vent Connector Capacity

Vent Height H (ft)		Connector Rise R (ft)		Vent Connector Diameter - D																																	
				3"			4"			5"			6"			7"			8"			9"			10"												
				Appliance Input Rating Limits in Thousands of Btu Per Hour																																	
		FAN			NAT			FAN			NAT			FAN			NAT			FAN			NAT			FAN			NAT			FAN			NAT		
		Min		Max		Max		Min		Max		Max		Min		Max		Max		Min		Max		Max		Min		Max		Max		Min		Max		Max	
6	1	NR	NR	26	NR	NR	46	NR	NR	71	NR	NR	102	207	223	140	262	293	183	325	373	234	447	463	286												
	2	NR	NR	31	NR	NR	55	NR	NR	85	168	182	123	215	251	167	271	331	219	334	422	281	458	524	344												
	3	NR	NR	34	NR	NR	62	121	131	95	174	198	138	222	273	188	279	361	247	344	462	316	468	574	385												
15	1	NR	NR	29	79	87	52	116	138	81	177	214	116	238	291	158	312	380	208	397	482	266	556	596	324												
	2	NR	NR	34	83	94	62	121	150	97	185	230	138	246	314	189	321	411	248	407	522	317	568	646	387												
	3	NR	NR	39	87	100	70	127	160	109	193	243	157	255	333	215	331	438	281	418	557	360	579	690	437												
30	1	47	60	31	77	110	57	113	175	89	169	278	129	226	380	175	296	497	230	378	630	294	528	779	358												
	2	50	62	37	81	115	67	117	185	106	177	290	152	236	397	208	307	521	274	389	662	349	541	819	425												
	3	54	64	42	85	119	76	122	193	120	185	300	172	244	412	235	316	542	309	400	690	394	555	855	482												
50	1	46	69	33	75	128	60	109	207	96	162	336	137	217	460	188	284	604	245	364	768	314	507	951	384												
	2	49	71	40	79	132	72	114	215	113	170	345	164	226	473	223	294	623	293	376	793	375	520	983	458												
	3	53	72	45	83	136	82	119	221	128	178	353	186	235	486	252	304	640	331	387	816	424	535	1013	518												

Common Vent Capacity

Vent Height H (ft)	Common Vent Diameter - D																				
	4"			5"			6"			7"			8"			9"			10"		
	Combined Appliance Input Rating in Thousands of Btu Per Hour																				
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT
6	89	78	64	136	113	100	200	158	144	304	244	196	398	310	257	541	429	332	665	515	407
8	98	87	71	151	126	112	218	173	159	331	269	218	436	342	285	592	473	373	730	569	460
10	106	94	76	163	137	120	237	189	174	357	292	236	467	369	309	638	512	398	787	617	487
15	121	108	88	189	159	140	275	221	200	416	343	274	544	434	357	738	599	456	905	718	553
20	131	118	98	208	177	155	305	247	223	463	383	302	606	487	393	824	673	512	1013	808	626
30	145	132	113	236	202	179	350	286	257	533	446	349	703	570	459	958	790	593	1183	952	723
50	159	145	128	268	233	204	406	337	296	622	529	410	833	686	535	1139	954	689	1418	1157	838

© 1990 by Gas Research Institute

EXAMPLES USING SINGLE APPLIANCE VENTING TABLES

Example 1: Single Draft-Hood-Equipped Appliance

Suppose that an installer has a 120,000 Btu/hr input appliance with a 5 inch diameter draft hood outlet that needs to be vented into a 10 foot high Type B vent system. What size vent should be used assuming (a) a 5-Ft lateral single-wall metal vent connector is used with two 90° elbows, (b) a 5-Ft lateral single-wall metal vent connector is used with three 90° elbows in the vent system?

Solution

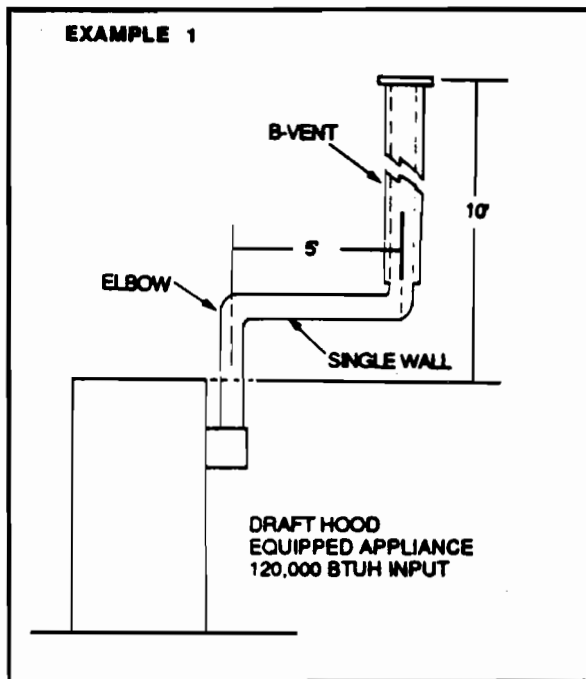
Table 2 should be used to solve this problem because single-wall metal vent connectors are being used with a Type B vent. Refer to Figure 2 of Typical Applications.

- (a) Read down the first column in Table 2 until the row associated with a 10-Ft height and 5-Ft lateral is found. Read across this row until a vent capacity greater than 120,000 Btu/hr is located in the shaded columns labeled "NAT Max" for draft-hood-equipped appliances. In this case, a 5 inch diameter vent has a capacity of 122,000 Btu/hr and may be used for this application.
- (b) If three 90° elbows are used in the vent system, then the maximum vent capacity listed in the tables must be reduced by 10 percent (see Note 6). This implies that the 5 inch diameter vent has an adjusted capacity of only 110,000 Btu/hr. In this case, the vent system must be increased to 6 inches in diameter. See calculations below:

$$122,000 \times .90 = 110,000 \text{ for 5" Vent}$$

From Table 2 - Select 6" Vent

$$186,000 \times .90 = 167,000; \text{ This is greater than the required 120,000, therefore use a 6" Vent}$$



Example 2: Single Fan-Assisted Appliance

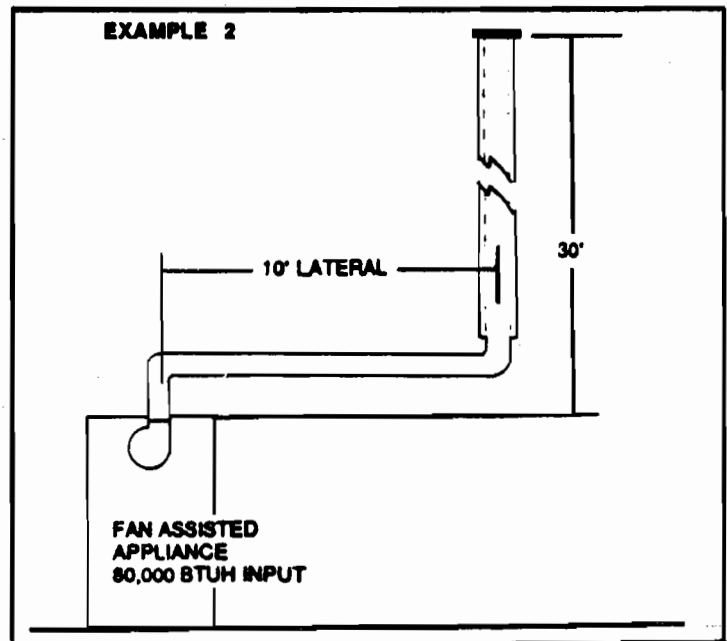
Suppose an installer has an 80,000 Btu/hr input fan-assisted appliance that must be installed using 10 feet of lateral connector attached to a 30-Ft high Type B vent. Two 90° elbows are needed for the installation. Can a single-wall metal vent connector be used for this application?

Solution

Table 2 refers to the use of single-wall metal vent connectors with Type B vent. In the first column find the row associated with a 30-Ft height and a 10-Ft lateral. Read across this row, looking at the "FAN Min" and "FAN Max" columns, to find that a 3 inch diameter single-wall metal connector vent is not recommended. Moving to the next larger size single wall connector (4") we find that a 4 inch diameter single-wall metal connector has a recommended minimum vent capacity of 91,000 Btu/hr and a recommended maximum vent capacity of 144,000 Btu/hr. The 80,000 Btu/hr fan-assisted appliance is outside this range, so we conclude that a single-wall metal vent connector cannot be used to vent this appliance using 10 feet of lateral for the connector.

However, we see that if the 80,000 Btu/hr input appliance could be moved to within 5 feet of the vertical vent, then a 4 inch single-wall metal connector could be used to vent the appliance. Table 2 shows the acceptable range of vent capacities for a 4 inch vent with 5 feet of lateral to be between 72,000 Btu/hr and 157,000 Btu/hr.

If the appliance cannot be moved closer to the vertical vent, then Type B vent could be used as the connector material. In this case, Table 1 shows that for a 30-Ft high vent with 10 feet of lateral, the acceptable range of vent capacities for a 4 inch diameter vent attached to a fan-assisted appliance are between 37,000 Btu/hr and 150,000 Btu/hr.



EXAMPLES USING COMMON VENTING TABLES

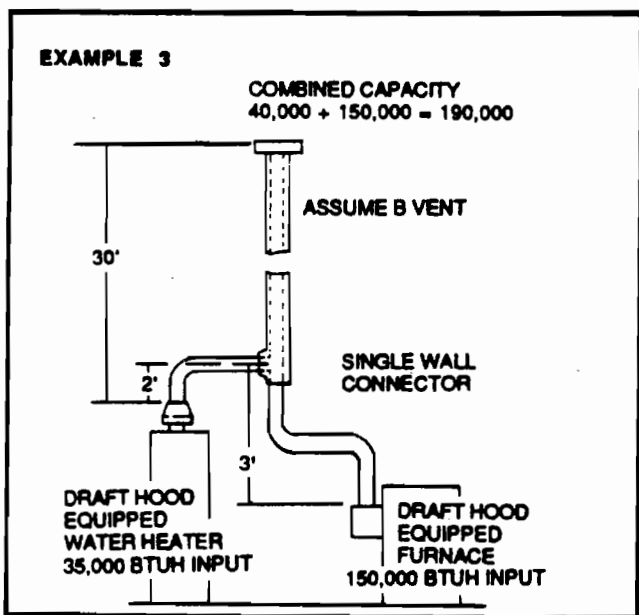
Example 3; Common Venting Two Draft-Hood Appliances

Suppose a 35,000 Btu/hr water heater is to be common vented with a 150,000 Btu/hr furnace using a common vent with a total height of 30 feet. The connector rise is 2 feet for the water heater and 3 feet for the furnace. Assume single-wall metal connectors will be used with Type B vent. What size connectors and combined vent should be used in this installation?

Solution - (Table 4 apply's in this example)

Table 4 should be used to size single-wall metal vent connectors attached to Type B vertical vent. In the vent connector capacity Table 4, find the row associated with a 30-Ft vent height. For a 2-Ft rise on the vent connector for the water heater, read the shaded columns for draft-hood-equipped appliances to find that a 3 inch diameter vent connector has a capacity of 37,000 Btu/hr. Therefore, a 3 inch single-wall metal vent connector may be used with the water heater. For a draft-hood-equipped furnace with a 3-Ft rise, read across the appropriate row to find that a 5 inch diameter vent connector has a maximum capacity of 120,000 Btu/hr (which is too small for the furnace) and a 6 inch diameter vent connector has a maximum vent capacity of 172,000 Btu/hr. Therefore, a 6 inch diameter vent connector should be used with the 150,000 Btu/hr furnace.

For the capacity of the combined vent, the lower portion of Table 4 should be used. The combined vent capacity required is 185,000 Btu/hr. Table 4 shows that the combined vent capacity of a 6 inch diameter vent with a 30-Ft vent height is 257,000 Btu/hr. This is more than adequate to handle the 35,000 Btu/hr input water heater and the 150,000 Btu/hr input furnace.

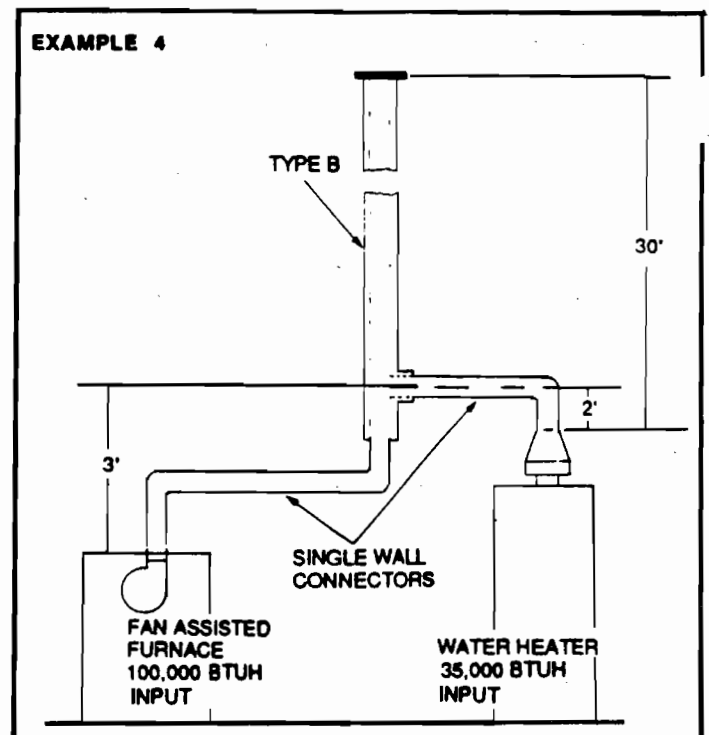


Example 4: Common Venting a Draft Hood Water Heater with a Fan-Assisted Furnace

In this case, a 35,000 Btu/hr input draft-hood-equipped water heater with a 2 foot connector rise is to be common vented with a 100,000 Btu/hr fan-assisted furnace with a 3-Ft connector rise. The common vent consists of a 30-Ft rise of Type B vent. What are the recommended vent diameters for each connector and the common vent?

Solution - (Table 4)

Water Heater Vent Connector Diameter. Let us assume the installer would like to use a single-wall metal vent connector. Using Table 4, Vent Connector Capacity, read down the Total Vent Height "H" column to 30 feet and read across the 2-Ft Connector Rise "R" row to the first Btu/hr rating in the "NAT Max" column that is equal to or greater than the water heater input rating. The table shows that a 3 inch vent connector has a maximum input rating of 37,000 Btu/hr. Since this is greater than the water heater input rating, a 3 inch vent connector is adequate. Furthermore, since the water heater is equipped with a draft hood, there are no minimum input rating restrictions.



Furnace Vent Connector Diameter. Again, let us assume the installer would like to use a single-wall metal vent connector. Using Table 4, Vent Connector Capacity, read down the Total Vent Height "H" column to 7 feet and across the 3-ft Connector Rise "R" row.

Since the furnace has a fan-assisted combustion system, find the first "FAN Max" column with a Btu/hr rating greater than the furnace input rating. The 4 inch vent connector has a maximum input rating of 119,000 Btu/hr and a minimum input rating of 85,000 Btu/hr. The 100,000 Btu/hr furnace in this example falls within this range, so a 4 inch connector is adequate. If the furnace would have had an input rating of 80,000 Btu/hr, then a Type B vent connector (see Table 4) would have to be used in order to meet the minimum capacity limit.

Common Vent Diameter. The total input to the common vent is 135,000 Btu/hr. Using Table 4, Common Vent Capacity, read down the Total Vent Height "H" column to 30 feet and across this row to find the smallest vent diameter in the "FAN+NAT" column that has a Btu/hr rating equal to or greater than 140,000 Btu/hr. The 4 inch common vent has a capacity of 132,000 Btu/hr and the 5 inch common vent has a capacity of 202,000 Btu/hr. Therefore, the 5 inch common vent should be used in this example.

Summary. In this example, the installer may use a 3 inch diameter, single-wall metal vent connector for the water heater and a 4 inch diameter, single-wall metal vent connector for the furnace. The common vent should be a 5 inch diameter Type B vent.

PRODUCT DESIGN

XIII. GSI Furnace Horizontal Side Wall Venting

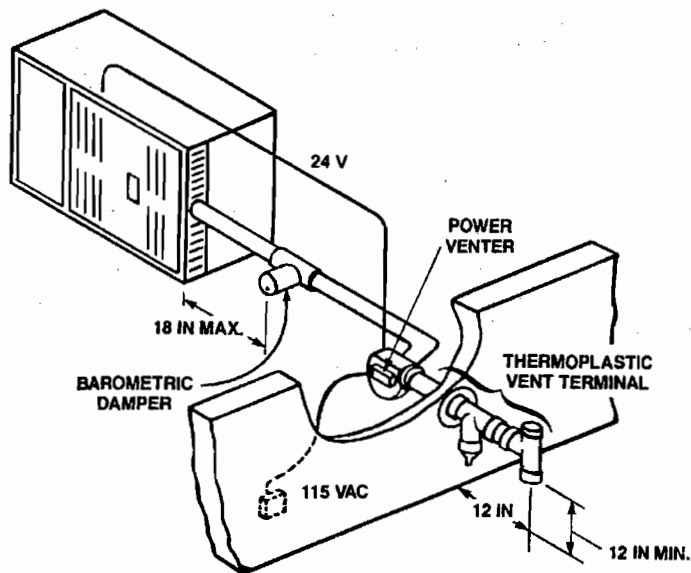


FIGURE 1

Horizontal Vent System

Required Materials

The following special materials and components are required when venting this appliance horizontally through a side wall. In some cases, optional component manufacturers are listed.

Description	Manufacturer	Part	Qty
Power Venter	Tjernlund Products, Inc.	HST-J	1
RTV Sealant	Dow Corning Corp.	RTV 732 or 736	AR
RTV Prime Coat	Dow Corning Corp.	1200 Prime Coat	AR
3" Wall Thimble	Selkirk Metalbestos Americal Metal Products	- OR - SM 3PV-WT AMP 3PWT	1 1
Barometric Damper Single Acting			1
4" - 3" Metal Reducer			1
Single-Wall or Type B Vent Pip and Fittings**			AR
Class 1 Wiring			AR
3" I.D. Plexvent® Pipe	Plexco, Inc.	901220	5 ft.
3" Plexvent Coupling	Plexco, Inc.	905630	1
3" Plexvent Tee	Plexco, Inc.	905268	1
3" Plexvent Cond. Drain*	Plexco, Inc.	901462	1
3" Plexvent Term. Tee	Plexco, Inc.	901971	1
- OR -			
3" I.D. Ultravent® Pipe	Hart & Cooley, Inc.	17849	5 ft.
3" Ultravent Coupling	Hart & Cooley, Inc.	17855	1
3" Ultravent Tees*	Hart & Cooley, Inc.	17854	2
3" Ultravent Drain Plug*	Hart & Cooley, Inc.	17858	1
3" Ultravent Debris Screens	Hart & Cooley, Inc.	17869	2

Plexvent® is a registered trademark of Plexco, Inc.

Ultravent® is a registered trademark of Hart & Cooley, Inc.

*A coupling may be substituted for the drain and tee combination if the vent terminal is to be installed in a location where it is not exposed to rain, such as under an overhang, or where it slopes downhill from the power venter outlet.

**For many installations, Single-Wall Vent Pipe will not be suitable. See Page 62 for details.

AR = As required.

Some installations may require this appliance to be horizontally-vented directly through a side wall. When this occurs, the instructions listed below must be followed in order to insure safe and reliable operation. A completed horizontal vent system for GSI furnace is shown in Figure 1, while the GUI/GHI horizontal vent system is shown in Figure 2. When properly installed, the vent system is shown in Figure 2. When properly installed, the vent extending from the furnace to the power venter is under negative pressure, and the furnace operates as a Category I appliance. THIS SYSTEM IS ONLY TO BE USED WITH ONE GSI FURNACE. COMMON VENTING WITH OTHER APPLIANCES IS NOT ALLOWED.

PRODUCT DESIGN

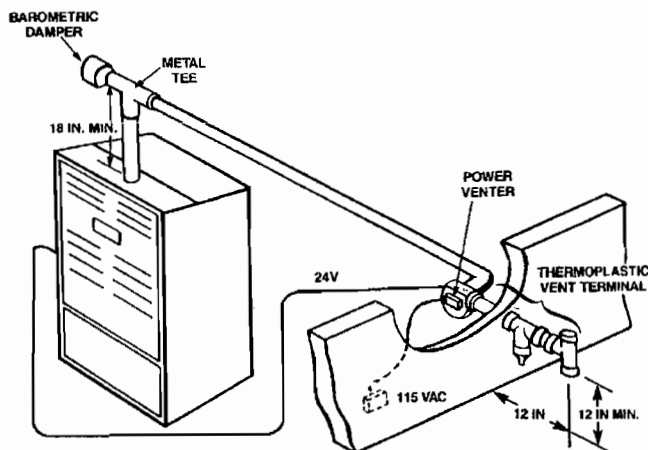


FIGURE 2

Vent Pipe Selection Location



TO AVOID THE POSSIBILITIES OF PERSONAL INJURY, ILLNESS, DEATH, PROPERTY DAMAGE, AND/OR FIRE; BE SURE TO OBSERVE THE PRECAUTIONS BELOW REGARDING VENT PIPE SELECTION AND LOCATION.

1A. Select a suitable location for the power venter and vent termination:

- The bottom of the vent termination tee must be at least 12 inches above ground level, and at least 12 inches above expected snow accumulation level.
- All portions of the vent termination tee must be at least 4 feet below, 4 feet horizontally from, or 1 foot above any door, window, or gravity air inlet into any building.
- All portions of the vent termination tee must be at least 3 feet above any forced air inlets located within ten (10) feet.
- If local experience indicates that condensation of flue gases could occur with this type of installation, then the vent termination tee shall not terminate over public walkways, or over or under 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. A clearance of four feet above the vent termination to eaves or decks should be observed.
- Do not locate the vent termination tee near shrubs or trees, since flue products may damage them.

- All thermoplastic portions of the vent termination must have at least three inches clearance to all combustible surfaces.
- Avoid areas where children will have ready access to the vent terminal, as the vent terminal and/or flue gases may be hot enough to cause burns.

1B. Determine the length of metal pipe and the number of fittings required to run the flue pipe from the furnace outlet to the power venter inlet. The power venter is to be located as close as possible to the side wall.



THE LENGTH OF STRAIGHT PIPE CANNOT EXCEED 50 FEET. NO PORTION OF THE POWER VENTING SYSTEM CAN EXTEND INTO OR PASS THROUGH ANY CIRCULATING AIR DUCT OR PLENUM.

2. Calculate the equivalent feet of the metal flue pipe from the following equation. For this calculation, one 45 degree elbow is equivalent to one half of a 90 degree elbow.

$$\text{Equiv. ft.} = \text{Straight ft.} + \left(\frac{\#90 \text{ deg elbows}}{2} \times \begin{matrix} 7.5' \text{ for } 3'' \text{ pipe} \\ \text{or } 10.0' \text{ for } 4'' \text{ pipe} \end{matrix} \right)$$

Example: Calculate the equivalent length of 4" pipe for 20 feet of straight 4" pipe with two 90 degree elbows.

Solution: $20.0 + (2 \times 10.0) = 40.0$ equivalent feet of 4" pipe.

3. Enter Table 1 and read the maximum allowable equivalent pipe length for the desired pipe diameter and furnace input. This maximum allowable equivalent length must be greater than, or equal to, the equivalent length of calculated in Step 2.

Example: Determine if a 115,000 BTUH furnace may be installed with 40.0 equivalent feet of 4" pipe.

Solution: From Table 1, the maximum allowable length is 80 equivalent feet of 4" pipe, so 40.0 equivalent feet is acceptable.

Table 1 Maximum Allowable Equivalent Feet

Input (BTUH)	3" pipe	4" pipe
45,000	80	80
70,000	80	80
90,000	80	80
115,000	NA	80
140,000	NA	80

(NA - Not Approved)

PRODUCT DESIGN

4. Select the flue pipe material (single-wall or Type B vent).

If single-wall metal pipe is to be used, the following requirements must be met.

- The single-wall pipe must be located entirely in a space which will be heated to 60°F. or higher.
- The single-wall pipe must have a straight length of 30 feet or less, an equivalent length of 80 feet or less as calculated above, and a diameter as shown in Table 1.
- The single-wall pipe must not pass through any interior wall, attic, concealed space, or floor.
- The single-wall pipe must have a minimum clearance of 6 inches from all combustible materials.
- The single-wall pipe must be constructed of galvanized sheet steel of at least 26 Gauge. (.019 inch) thickness.

If Type B vent is to be used, the following requirements must be met:

- The Type B vent must have a straight length of 50 feet or less, an equivalent length of 80 feet or less as calculated above, and a diameter as shown in Table 1.
- The Type B vent must have a minimum clearance of 1 inch from all combustible materials.
- If the Type B vent must pass through floors, ceilings, or interior walls; then it must be installed with the proper clearance to combustible materials and be fire-stopped according to local codes and the National Fuel Gas Code.

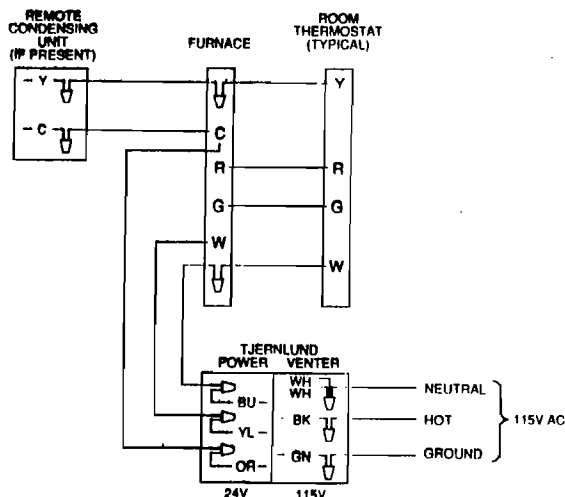
Vent System Installation

1. Remove the furnace access door. If the rating plate does not give instructions for horizontal venting, affix the Amana horizontal venting label 10290202 from Horizontal Venting Kit HVLK01 beside the existing rating plate.
2. Mount the power venter according to the manufacturer's instructions.
3. Install the metal flue pipe and the single-acting barometric damper as shown in Figure 1 for GSI furnaces or Figure 2 for GUI/GHI furnaces. The damper must connect to a horizontal tee off the flue pipe no more than 18 inches from the furnace outlet (GSI furnaces), or at least 18 inches above the furnace outlet (GUI/GHI furnaces). Consult local building codes and manufacturers' instructions for proper installation procedures.
4. Wire the power venter as shown in Figure 3. the vent proving switch must be wired in series with the room thermostat, as shown. The timer relay should be set such that, following furnace shutdown, the power venter will operate longer than will the furnace's combustion blower. When the

timer relay is set to its minimum position, the power venter will operate for about 45 seconds following furnace shutdown.

5. Make sure the heat anticipator in the room thermostat is set as shown on the furnace wiring diagram.
6. Proper sequence of operation is as follows:
 1. The room thermostat calls for heat.
 2. The timer relay on the power venter closes.
 3. The power venter blower begins operating. The barometric damper may open.
 4. The fan proving (pressure) switch on the power venter closes.
 5. A 24V signal is now present at terminal W of the furnace's induced draft blower begins operating. The barometric damper may close partially or completely, or may remain open.
 6. The pressure switch on the furnace closes.
 7. Assuming there is no interruption from the safety controls or ignition control, the ignition control is energized.
 8. The ignition control energizes the hot surface ignitor for the specified time. Consult the furnace's installation or service manual for details.
 9. At the end of the specified time, and assuming there is no interruption from the safety controls, the gas valve opens, and combustion begins.
 10. Once flame is proven, the ignitor is deenergized.
 11. Some time after the gas valve opens, the air circulation blower on the furnace begins operating. Consult the furnace's installation or service manual for details.
 12. When the room thermostat stops calling for heat, the 24 V coil on the power venter's timer relay is deenergized.
 13. The 24V signal at terminal W of the furnace is lost, and the furnace gas valve closes. Combustion ends.
 14. Assuming you have set the time to its minimum setting, the 115V contacts on the power venter's timer relay will remain closed for approximately 45 seconds. During this time, the power venter's blower will continue to operate.
 15. The air circulation blower on the furnace will continue to operate for some period of time. On some furnaces, the induced draft blower will also continue to operate. Consult the furnace's installation or service manual for details.
 16. Eventually, all three blowers (power venter, air circulation, and induced draft) will cease operation. Once the power venter's blower ceases to operate, the barometric damper will close.

PRODUCT DESIGN



NOTES: 115V wiring and ground to furnace, and line voltage wiring and ground to condensing unit are not shown as above. Some room thermostats will require that a connection be made from C (furnace) to C (thermostat). Disconnects and overcurrent protection are not shown above. All wiring which connects to the power venter must be installed in accordance with the power venter manufacturer's instruction.



WARNING

TO AVOID PERSONAL INJURY, SHOCK, OR DEATH, DISCONNECT THE ELECTRICAL POWER BEFORE ELECTRICALLY CONNECTING ANY EQUIPMENT OR CHANGING ANY EXISTING WIRING.

COLOR CODE 1ST GROUP-COLOR 2ND GROUP-NUMBER

OR - ORANGE	BK - BLACK
YL - YELLOW	BU - BLUE
VT - VIOLET	RD - RED
BR - BROWN	TN - TAN
GN - GREEN	WH - WHITE

NOTE: It is recommended that the power venter's time relay be adjusted such that the power venter will operate longer than will the induced draft blower.

Vent Terminal Assembly



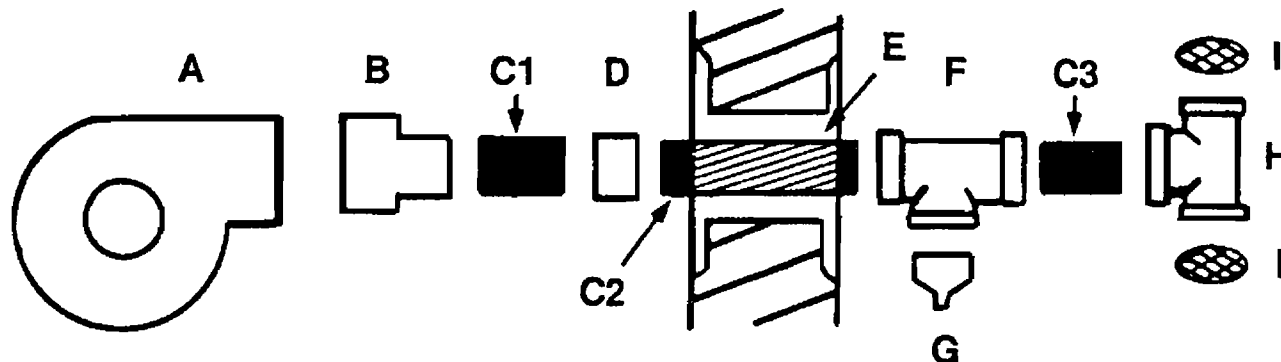
WARNING

TO AVOID POSSIBLE PERSONAL INJURY OR DEATH FROM ASPHYXIATION FOLLOW THESE INSTRUCTIONS:

Assemble the vent terminal as shown in Vent Terminal Assembly Figure, according to the following instructions. **SINCE THE OUTLET SIDE OF THE POWER VENTER IS POSITIVELY PRESSURED, ALL PIPE DOWNSTREAM**

OF THE POWER VENTER (OTHER THAN THE METAL REDUCER) MUST BE THERMOPLASTIC VENT PIPE, AND ALL JOINTS MUST BE SEALED WITH RTV 732 OR 736. DO NOT DRILL HOLES OR DRIVE SHEET METAL SCREWS OR RIVETS THROUGH THE TERMINAL PIPE OR FITTINGS.

1. Cut the thermoplastic pipe to length using a sharp handsaw. Pipe section C2 must be sized to allow D and F to be placed firmly against the wall thimble to provide structural integrity. Section C3 must be six inches in length to that the center-line of the termination tee is twelve inches from the outside surface of the side wall. (If a coupling has been substituted for F, then section C3 must be 9 1/4 inches.)



VENT TERMINAL ASSEMBLY

PRODUCT DESIGN

2. Clean and smooth all pipe ends.
3. Apply a thin film of the prime coat to all joint surfaces. Allow to air dry for 30 to 45 minutes at room temperature.
4. Seal each joint by applying a 1/4 inch continuous bead around each pipe end, approximately 1/8 inch from the edge. ITEMS A AND B MUST BE SECURED WITH SHEET METAL SCREWS; AND, THIS JOINT MUST ALSO BE SEALED WITH RTV 732 OR 736. DO NOT USE ANY SHEET METAL SCREWS TO CONNECT ITEM C1 TO ITEM B. USE ONLY PRIME COAT, AND RTV 732 OR 736 FOR THIS JOINT.
5. Insert the pipe into the fittings, rotating the pipe until the pipe bottoms out in the fittings' sockets. Full joint strength is developed after 24 hours.

MAINTAIN A 3 INCH MINIMUM AIR SPACE BETWEEN THE THERMOPLASTIC VENT PIPE AND ANY COMBUSTIBLES.

See Item 1A under "Vent Pipe Selection" for complete termination requirements.

Setting the Draft

1. Insofar as is practical, close all building doors and windows and all doors between the space in which the furnace is located and other spaces of the building.
2. Turn on clothes dryers and any appliance not connected to the power venting system. Adjust thermostats so these appliances will operate continuously at their full inputs. Turn on any exhaust fans such as range hood and bathroom exhausts, so they will operate at their maximum speed. Do not operate a summer exhaust fan. Close fire place dampers.
3. Attach a pressure tap on the vent six to nine inches downstream from the flue collar of the furnace, and upstream of the metal tee which holds the barometric damper. Using a flexible hose, connect this pressure tap to an inclined manometer. Make certain the manometer is level, and is zeroed correctly.
4. Following the instructions shipped with the furnace, prepare the furnace for operation. Adjust the room thermostat so that the furnace and the power venter will operate continuously.
5. Wait five minutes after the gas valve opens, then examine the inclined manometer. By following the manufacturers' instructions, the power venter's air-flow damper control and the barometric damper's counterweight are to be adjusted until

the inclined manometer indicates a static pressure of -.05 to -.10 inches water column.



THE POWER VENTER AND THE BAROMETRIC DAMPER MAY BE HOT. TO AVOID BURNS, USE CAUTION, PROTECTIVE HAND COVERING AND CONSULT MANUFACTURERS' INSTRUCTIONS BEFORE ADJUSTING.

6. Test for draft hood spillage at the draft hood relief opening of the other appliances. Use the flame of a match or candle. For proper venting, smoke or flame should be drawn into the draft hood.
7. If improper venting is observed, or if you need further information on this topic, see Horizontal Venting Installation Instructions.
8. After it has been confirmed that each appliance vents properly when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers, and all appliances to their previous conditions of use.



UPON COMPLETION OF THE FURNACE INSTALLATION, CAREFULLY INSPECT THE ENTIRE FLUE SYSTEM. METAL VENT PIPE MUST BE PROPERLY ASSEMBLED AND SUPPORTED IN ACCORDANCE WITH THE VENT PIPE MANUFACTURER'S INSTRUCTIONS. THE VENT TERMINAL MUST BE CAREFULLY INSPECTED TO ASSURE IT IS PROPERLY SEALED. LEAKS IN THE VENT TERMINAL COULD RESULT IN SERIOUS PERSONAL INJURY OR DEATH DUE TO EXPOSURE OF FLUE PRODUCTS, INCLUDING CARBON MONOXIDE.

PRODUCT DESIGN

DUCTWORK

Duct systems and register sizes must be properly designed for the CFM and external static pressure rating of the furnace. Ductwork should be designed in accordance with recommended methods of "National Environmental Systems Contractors Association" manual.

Oversizing ductwork is unnecessarily expensive, while undersizing can be even more expensive in terms of customer dissatisfaction and service problems. When ductwork is undersized, imposing higher external static pressure than the furnace is designed for, the result is either poor air distribution or noise problems.

Motors used on direct drive blowers automatically increase speed with increase in external static pressure, and thus may become noisy when the external static pressure is excessive.

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

It is a must that a closed return duct system be used, with return duct connected to furnace, and that supply and return duct connections at the unit 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 SO THAT THE FURNACE BLOWER WILL NOT INTERFERE WITH COMBUSTION AIR OR DRAFT. ROOM, CLOSET, OR ALCOVE IN WHICH THE FURNACE IS INSTALLED MUST NOT BE USED AS A RETURN AIR COLLECTING CHAMBER.

FILTERS

Furnaces which are designed for low air velocity through the filter are equipped with disposable filters which must be periodically replaced to obtain proper operation.

Furnaces with higher velocities through the filters, such as air conditioning types, are equipped with permanent type washable high-velocity filters. These filters must be cleaned periodically, following filter manufacturer's instructions on the filter. If replacement of the permanent type filter supplied with the furnace ever becomes necessary, it must be REPLACED WITH A FILTER OF THE SAME TYPE. DISPOSABLE FILTERS MUST NOT BE USED. When two filters are required, on up-flow models, return air openings shall be cut in each side panel, or one duct large enough to carry the en-

tire return CFM and install the two filters supplied with the furnace in an inverted position.

BOTTOM RETURN AIR

The bottom of the cabinet has to be removed (knocked or cut-out) before the furnace is positioned on the raised platform or set on top of the return air duct.

In order to filter the return air, a filter has to be installed across the bottom opening. See the following for the recommended size filter. In some cases the filter size must be reduced or increased. Therefore, the filter supplied with the furnace may not have the correct dimensions.

See sketch below on how the filter is retained over the bottom return air opening.

BOTTOM RETURN AIR FILTER SIZE

45,000 & 70,000	14 x 25 x 1 Permanent
90,000	16 x 15 x 1 Permanent
115,000 & 140,000	20 x 25 x 1 Permanent



FIGURE 16

PLUMBING

Proper sizing of gas piping depends on the cubic feet per hour of gas flow required, specific gravity of the gas and the length of the run. In cases where local regulations are at variance with instructions, installer should adhere to local code, or in absence of local codes, with the National Fuel Gas Code, ANSI Z223.12-1987. (Canadian - CAN/COA B149 Installation Codes.)

All gas piping should comply with Standards for Installation of Gas Piping and Gas Appliances in Buildings. Connect gas supply, placing main manual shut-off valve or service valve at least five feet from floor, when required by local codes.

PRODUCT DESIGN



DO NOT SUPPORT THE GAS PIPING ADJACENT TO THE FURNACE WITH THE GAS VALVE. TIGHTEN PIPE NIPPLE INTO FURNACE GAS VALVE WITH PIPE WRENCH AND USE A PARALLEL JAW WRENCH ON ADJACENT HEX OF THE GAS VALVE. DO NOT APPLY FORCE THROUGH VALVE BODY. THE PIPING TO THE FURNACE MUST INCLUDE A DRIP LEG IN THE FORM OF A TEE AND CAPPED NIPPLE AHEAD OF GAS VALVE. A UNION OF THE GROUND JOINT OR FLANGE TYPE MUST BE INSTALLED (NORMALLY INSIDE THE CASING) BETWEEN THE MAIN MANUAL VALVE OR SERVICE VALVE AND THE MANIFOLD CONTROLS SO THAT THE CONTROLS CAN BE REMOVED FOR SERVICING.

Check all connections for leaks when piping is completed, using a soap solution - never an open flame.

The blower motor for air distribution is a permanent split capacitor direct drive type. The direct drive motors are multiple speed tap motors so the installer may select the proper speed for respective air flow requirements. (See Specification section for CFM and temperature rise versus external static pressure.)

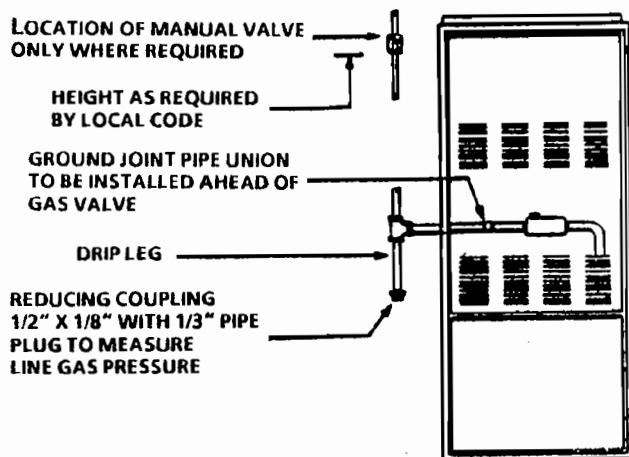


FIGURE 17

GENERAL

Supply and return duct connections are made to the appropriate end of the furnace.

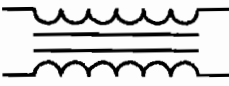
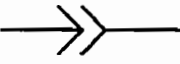
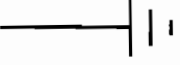
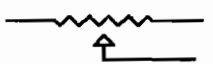
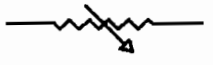
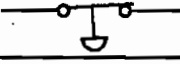
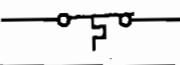
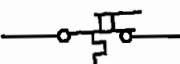
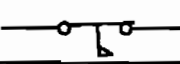
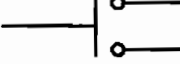
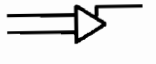
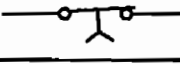
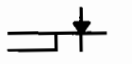
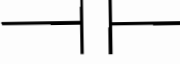
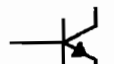
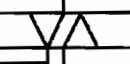
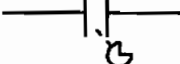
Duct systems and register sizes must be properly designed for the CFM and external static pressure rating of the furnace.

Conditioned air (room) is down through the filters, into the blower and then discharged over the heat exchanger.

Air conditioning may be used in conjunction with those units so designated without any major changes.

SYSTEM OPERATION

ELECTRICAL SYMBOL IDENTIFICATION

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	TRANSFORMER		CONNECTOR
	RELAY HOLDING COIL (FAST ACTION)		TIE CONNECTION
	RELAY HOLDING COIL (TIME DELAY)		GROUND CONNECTION
	FIXED RESISTANCE (HEATERS, ANTICIPATORS, ETC.)		FUSE, FUSESTAT
	ADJUSTABLE RESISTANCE (ANTICIPATORS, POTENTIOMETER, ETC.)		CIRCUIT BREAKER
	PTC RESISTANCE (POSITIVE TEMP COEFFICIENT-RESISTANCE CHANGE AS TEMP. CHANGES)		OVERLOAD
	MOTOR WINDINGS		FUSE LINK
	SOLENOID COIL, GAS VALVE COIL, ETC.		NC PRESSURE SWITCH (AUTO RESET)
	CAPACITOR		NC TEMPERATURE SWITCH (AUTO RESET)
	OVERLOAD, CURRENT-TEMP. OPERATED-AUTO RESET		NC TEMPERATURE SWITCH (MANUAL RESET)
	INDICATING LAMP		NC SAIL SWITCH (AUTO RESET)
	DIODE		NO PUSH BUTTON SWITCH
	AMPLIFIER		NC TIME DELAY SWITCH- (BREAK ON POWER INTERRUPTION)
	SILICON CONTROLLED RECTIFIER		NO CONTACTS SPST
	TRANSISTOR		NC CONTACTS SPST
	TRIAC		SPDT CONTACTS 1-NC, 1-NO
	PHASED TRANSFORMER POWER SIDE OF PRIMARY TO POWER SIDE OF SECONDARY		NO CONTACTS (MECHANICAL OPERATED)

SYSTEM OPERATION

HEATING CYCLE

The following schematics illustrate each of the control and electrical components wired into the electrical circuit.

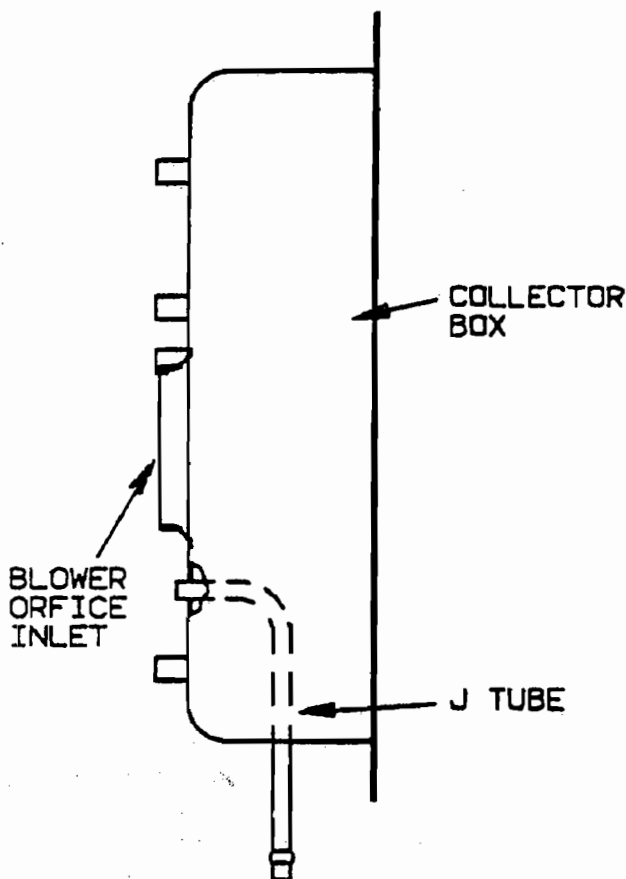
The system may be controlled by any good heating or heating/cooling thermostat, however, it must have an adjustable heating anticipator.

In order to illustrate the heating sequence using an induced draft blower motor, the following has been simplified to give a better understanding of the pressure switch operation.

The induced draft blower motor assembly is mounted to the collector box so the blower orifice inlet is the inlet to the blower wheel. When the motor is in operation, a negative pressure will be created on the J-tube, collector box and heat exchanger flue passages.

A pressure control using a single pole, double throw electrical switch is used as a safety requirement in case of a blocked flue. "C" Canadian Models also require a temperature activated vent safety switch.

The following illustrates the pressure control in an off and on position.



NOTE: J-tube must protrude 1/8" for proper negative reading to be obtained.

FIGURE 18

The first illustration is an end view of the collector box with J-tube. This box is mounted on the front of the Heat Exchanger with its flue passages terminating into the collector box.

The J-tube has a predetermined orifice size for reading static pressures.

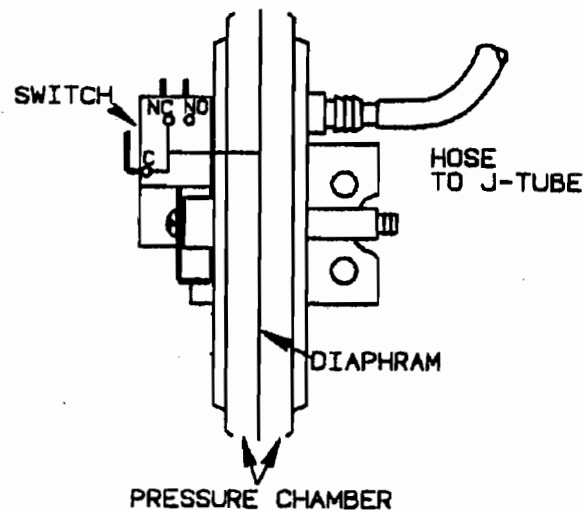


FIGURE 19

With the furnace in the off position the induced draft blower motor will not be running. Atmospheric pressure will therefore be on both sides of the diaphragm and the electrical switch will be made between (C) common and (NC) normally closed terminals.

SYSTEM OPERATION

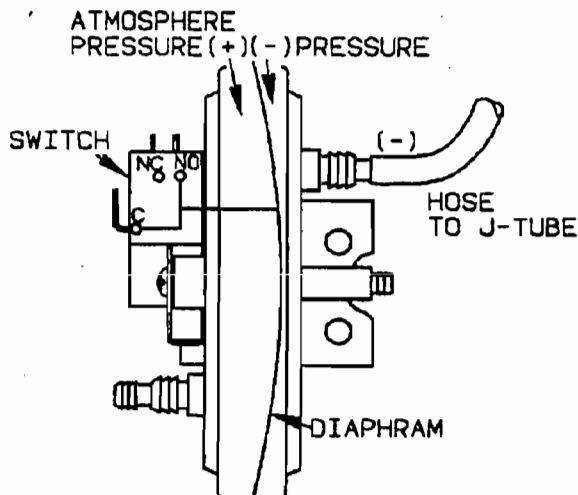


FIGURE 20

When the induced draft blower motor is in operation, the J-tube hose will create a negative pressure on one side of the diaphragm and atmospheric pressure will be on the other side causing the diaphragm to move toward the negative pressure.

This in turn will open the (NC) normally closed switch and make the (C) common to the (NO) normally open terminals.

In the event of a partially restricted or blocked flue pipe our induced draft blower will create less negative pressure and at approximately $-.54''$ W.C. negative pressure would open the contacts (C) to (NO).

HEAT SEQUENCE

1. Room thermostat calls for heat.
2. Combustion relay holding coil becomes energized through the (NC) normally closed set of contacts of the pressure switch.
3. A set of contacts close starting the induced draft blower motor. Another set of contacts close, which are wired in parallel to the pressure switch, keeping the combustion relay energized.
4. As the induced draft blower motor comes up to speed, a high negative pressure is created causing the (NO) normally open set of contacts in the pressure control to close.
5. The ignition control module, now becomes energized. The ignition control now energizes the hot surface ignitor for a period of 45 seconds.

6. At the end of the ignitor warm-up, the ignition control energizes the gas valve allowing gas to flow to the burners for combustion and provides a minute voltage (for micro-amp circuit) for proof of flame.
7. Soon as flame is proved (completed micro-amp circuit) the ignitor is de-energized. The maximum time allowed to prove combustion is seven seconds before the control retrips or locks out.
8. When the fan control has been heated to its pre-set cut-in temperature and closes, the indoor fan motor will come on to distribute the heated air.

In the event, combustion was not proven as in Step 7, the gas valve is de-energized and the ignition control will attempt a "retry" after a 60 second wait period. If this ignition attempt is unsuccessful, one more retry will be made before lockout.

The ignition control will repeat the ignition sequence for a total of three retries if flame is lost within the first ten seconds of establishment. The total of ignition retries plus the number of recycles cannot exceed eight.

If flame is established for more than ten seconds after ignition, the control will clear the ignition attempt (or retry) counter. If flame is lost after ten seconds, within .8 second the gas valve will de-energize and the control will restart the ignition sequence.

If the ignition control should go into lockout after unsuccessful attempts to light, the control may be reset by momentary power interruption of either the 24 volt or line voltage circuits.



**NEVER BYPASS ANY
SAFETY COMPONENTS.**

SAFETY COMPONENTS

A combination fan and limit switch is used on each furnace. The limit setting is fixed and must not be readjusted in the field.

Depending on the individual type of furnace (upflow, counterflow, etc.) will determine as to what the cutout point setting of the control will be.

In all instances the limit portion of the control is wired in series with the ignition control.

If the temperature within the furnace should exceed this setting, the control will open, de-energizing the ignition control which in turn will open the electrical circuit to the gas valve.

The control will automatically reset when the temperature within the combustion chamber is sufficiently lowered.

AUXILIARY LIMIT CONTROL

On the counterflow and horizontal furnaces, an additional limit switch is required for safety control of high temperature within the furnace or duct work.

This control is a preset non-adjustable control mounted in the blower compartment area.

It is connected in series with the limit control wiring to the ignition control. If its temperature should be exceeded, it will open, interrupting the voltage to the gas valve causing it to close.

This control is temperature actuated and manual reset.

FLAME SENSING DEVICE

A flame sensing device is used in conjunction with the ignition control module to prove combustion. If a micro-amp signal is not present the control will de-energize the gas valve and "retry" for ignition or lockout.

PRESSURE CONTROL

A pressure control device is used to measure negative pressure at the induced draft blower motor inlet to detect a partial or blocked flue.

BLOWER MOTOR OVERLOAD (INTERNAL)

All blower motors have current temperature sensitive overload, wired internal within the motor winding. This device will open to protect the motor windings due to excessive amperage draw or temperature rise caused by overloading, voltage variations, restricted air-flow and etc. Once the heat generated within the motor body has been dissipated the overload will automatically reset.

VENT SAFETY SWITCH (CANADIAN) (C & CV)

A temperature actuated, manual reset control is mounted adjacent to the flue outlet on a small "Fresh Air" duct.

In the event of a restriction at the flue outlet, flue gases will pass over the control causing it to open, shutting the furnace down.

OPERATING COMPONENTS

CAPACITOR

The direct drive motors are of the permanent split capacitor design. A run capacitor is wired across the auxiliary and a portion of the main windings. The capacitors primary function is to reduce the line current while greatly improving the torque characteristics of a motor. This is accomplished by using the 90° phase relationship between the capacitor current and voltage in conjunction with the motor windings so that the motor will give two phase operation when connected to a single phase circuit. The capacitor also reduces the line current to the motor by improving the power factor to the load.

FAN RELAY (HEATING AND COOLING MODELS)

The relay magnetic holding coil is wired into the low voltage circuit.

For direct drive furnaces the contacts are single pole double throw or one normally closed and one normally open. The normally closed contacts are wired in series with the fan switch to control the blower motor in the heating cycle. The normally open contacts are wired in series with a different motor speed for cooling.

In the case of a direct drive furnace, the normally closed contacts would open and the normally open contacts would close energizing the blower motor on a higher speed. This also prevents more than one motor speed being energized at one time.

TRANSFORMER

A step-down transformer 120 volt primary to 24 volt secondary, 40 VA (Heating and Cooling Models) supplies ample capacity of power for either operation.

FAN CONTROL

A combination fan and limit switch is used on each furnace. The fan setting is field adjustable and should be set in accordance with each installation.

The fan "ON" setting should be high enough to minimize the blowing of cold air, when the blower first comes on.

Most satisfactory results are obtained when the blower operates for prolonged periods and stops only when register temperature is so low to cause discomfort.

In all instances the fan portion of the control is wired in series with the blower motor. On a temperature rise within the furnace, which reaches to predetermined setting for the "ON" cycle, the contacts will close energizing the blower motor. The motor will continue to run until the temperature is lowered to the cut-off point.

GAS VALVE

A combination redundant operator type gas valve which provides all manual and automatic control functions required for gas fired heating equipment is used.

The valve provides control of main burner gas flow, pressure regulation and 100% safety shut-off.

HOT SURFACE IGNITOR

A silicon carbide resistive element ignitor is used for ignition. The normal operating temperature is approximately 2550°F.

IGNITION CONTROL MODULE

An electronic and electrical-mechanical device used for control of ignitor, gas valve and proof of combustion.

ROLL OUT LIMIT

This control is temperature actuated and manual reset.

It is connected in series with the limit control wiring to the ignition control. If its temperature should be exceeded, it will open, interrupting the voltage to the gas valve causing it to close.

The owner should be made aware of the fact, that as with any mechanical equipment, the gas furnaces require regularly scheduled maintenance to preserve high performance standards, prolong the service life of the equipment and less the chance of costly failure.

In many instances the owner may be able to perform some of the maintenance, however, the advantage of a service contact which places all maintenance in the hands of a trained serviceman should be pointed out to the owner.



DISCONNECT ELECTRIC POWER SUPPLY BEFORE SERVICING.

ONCE A MONTH

1. Inspect the return air filter(s) and clean or replace if necessary. **NOTE:** Depending on operating conditions, it may be necessary to clean or replace the filters more often.

ONCE A YEAR

Qualified Service Personnel Only

1. Replace the air filters.
2. Remove the blower assembly, clean the blower wheel and inspect the blower wheel setscrew for tightness (Direct Drive Models).
3. Even though the blower motor is permanently lubricated, oil ports are provided and plugged at the front and rear bearings. Under continuous blower operation it may be advisable to lightly (2 or 3 drops) lubricate both bearings. Use an SAE 20 weight motor oil.

NOTE: Use only Anderol 465 to lubricate the induced draft motor.

4. Inspect all wiring connections for tightness and wire insulation to be certain that it is good.
5. Check the combustion chamber (heat exchanger) for soot, scale, and etc. Inspect all burners for lint, proper position, and air shutter adjustment.
6. Start the system, using proper instrumentation - check gas inlet and manifold pressure, burner flame and micro-amp output. Adjust if necessary.

Conduct a heating performance test to confirm proper air distribution and temperature rise.

POWER VENTING SYSTEM MAINTENANCE

Qualified Service Personnel Only



TO AVOID ELECTRICAL SHOCK, INJURY OR DEATH, DISCONNECT ELECTRICAL POWER FROM ALL EQUIPMENT BEFORE PERFORMING ANY MAINTENANCE.

At least once each year, check the installation to be certain the furnace has an adequate supply of combustion air and that the power venting system is working properly. It is recommended that this yearly inspection be performed in the fall, before the heating season begins.

Replace any rusted-out metal vent pipe. Any rusted-out single-wall vent pipe must be replaced by Type B vent pipe.

If any vent pipe has rusted significantly, it is strongly recommended that the power venting draft be rechecked as outlined in "Setting the Draft" above.

Check the vent terminal to be certain it is properly sealed, and to be certain that it is not blocked by debris. Reseal any leaking sections of the vent terminal. Clean out debris as necessary.

Inspect the exterior of the building to confirm that it has not been damaged by flue products or condensation.

The furnace itself should be maintained and inspected in accordance with the instructions in its Installation and Users' Information manuals.

The power venter and barometric damper should be inspected and maintained in accordance with their manufacturers' instructions.

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 appliances 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 gasburning 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 and in accordance with the National Fuel Gas Code, ANSI Z223.1-1984 and Addenda, Z223.1a-1987.

If resizing any portion of the common venting system, use the appropriate tables in Appendix G of the National Fuel Gas Code, ANSI Z223.1 and Appenda, Z223.1a-1987.

POLARIZATION AND PHASING

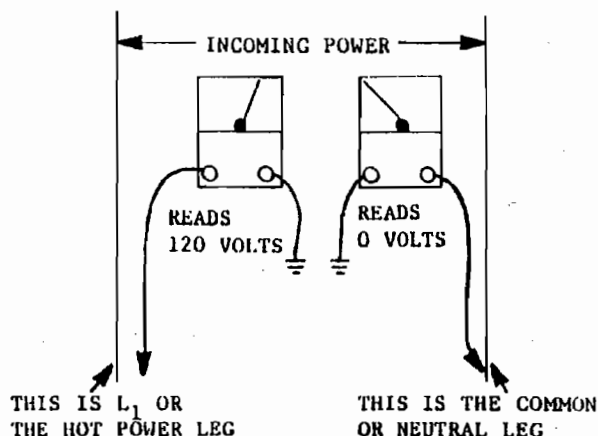
As more and more electronic's are introduced to the Heating Trade, Polarization of incoming power and phasing of primary to secondary voltage on transformers becomes more important.

Polarization has been apparent in the Appliance Industry since the introduction of the three prong plug, however, the Heating Industry does not use a plug for incoming power, but is hard wired.

Some of the electronic boards being used today, with flame rectification, will not function properly and/or at all without polarization of incoming power. Some also require phasing between the primary and secondary sides of step-down transformers.

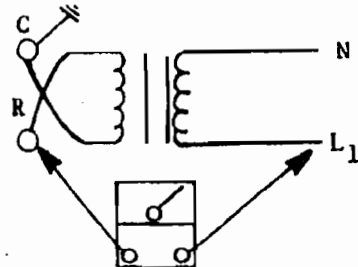
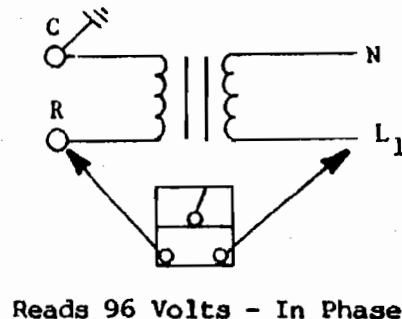
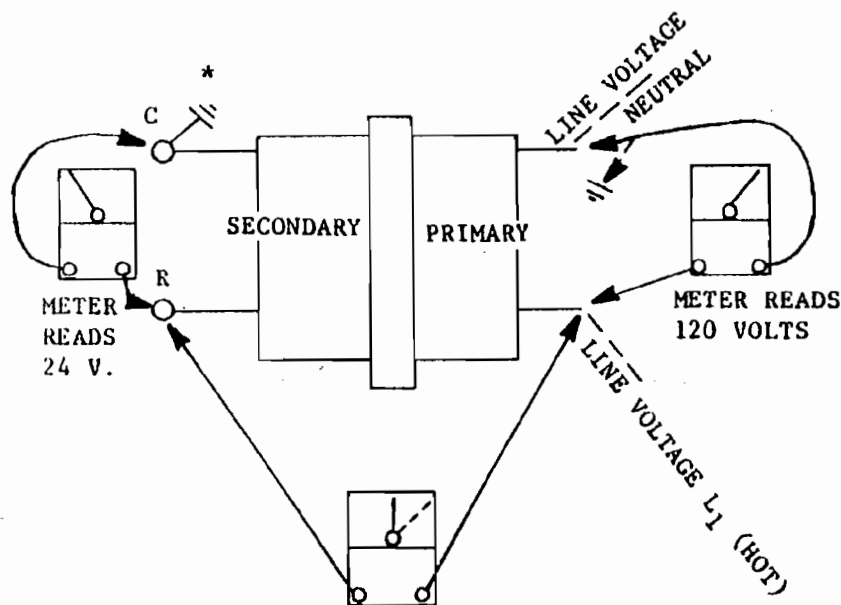
To install new working habits for our trade, we recommend that these two items be checked during normal installation and/or service calls. See as follows:

CHECKING FOR POLARIZATION



These then should be wired to the furnace accordingly.

CHECKING FOR PHASING - PRIMARY TO SECONDARY OF UNMARKED TRANSFORMERS*

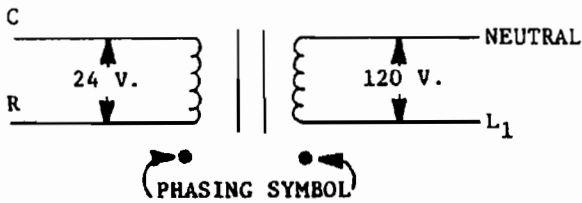


If meter reads approximately 96 volts -- the primary to secondary are in phase - if reads approx. 144 volts out of phase - reverse low voltage wires.

***NOTE:** For flame rectification the common side of the secondary voltage (24 V) is cabinet grounded. If you were to bench test a transformer the primary neutral and secondary common must be connected together for testing purposes.

POLARIZATION AND PHASING

We as a manufacturer will begin to show phasing symbols on all schematic drawings where phasing is mandatory.



We as a manufacturer are using transformers with identified markings on all transformers supplied that require phasing.

However, if replacement transformers are secured from some other source, they more than likely will not be identified.

Checking for polarization and phasing should become a habit in servicing. Lets start now.

SERVICING

TEST EQUIPMENT

Proper test equipment for accurate diagnosis is as essential as regular hand tools.

The following is a must for every service technician and service shop.

1. Dial type thermometers or thermocouple meter (optional) - to measure dry bulb temperature.
2. Amprobe - to measure amperage and voltage.
3. Volt-Ohmmeter - testing continuity, capacitors and motor windings.

4. Inclined Manometer - to measure static pressure, pressure drop across coils, filters and draft.

5. Water Manometer (12") - to test gas inlet and manifold pressure.

Other recording type instruments can be essential in solving abnormal problems, however, in many instances they may be rented from local sources.

Proper equipment promotes faster, more efficient service and accurate repairs resulting in fewer call backs.

SERVICING

HEATING PERFORMANCE TEST

Before attempting to diagnose an operating fault, run a heating performance test and apply the results to the Service Problem Analysis Guide.

To conduct a heating performance test, the BTU input to the furnace must be calculated.

After the heating cycle has been in operation for at least 15 minutes and with all other gas appliances turned off, the gas meter should be clocked.

To find the BTU input, multiply the number of cubic feet of gas consumed per hour by the heating value of the gas being used. (The calorific value of the gas being used is found by contacting your local utility.)

Example:

It is found by the gas meter, that it takes 40 seconds for the hand on the cubic foot dial to make one complete revolution, with all appliances off, except the furnace. Take this information and locate it on the gas rate chart. Observe the 40 seconds, locate and read across to the one cubic foot dial column. There we find the number 90, which shows that 90 cubic feet of gas will be consumed in an hour.

Let's assume the local gas utility has stated that the calorific value of the gas is 1025 BTU.

Multiplying the 90 cubic feet by 1025 BTU gives us an input of 92,250 BTUH.

Check the BTU input on the rating plate of the furnace being tested.

Example: GUI090B30A

Input: 90,000 BTU/HR.

Output Cap.: 72,000 BTU/HR.

Should the figure you calculated not fall within 5% of the nameplate rating of the unit, adjust the gas valve

pressure regulator or resize orifices. In no case should input exceed that shown on the rating plate.



ALWAYS CONNECT A MANOMETER TO THE 1/8" PIPE TAP ON THE MANIFOLD BEFORE ADJUSTING THE PRESSURE REGULATOR. IN NO CASE SHOULD THE FINAL MANIFOLD PRESSURE VARY MORE THAN PLUS OR MINUS .3 INCHES WATER COLUMN FROM 3.5 INCHES WATER COLUMN FOR NATURAL GAS OR 10 INCHES WATER COLUMN FOR PROPANE GAS.

To adjust the pressure regulator on the gas valve, turn down (clockwise) to increase pressure and input, and out (counterclockwise) to decrease pressure and input.

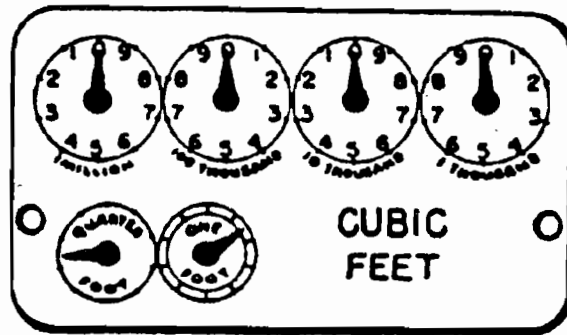
Since normally, propane gas is not installed with a gas meter, clocking will be virtually impossible. The gas orifices used with propane are calculated for 2500 BTU gas and with proper inlet pressures and correct piping size, full capacity will be obtained.

With propane gas the second stage supply line pressure regulator should be adjusted to give 11" water column with all other gas consuming appliance running.

The dissipation of the heat transferred to the heat exchanger is now controlled by the amount of air circulated over its surface.

The amount (CFM) of air circulated is governed by the external static pressure in inches of water column of duct work, cooling coil, registers and etc., applied externally to the unit versus the motor speed tap.

A properly operating unit must have the BTU input and CFM of air, within the limits shown to prevent short cycling of the equipment. As the external static pressure goes up, the temperature rise will also increase. Consult the proper tables for temperature rise limitation.



GAS RATE - CUBIC FEET PER HOUR

SECONDS FOR ONE REVOLUTION	SIZE OF TEST DIAL					SECONDS FOR ONE REVOLUTION	SIZE OF TEST DIAL				
	1/4 cu/ft	1/2 cu/ft.	1 cu/ft.	2 cu/ft.	5 cu/ft.		1/4 cu/ft	1/2 cu/ft.	1 cu/ft.	2 cu/ft.	5 cu/ft.
10	90	180	360	720	1800						
11	82	164	337	655	1636	36	25	50	100	200	500
12	75	150	300	600	1500	37	--	--	97	195	486
13	69	138	277	555	1385	38	23	47	95	189	474
14	64	129	257	514	1286	39	--	--	92	185	462
15	60	120	240	480	1200	40	22	45	90	180	450
16	56	113	225	450	1125	41	--	--	--	176	439
17	53	106	212	424	1059	42	21	43	86	172	429
18	50	100	200	400	1000	43	--	--	--	167	419
19	47	95	189	379	947	44	--	41	82	164	409
20	45	90	180	360	900	45	20	40	80	160	400
21	43	86	171	343	857	46	--	--	78	157	391
22	41	82	164	327	818	47	19	38	76	153	383
23	39	78	157	313	783	48	--	--	75	150	375
24	37	75	150	300	750	49	--	--	--	147	367
25	36	72	144	288	720	50	18	36	72	144	360
26	34	69	138	277	692	51	--	--	--	141	355
27	33	67	133	265	667	52	--	--	69	138	346
28	32	64	129	257	643	53	17	34	--	136	340
29	31	62	124	248	621	54	--	--	57	133	333
30	30	60	120	240	600	55	--	--	--	131	327
31	--	--	116	232	581	56	16	32	64	129	321
32	28	56	113	225	563	57	--	--	--	126	316
33	--	--	109	218	545	58	--	31	62	124	310
34	26	53	106	212	529	59	--	--	--	122	305
35	--	--	103	206	514	60	15	30	60	120	300

SERVICE PROBLEM ANALYSIS GUIDE

The "Service Problem Analysis Guide" is designed to lead the serviceman from the "Symptom", through steps, to the "Possible Cause". "S" numbers are keyed to paragraphs in the "Servicing" section which provides detailed test and servicing procedures. Normal values are given where they apply.

HEATING ANALYSIS GUIDE

POSSIBLE CAUSE	COMPLAINT											TEST METHOD-REMEDY	SEE SERVICE PROCEDURE
	NO HEAT					UNSATISFACTORY HEAT							
	SYMPTOM	SYSTEM WILL NOT START	BURNER WON'T IGNITE	BURNER IGNITES-LIDS OFF	ANY BURNER SHUTS OFF PRIOR TO FURNACE BEING RESET	SHORT CYCLES	LONG CYCLES	SOOT AND/OR FUMES	TOO MUCH HEAT	NOT ENOUGH HEAT	EXCESSIVE OFF TIME		
NO MAIN POWER	●											TEST VOLTAGE	S-1
FAULTY TRANSFORMER	●											TEST TRANSFORMER	S-4
FAULTY THERMOSTAT	●											TEST THERMOSTAT	S-3
FAULTY LIMIT SWITCH		●		●						●		TEST FAN AND LIMIT CONTROL	S-6
FAULTY FLAME SENSOR			●									TEST FLAME SENSOR	S-22
FAULTY IGNITION CONTROL MODULE		●	●									TEST IGNITION CONTROL MODULE	S-21
GAS SUPPLY VALVES IN OFF POSITION OR GAS VALVE OFF		●										TURN VALVES TO "ON" POSITION	
FAULTY INDUCED DRAFT BLOWER MOTOR	●											TEST MOTOR	S-8
OPEN DOOR SWITCH	●											CHECK DOOR CLOSED-TEST SWITCH	
FAULTY WIRING HARNESS		●										TEST WIRING	S-2
BROKEN OR SHORTED IGNITER		●										TEST IGNITER	S-20
FAULTY COMBUSTION RELAY	●			●								TEST RELAY	S-5
SENSOR NOT IN FLAME LOW MICRO-AMPS			●									TEST FLAME SENSOR	S-22
FAULTY GAS VALVE DPR.		●										TEST GAS VALVE MAIN OPERATOR	S-10
OPEN AUX. LIMIT		●		●								PUSH MANUAL RESET	S-7
IMPROPER HEAT ANTICIPATOR SETTING				●	●	●						CHECK HEAT ANTICIPATOR SETTING	S-3B
IMPROPER AIR FLOW OR DISTRIBUTION				●	●			●	●			CHECK DUCT STATIC	S-17
CYCLING ON LIMIT					●					●		CHECK CONTROLS & TEMP. RISE	S-6, S-7 S-18
IMPROPER THERMOSTAT LOCATION					●	●		●	●			RELOCATE THERMOSTAT	
DELAYED IGNITION							●					TEST FOR DELAYED IGNITION	S-15
FLASHBACK							●					TEST FOR FLASH BACK	S-16
ORIFICE SIZE							●					CHECK ORFICES	S-13
GAS PRESSURE		●					●		●			CHECK GAS PRESSURE	S-14
BURNED OUT HEAT EXCHANGER CHECK TEMPERATURE RISE							●					CHECK TEMP. RISE	S-18
THERMOSTAT OUT OF CALIBRATION								●	●			RECALIBRATE OR REPLACE	
STUCK GAS VALVE								●				REPLACE GAS VALVE	
FURNACE UNDERSIZED										●		REPLACE FURNACE WITH PROPER SIZE	
NO LOW VOLTAGE	●											CHECK WIRING	S-2
FAULTY PRESSURE SWITCH		●		●								TEST PRESSURE SW.	S-19
BLOCKED OR RESTRICTED FLUE		●		●								CHECK FLUE	S-19
HIGH RESISTANCE GROUND			●									TEST GROUND	S-21
VENT SAFETY SWITCH OPEN	●											TEST CONTINUITY	S-23

SERVICING

S-1 CHECKING VOLTAGE

With Power OFF:

1. Remove access door from furnace to gain entry to Junction Box.
2. Remove cover from Junction Box and gain access to incoming power lines.

With Power ON:



**LINE VOLTAGE NOW
PRESENT.**

3. Using a voltmeter, measure the voltage across the hot and neutral connections. "With blower door installed."
4. No reading - indicates open wiring, open fuse, no power or etc. from unit to fused disconnect service. Repair as needed.
5. With ample voltage at line voltage connectors, energize the furnace blower motor.
6. With the blower motor in operation, the voltage should be 115 Volts $\pm$ 10%.
7. If the reading falls below the minimum voltage, check the line wire size. Long runs of undersized wire can cause low voltage. If wire size is adequate, notify the local power company of the condition.

S-2 CHECKING WIRING

With Power OFF:

1. Check wiring visually for signs of overheating, damaged insulations and loose connections.
2. Use an ohmmeter to check continuity of any suspected open wires.
3. If any wires must be replaced, replace with AWM, 105°C. 4/64 thick insulation of the same gauge or its equivalent.

S-3 CHECKING THERMOSTAT, WIRING, AND ANTICIPATOR

S-3A Thermostat and Wiring

With Power OFF;

1. Remove the thermostat low voltage wires at the furnace control panel terminal board.
2. Jumper terminals R to W.

With Power ON:

Combustion I.D. Motor must run.

3. If the hot surface ignitor heats and approximately 45 seconds later the gas valve opens and the burners ignite, the the trouble is in the thermostat or wiring.
4. With power off, check the continuity of the thermostat and wiring. Repair or replace as necessary.

If the furnace is an air conditioning model and wired for same, proceed as follows.

5. With power off, Jumper terminals R 50 Y to G.
6. Turn on the power.
7. If the furnace blower motor starts and the condensing unit runs, then the trouble is in the thermostat or wiring. Repair or replace as necessary.

S-3B Heating Anticipator

The heating anticipator is a wire wound adjustable heater which is energized during the "ON" cycle to help prevent overheating of the conditioned space.

The anticipator is a part of the thermostat and if it should fail for any reason, the thermostat must be replaced.

The heating anticipator setting for our furnaces covered in this manual require a .80 heat anticipator setting.

If the anticipator current draw is unknown, then an amp draw should be taken to determine the anticipator setting. Use an amprobe as shown.

SERVICING

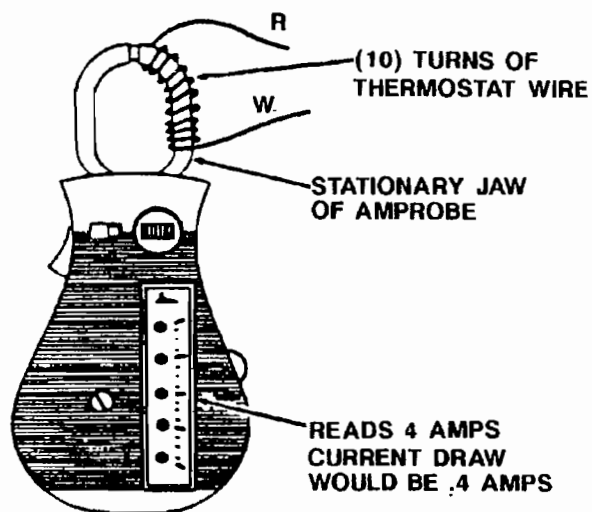


FIGURE 21

S-3C Cooling Anticipator

The cooling anticipator is a small heater (resistor) in the thermostat. During the "OFF" cycle it heats the bi-metal element helping the thermostat call for the next cooling cycle. This prevents the room temperature from rising too high before the system is restarted. A properly sized anticipator should maintain room temperature within 1-1/2 to 2 degrees range.

The anticipator is fixed in the subbase and is not to be replaced. If the anticipator should fail for any reason, the subbase must be changed.

S-4 CHECKING TRANSFORMER AND CONTROL CIRCUIT

With Power OFF:

1. Remove the thermostat leads from the low voltage terminal board.
2. With power on, using a voltmeter, check voltage across terminals R and C. Must read 24 VAC.

3. Check transformer primary voltage at incoming line voltage connections, fuse, splices and blower door.
4. If line voltage available to primary side of transformer and not at secondary side, transformer is inoperative. Replace.

S-5 CHECKING FAN RELAY (A/C MODELS)

With Power OFF:

1. Tag and disconnect all wires from male spade connections of relay. On those furnaces with the plug in relay, remove the relay from the plug in receptacle.
2. Using an ohmmeter, test across the coil terminals - should read approximately 12 ohms.

If the coil does not test continuous - replace.

3. On the single pole single throw relays, test across terminals 1 to 3 - should have no reading.
4. On the single pole double throw relays, test across terminals 4 and 5, should read continuous; 4 and 2 should have no reading.
5. Apply 24 volts to coil terminals and retest. On SPST relays, 1 to 3 should read continuous. On SPDT relays, 4 to 5 should have no reading, 4 to 2 should test continuous. If not replace the relay.
6. Combustion Relay. With no voltage applied ohms terminals:

7 to 8 should read continuous
3 to 5 N.O. (Normally Open)
6 to 4 N.O.
5 to 1 N.C. (Normally Closed)
6 to 2 N.C.

Apply 24 VAC to #7 and #8

3 to 5 will close
6 to 4 will close
5 to 1 will open
6 to 2 will open

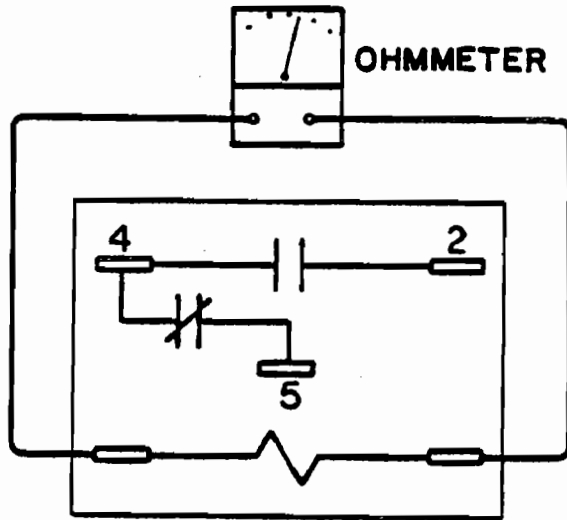


FIGURE 22
TESTING FAN RELAY

S-6 CHECKING COMBINATION FAN AND LIMIT CONTROL

With Power OFF:

1. Remove load and line voltage wires at fan portion terminals.
2. Set fan "OFF" and fan "ON" indicators above the heat exchanger temperature.
3. With an ohmmeter, test between these two terminals, should have no reading.
4. Set fan "OFF" and fan "ON" indicators below the heat exchanger temperature.
5. With an ohmmeter, test between these two terminals, should read continuous.

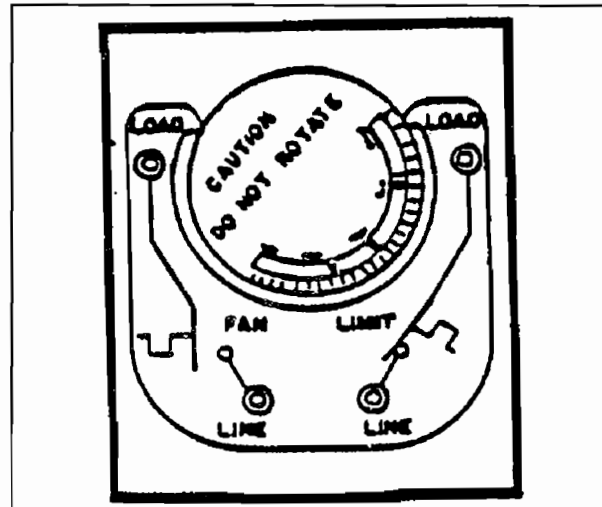
If not as above, replace the complete control.

6. Remove load and line voltage wires at limit position terminals.
7. With an ohmmeter, test between these two terminals, should read continuous unless heat exchanger temperature is above limit control setting.

8. A fan control set too low may not let furnace recyle til discharge air is uncomfortable.

If not as above, replace the complete control.

NOTICE: Reset the fan "OFF" and "ON" settings back to their original positions. These settings should have been predetermined at the time of installation.



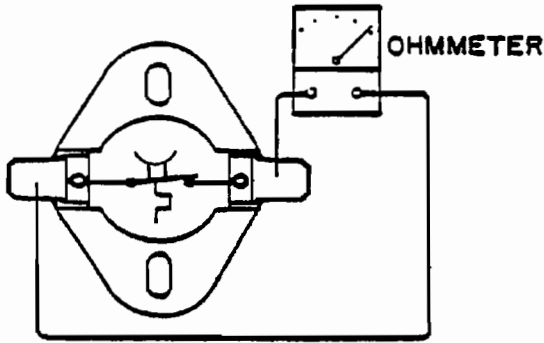
HONEYWELL FAN AND LIMIT CONTROL
FIGURE 23

S-7 CHECKING AUXILIARY LIMIT CONTROL (Counterflow and Horizontal Models)

With Power OFF:

1. Remove the wires from the auxiliary limit control terminals.
2. Using an ohmmeter, test for continuity across the two terminals. No reading indicates the control is open. Push the read reset button, test again - if still open, replace the control.

NOTE: The two terminal control opens at 160°F. $\pm$ 5°.



AUXILIARY LIMIT CONTROL
FIGURE 24

S-8 CHECKING BLOWER MOTOR

With Power OFF:

1. Disconnect the motor wire leads from its connection point and capacitor if applicable.
2. Using an ohmmeter, test for continuity between each of the motor leads.
3. Touch one probe of the ohmmeter to the motor frame (ground) and the other probe in turn to each lead.

If the windings do not test continuous or a reading is obtained from lead to ground, replace the motor.

S-9 CHECKING CAPACITOR



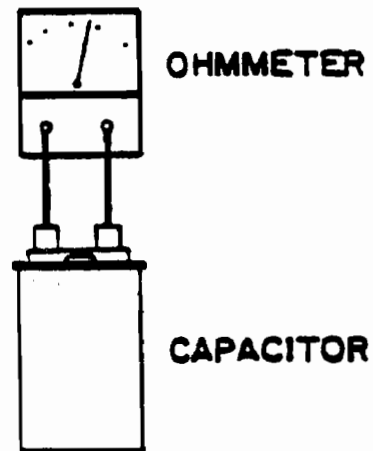
DISCHARGE CAPACITOR THROUGH A 20 TO 30 OHM RESISTOR BEFORE HANDLING.

Two quick ways to test a capacitor are a resistance and a capacitance check.

S-9A Resistance Check

With Power OFF:

1. Discharge capacitor and remove wire leads.
2. Set an ohmmeter on its highest ohm scale and connect the leads to the capacitor.
 - a. Good Condition - indicator swings to zero and slowly returns toward infinity.
 - b. Shorted - indicator swings to zero and stops there - replace.
 - c. Open - no reading - replace. Reverse leads. Check again no reading - replace.



TESTING CAPACITOR RESISTANCE
FIGURE 25

S-9B Capacitance Test



LINE VOLTAGE NOW PRESENT.

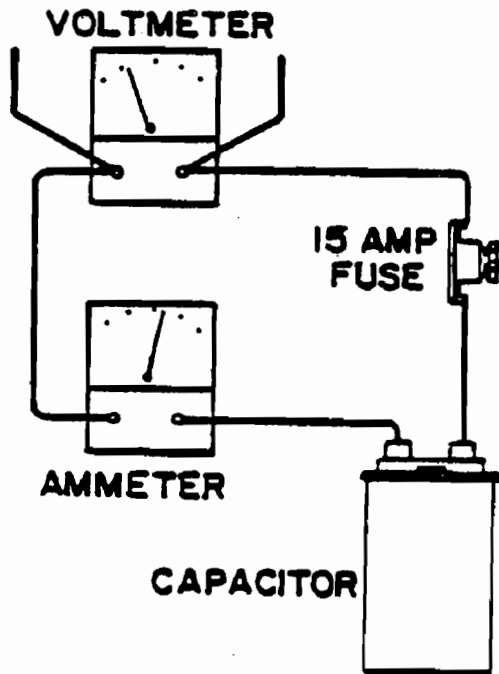
Using a hook-up as shown, take the amperage and voltage readings and use them in the formula:

$$\text{Capacitance (MFD)} = \frac{2650 \times \text{Amperage}}{\text{Voltage}}$$

S-10 CHECKING GAS VALVE (REDUNDANT)

With Power OFF:

1. Remove wire connections from gas valve terminals.
2. Using an ohmmeter, test across the gas valve coil terminals, both the redundant and the main valve.



TESTING CAPACITANCE
FIGURE 26

3. Should read approximately 130 Ohms for the Robertshaw main valve operator coils. The redundant coil will vary somewhat as well.
4. Reverse leads. Some redundant coils have (dividers) diodes.

If not as above, replace the entire valve.

S-12 CHECKING MAIN BURNERS

The main burners are used to provide complete combustion of various fuels in a limited space, and transfer this heat of the burning process to the heat exchanger.

Proper ignition, combustion and extinction are primarily due to burner design, orifice sizing, gas pressure, primary and secondary air, vent and proper seating of burners.

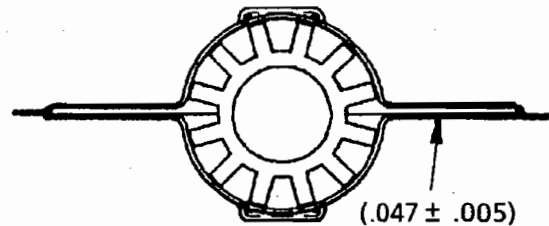
WITH POWER OFF AND GAS OFF:

In checking main burners, look for signs of rust, oversized and undersized carryover (Figure 27), ports restricted with foreign material and etc.

S-13 CHECKING ORIFICES

A predetermined fixed gas orifice is used in all of these furnaces. That is an orifice which has a fixed bore and position.

No resizing should be attempted until all factors are taken into consideration such as inlet and manifold



CARRYOVER GAP
FIGURE 27

gas pressure, alignment and positioning, specific gravity and BTU content of the gas being consumed.

The only time resizing is required is when a reduction in firing rate is required for an increase in altitude.

Orifices should be treated with care in order to prevent damage. They should be removed and installed with a box-end wrench in order to prevent distortion. In no instance should an orifice be peened over and re-drilled. This will change the angle or deflection of the vacuum effect or entraining of primary air, which will make it difficult to adjust the flame properly. This same problem can occur if an orifice spud of a different length is substituted.

WITH POWER AND GAS OFF:

1. Check orifice visually for distortion and/or burrs.
2. Check orifice size with orifice sizing drills.
3. If resizing is required, a new orifice of the same physical size and angle with proper drill size opening should be installed.

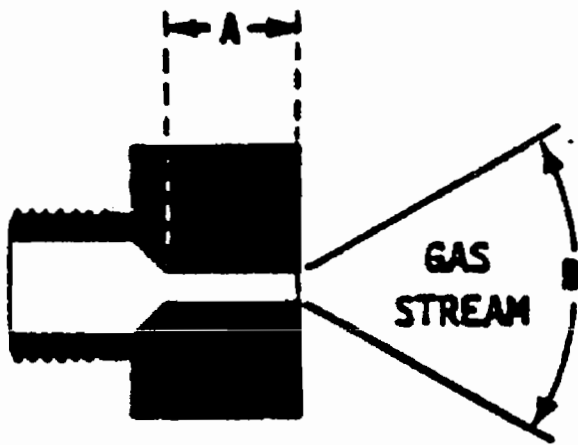


FIGURE 28

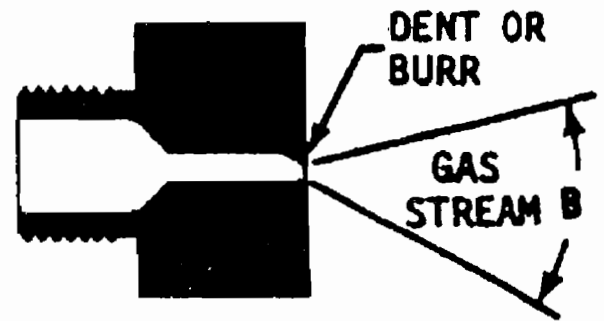


FIGURE 29

The length of Dimension "A" determines included angle of Spray "B".

A dent or burr will cause severe deflection of gas stream.

S-14 CHECKING GAS PRESSURE

Gas inlet and manifold pressures should be checked and adjusted in accordance to the type of fuel being consumed.

WITH POWER AND GAS OFF:

1. Connect a water manometer or adequate gauge upstream of the gas valve. (If no provisions provided, suggest removing cap from dripleg and install a predrilled cap with hose fitting.)
2. Remove the pressure tap fitting at the manifold if provided or from the gas valve and install fitting to connect another manometer or gauge.

WITH POWER AND GAS ON:

3. Put furnace into heating cycle and turn on all other gas consuming appliances.

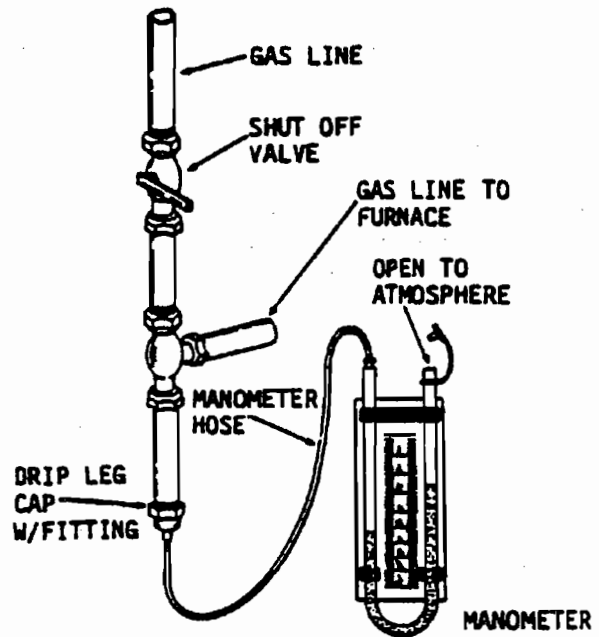
FOR NATURAL GAS:

- a. Inlet pressure should be a nominal 7" W.C.
- b. Manifold pressure should be $3.5 \pm .3$ " W.C. (Canadian - Sea Level $4.2 \pm .3$ " W.C.)

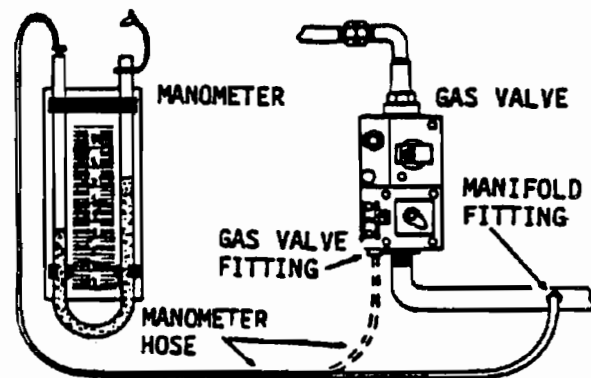
FOR PROPANE GAS:

- a. Manifold pressure should be a nominal 10" W.C.

If operating pressures differ from above, make necessary pressure regulator adjustments, check piping size, etc., and/or consult with local utility.



MEASURING INLET GAS PRESSURE
FIGURE 30



MEASURING MANIFOLD GAS PRESSURE
FIGURE 31

S-15 CHECKING FOR DELAYED IGNITION

Delayed ignition is a delay in lighting a combustible mixture of gas and air which has accumulated in the combustion chamber.

When the mixture does ignite, it may explode and/or rollout causing burning in the burner venturi.

If delayed ignition should occur, the following should be checked:

1. Improper gas pressure - adjust to proper pressure. See S-14.
2. Improper burner positioning - burners should be in locating slots, level front to rear and left to right.
3. Carry over (lighter tube or cross lighter) obstructed - clean.
4. Main burner orifice(s) deformed, or out of alignment to burner - replace.

S-16 CHECKING FOR FLASH-BACK AND ROLLOUT

Flash-back will also cause burning in the burner venturi, but is caused by the burning speed being greater than the gas-air flow velocity coming from a burner port.

Flash-back may occur at the moment of ignition, after a burner heats up or when the burner turns off. The latter is known as extinction pop.

Since the end results of flash-back and delayed ignition can be the same (burning in the burner venturi) a definite attempt should be made to determine which has occurred.

If flash-back should occur, check for the following:

1. Improper gas pressure - adjust to proper pressure. See S-14.
2. Check burner for proper alignment and/or replace burner.
3. Improper orifice size - check orifice for obstruction.
4. Rollout Symptoms.

16A SYMPTOMS

If the rollout control has opened the circuit between the ignition control and gas valve will be interrupted. The ignition will cycle and try to light 3 times but will

not sense flame and go into lockout. The servicer should reset the ignition control by opening and closing the thermostat circuit. The servicer should look for the ignitor glowing which indicates there is power to the ignition control. The servicer should measure the voltage between each side of the rollout control and ground while the ignition control is try to power the gas valve.

- a. If no voltage is measured on either side of control it indicates ignition control or wiring to control problem.
- b. If voltage is measured on one side of the control and not the other it indicates the control is open.
- c. If voltage is measured on both sides of the control the wiring to gas valve or valve is a fault.

S-17 CHECKING DUCT STATIC

The maximum and minimum allowable external static pressures are found in the specification section. These tables also show the amount of air being delivered at a given static by a given motor speed or pulley adjustment.

The furnace motor cannot deliver proper air quantities (CFM) against statics other than those listed.

Too great of an external static pressure will result in insufficient air that can cause excessive temperature rise, resulting in limit tripping and etc. Whereas no enough static may result in motor overloading.

To determine proper air movement, proceed as follows:

1. With clean filters in the furnace, use a draft gauge (inclined manometer) to measure the static pressure of the return duct at the inlet of the furnace. (Negative Pressure)
2. Measure the static pressure of the supply duct. (Positive Pressure)
3. Add the two readings together for total external static pressure.

NOTE: Both readings may be taken simultaneously and read directly on the manometer if so desired. If an air conditioning coil or Electronic Air Cleaner is used in conjunction with the furnace, the readings must also include these components.

4. Consult proper tables for the quantity of air.

If the total external static pressure exceeds the minimum or maximum allowable statics, check for closed dampers, registers, undersized and/or oversized poorly laid out duct work.

S-18 CHECKING TEMPERATURE RISE

Temperature rise is related to the BTUH output of the furnace and the amount of air (CFM) circulated over the heat exchanger.

All furnaces are designed for a given range of temperature increase; that is the temperature of the air leaving the furnace minus the temperature of the air entering the furnace.

The more air (CFM) being delivered through a given furnace, the less the rise will be; so the less air (CFM) being delivered, the greater the rise.

The temperature rise should be adjusted in accordance to a given furnace specifications and its external static pressure.

1. Check BTU input to furnace - do not exceed input rating stamped on rating plate.
2. Take entering and leaving air temperatures.

CAREFUL: Be sure that the location selected for the leaving air temperature will not allow radiation from the heater exchanger to the thermometer.

3. Adjust belt drive furnaces motor pulley accordingly and/or select the proper speed tap for direct drive furnaces.
4. Take motor amperage draw to determine that the motor is not overloaded during adjustments.

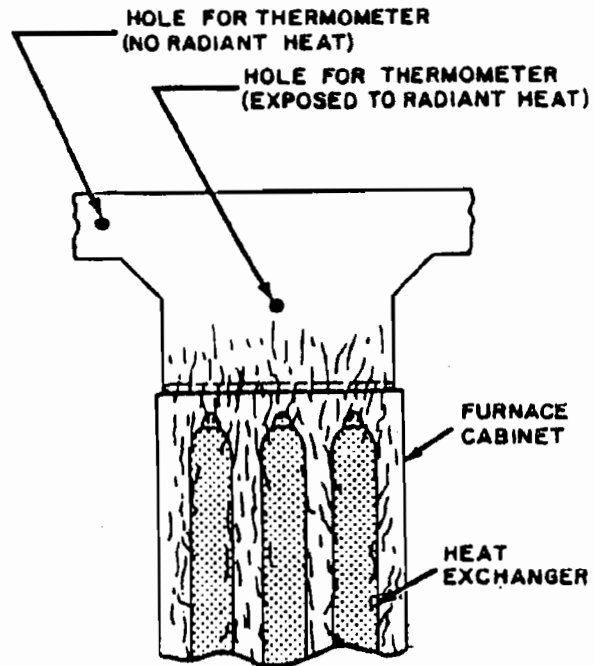
S-19 CHECKING PRESSURE CONTROL

With Power OFF:

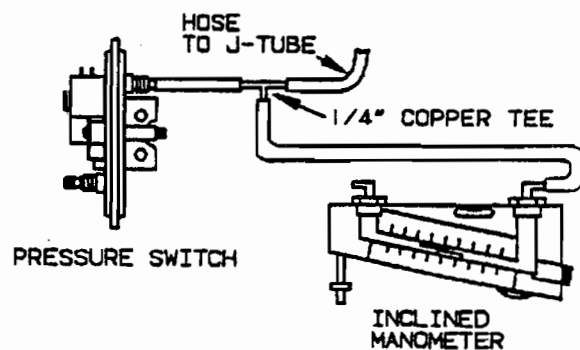
1. Remove wires from the three electrical terminals.
2. Using a VOM check from common terminal to NC (Normally Closed) - should read closed. Check from Common to NO (Normally Open) - should read open.

If switches read as above proceed to Step 3, otherwise replace control.

3. Remove the pressure control hose from the control and inter-connect with an inclined manometer as shown:



AIR LEAVING TEMPERATURE LOCATION
FIGURE 33



Reconnect wires OR-16 to Common and BL-10 to NC terminals.

With Power ON:

4. Energize furnace for heating cycle. The combustion relay should become energized and the induced draft blower motor commences to run.

The inclined manometer should read approximately negative 1.0 to 1.2" W.C. with no combustion. (See Figure 18 for proper J-tube location.)

5. Remove and check the two electrical wires and using the VOM check from Common to NC (Normally Closed) - should read open. Check from Common to NO (Normally Open) - should read closed.

If not as above, replace control.

6. Reconnect all three wires to the control and place in a heating cycle.
7. As the unit fires, the inclined manometer negative pressure will drop to approximately negative .60 to .65" W.C. as the flue temperature heats up.
8. The control should not trip unless something is blocking the flue outlet. The control is designed to trip at .54" W.C. negative pressure $\pm$.05" W.C.

S-20 CHECKING HOT SURFACE IGNITOR

With Power OFF:

1. Ignitor cool - approximately 70 - 75°F.
2. Disconnect the ignitor from the Ignition Control Module and line voltage terminal board.
3. Using an ohmmeter measure the resistance of the ignitor - should read between 50 to 400 ohms.
4. Reconnect ignitor.

With Power ON:

5. Place unit in heating cycle, measure current draw of ignitor during pre-heat cycle. Should read approximately 4 to 5 Amps.

S-21 CHECKING IGNITION CONTROL MODULE

NOTE: FAILURE TO EARTH GROUND THE FURNACE, REVERSING THE NEUTRAL AND HOT WIRE CONNECTION TO THE LINE (POLARITY), OR A HIGH RESISTANCE CONNECTION IN THE NEUTRAL LINE MAY CAUSE THE CONTROL TO LOCKOUT DUE TO FAILURE TO FLAME SENSE.

The ignition control module is a combination electronic and electro-mechanical device and is not field repairable. Complete unit must be replaced.

With Power OFF:

1. Disconnect wires from TR and TH. Using an ohmmeter, should measure approximately 12 ohms. If no reading, replace module.

Additional testing must be completed within a given time element due to retry and lockout nature of control.

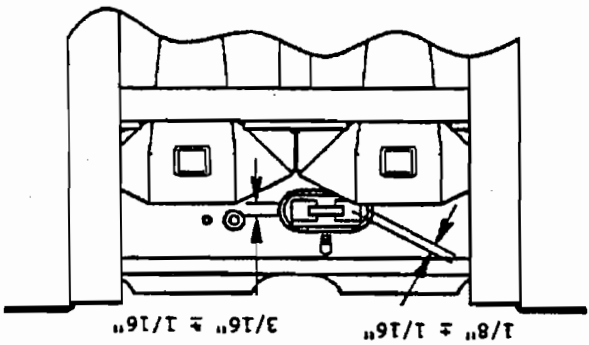
With Power ON:

Furnace thermostat calling for heat (45 second pre-heat time).

1. Check for 120 volts from L1 terminal of control module to neutral. No voltage - check wire connections, continuity, and etc.
2. Voltage Present - check for 120 volts from IGN. Terminal of control module to neutral. No voltage - replace Ignition Control Module.
3. After 45 seconds preheat time, check for 24 volts at terminals MV to MV of control module (7 seconds only) no voltage - bad ignition control module, replace.
4. If above tests are not completed within the prescribed time limit, the control will retry two more times. However, you will have a 60 second delay before the next try and your preheat time will be increased to 55 seconds. After the second retry, if no ignition, the control will go into lockout. To reset, must de-energize control for approximately five seconds.

S-22 CHECKING FLAME SENSOR - FLAME RECTIFICATION - IGNITION CONTROL MODULE

The following drawing illustrates from a bottom view, the approximate distances for the ignitor and flame sensor to the gas inshot burner. You will note they are not in the main burner stream, but along the carry-over ports.



With Power OFF:

- 1. Disconnect the flame sensor wire from terminal FP of the ignition control module.
- 2. Connect a micro-amp meter in series with this wire and terminal FP.
- 3. Be sure the negative side of the meter is to the wire and the positive of the meter is to terminal FP.

With Power ON:

- 4. Place the unit into a heating cycle.
- 5. As soon as flame is established a micro-amp reading should be evident once proof of flame (micro-amp reading) is established, the hot surface ignitor will be de-energized.
- 6. The micro-amp reading will vary with the vintage of the control being used. Early production White-Rogers C6411101 prior to 8731 date code on the control will have 1.5 to 6 microamps. From 8731 date code on, the control will have 10 to 14 microamps. The White-Rogers C6411102 control with the red diagnostic indicator light and the White-Rogers 10207701 integrated control will have 1 to 4 micro-amps. If the micro-amp reading is less than the minimum specified check

for high resistance wiring connections, the distance between the sensor and flame, ground connections, or poor grounding.

- 7. If absolutely no reading, check for continuity on all components and if good - replace ignition control module.

NOTE: Contaminated fuel or combustion air can create a nearly invisible coating on the flame sensor. This coating works as an insulator causing a loss in the flame sense signal. If this situation occurs the flame sensor must be cleaned with emery cloth or steel wool.

S-23 CHECKING VENT SAFETY SWITCH (CANADIAN) (C & CV)

A temperature activated, manual reset control is mounted to the collector box assembly (Flue outlet).

This control is wired in series with the hot line of the combustion blower motor.

These controls are designed to open as follows:

GUI045, 70, 90	250°F. ± 6°
GUI115, 140	275°F. ± 6°
GCI045, 115	200°F. ± 5°
GCI070, 140	225°F. ± 6°
GCI090	250°F. ± 6°

Under normal conditions, ambient air will pass over the control and mix with combustion air before being vented. If a partial restriction should occur to the flue (.05" W.C. positive), the pressure within the flue outlet will become positive and combustion products will pass over the control causing it to open.

S-24 CHECKING FLAME ROLLOUT SWITCH

A temperature activated manual reset control is mounted to the manifold assembly. Two (2) controls are used on GSI model horizontal furnaces.

This control is wired in series with the gas valve. The control is designed to open should a flame roll out occur. An over firing condition or flame impingement on the heat shield may also cause the control to open.

The controls are designed to open as follows:

GUI045, 70, 90, 115, 140	350°	White
GSI045, 70, 90, 115, 140	350°	White
GSI045, 70, 90, 115, 140	250°	Blue
GCI045, 70, 90, 115, 140	325°	Red

SERVICING

To aid in identifying these controls, color coded labels have been affixed to the back of these controls. See the above chart for details.

S-25 HIGH ALTITUDE APPLIANCE (USA)

For those altitudes starting at 3500 feet and above it may be necessary to replace either the pressure switch or orifices. In some instances both must be changed.

These changes are required to compensate for the reduction in atmospheric pressure (less available air for combustion) as the altitude increases.

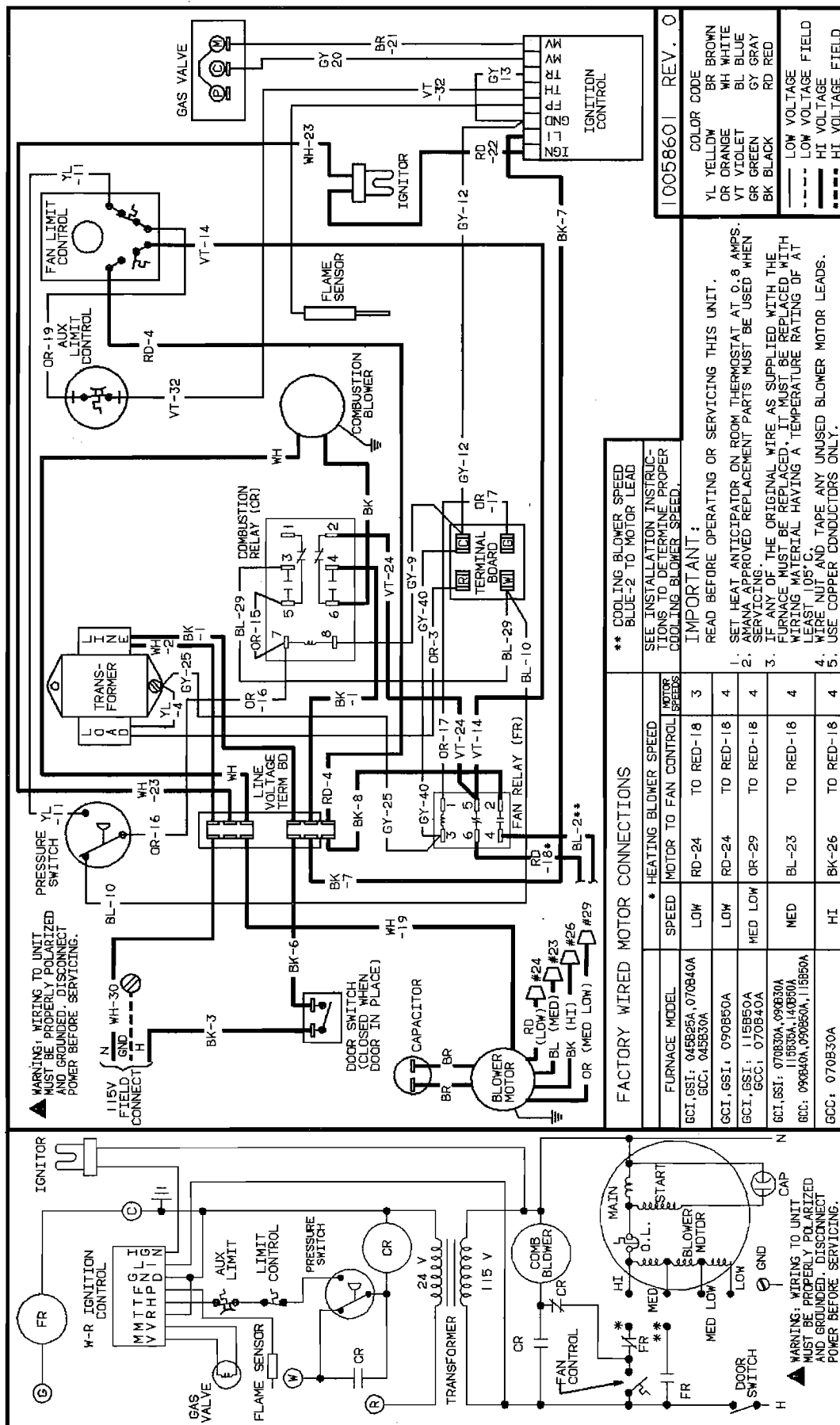
The following charts give the orifice drill size and pressure switch settings for difference elevation.

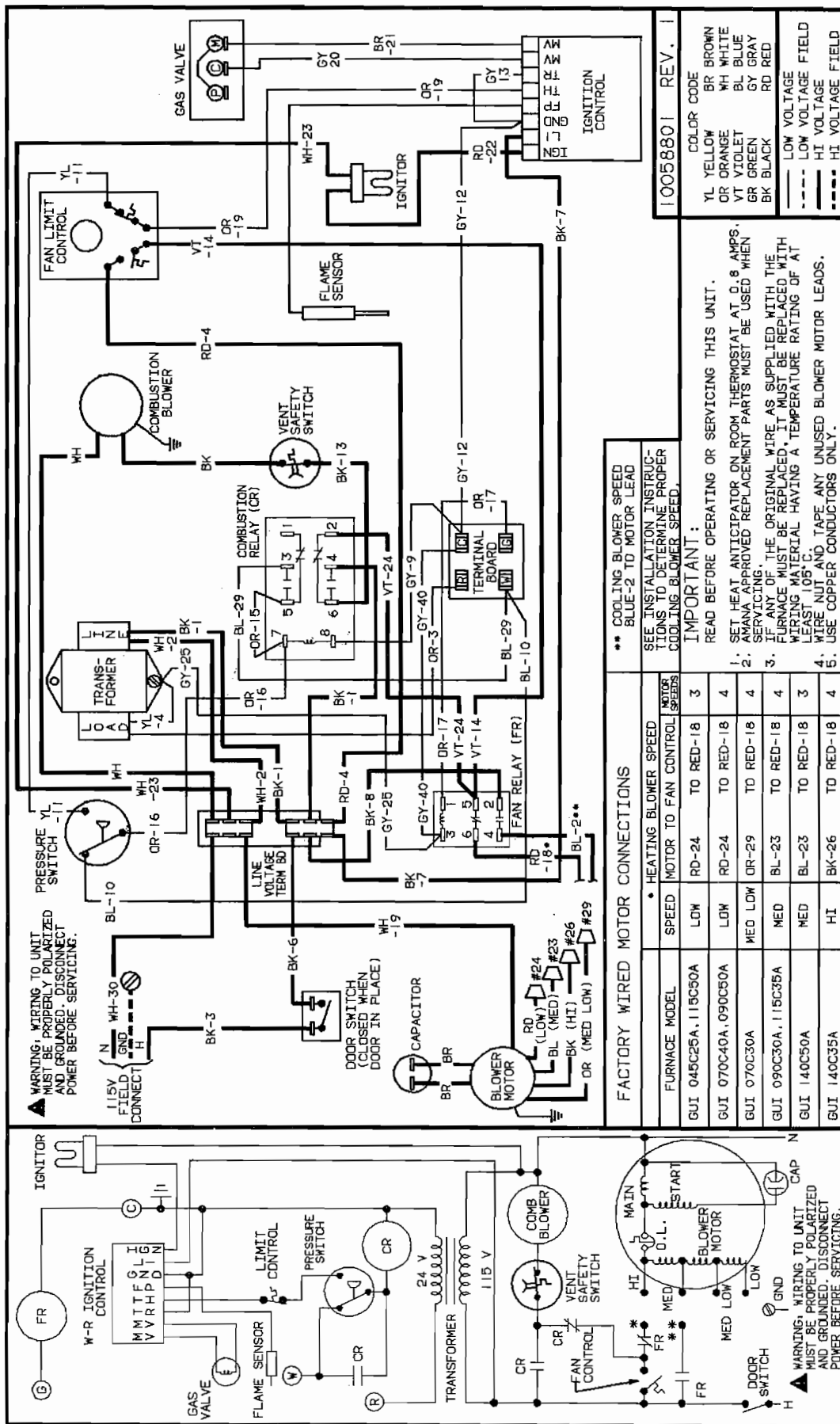
PRESSURE SWITCH TRIP SETTING

0 TO 4000 Ft.	.45"W.C. $\pm$.05	Original Equipment Factory Installed
4000 to 7000 Ft.	.42"W.C. $\pm$.05	HAPS03 or PS808A High Altitude Pressure Switch Kit (C6456505 Pressure Switch)
7000 to 11500 Ft.	.30"W.C. $\pm$.05	HAPS02 or PS809A High Altitude Pressure Switch Kit (C6456509 Pressure Switch)

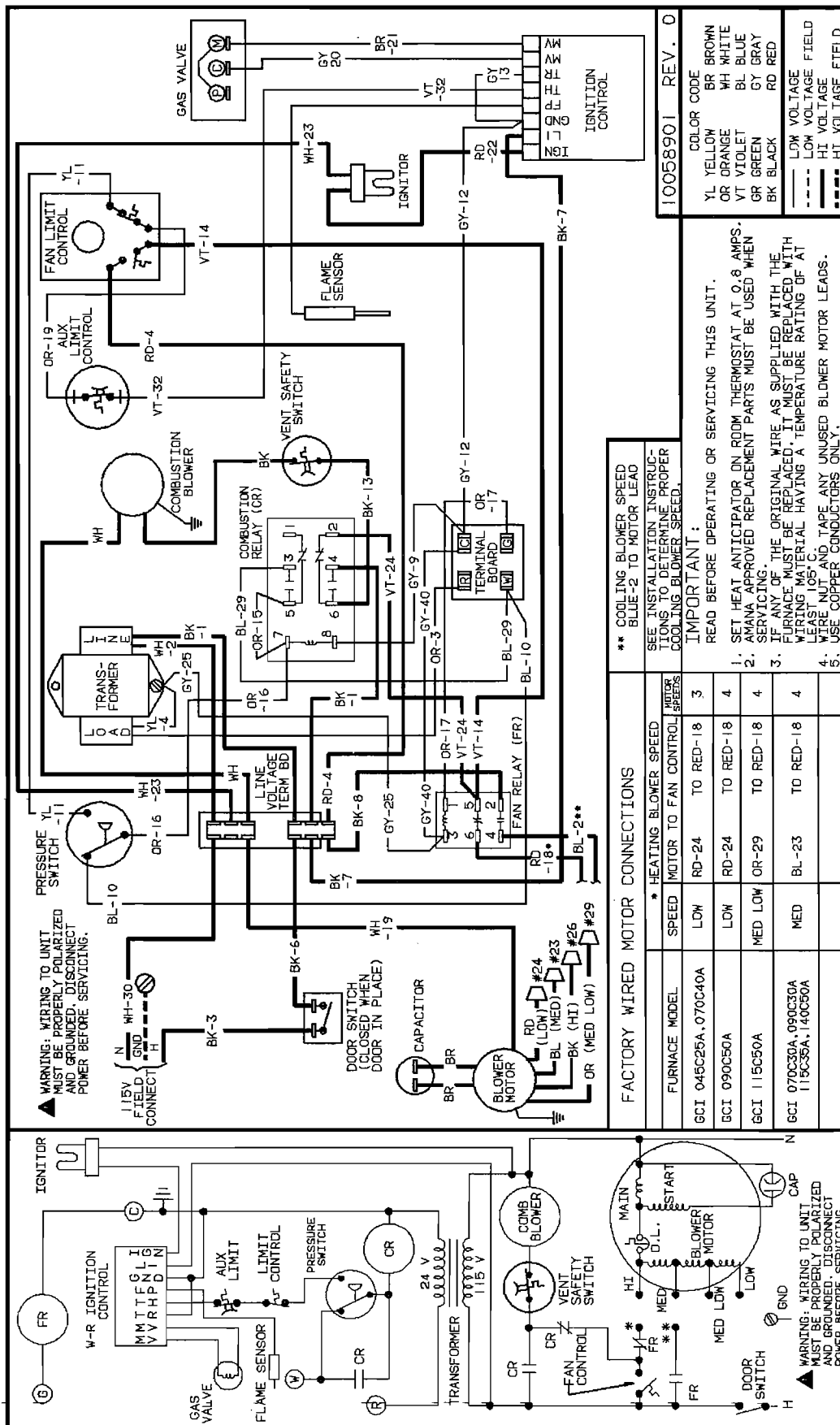
ORIFICE SIZE CHART

0 to 3500 Ft.	Nat. #43	Original Equipment Factory Installed
3500 to 6000 Ft.	Nat. #44	HANG01 or NG01A High Altitude Orifice Kit (Uses C6437604 orifices)
6000 to 7500 Ft.	Nat. #45	HANG02 or NG02A High Altitude Orifice Kit (Uses C6437605 orifices)
7500 to 8500 Ft.	Nat. #46	HANG03 or NG03A High Altitude Orifice Kit (Uses C6437606 orifices)
8500 to 10000 Ft.	Nat. #47	HANG04 or NG04A High Altitude Orifice Kit (Uses C6437607 orifices)
10000 to 11500 Ft.	Nat. #48	HANG05 or NG05A High Altitude Orifice Kit (Uses C6437608 orifices)
0 to 4500 Ft.	Propane #54	LPTK02 Propane Conversion Kit (Uses C6437602 orifices)
4500 to 7500 Ft.	Propane #55	HALP01 or LP01A High Altitude Orifice Kit (Uses C6437609 orifices)
7500 to 11500 Ft.	Propane #56	HALP02 or LP02A High Altitude Orifice Kit (Uses C6437610 orifices)





SYSTEM OPERATION



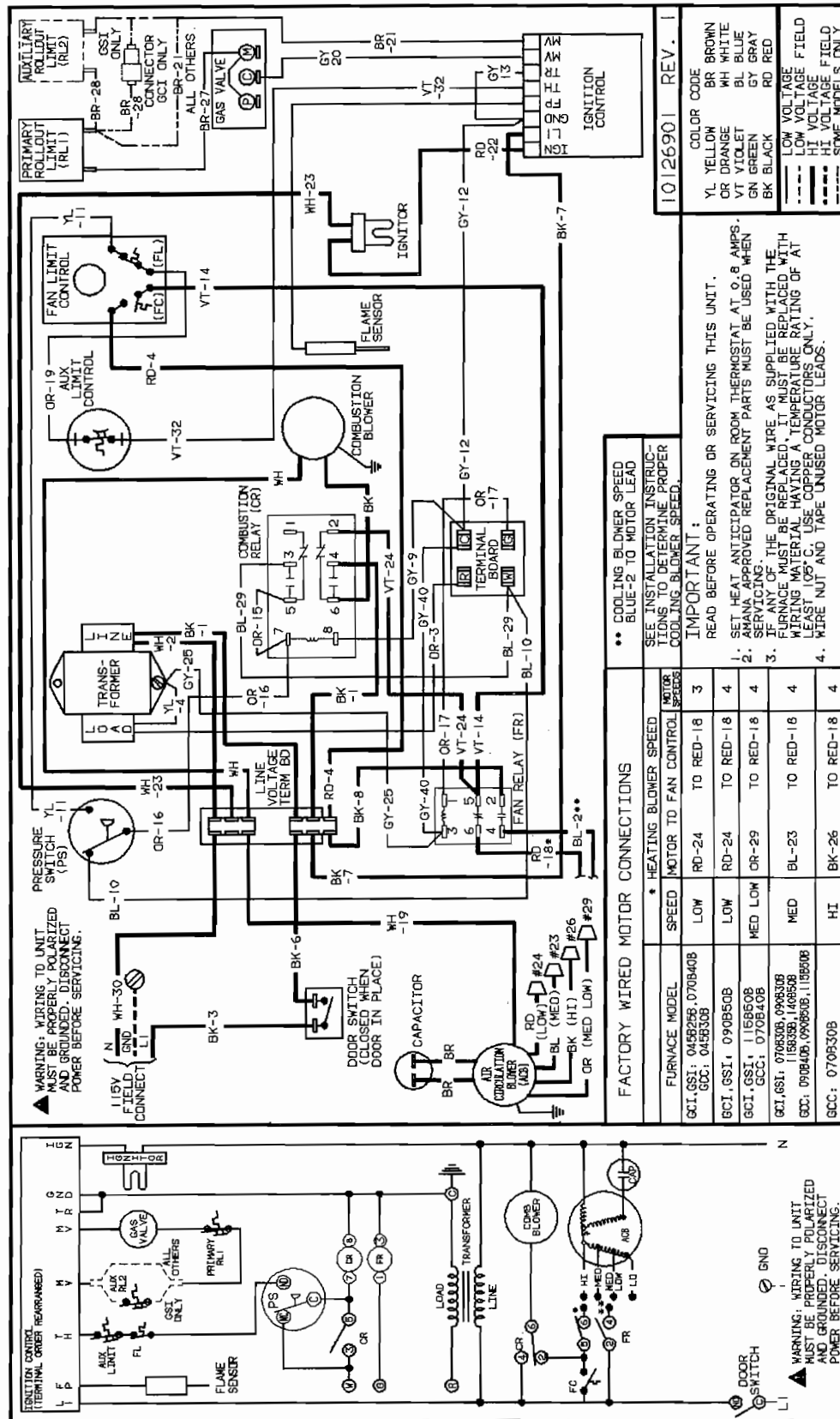
WARNING

**TO AVOID POSSIBLE ELECTRIC SHOCK, PERSONAL INJURY, OR DEATH
DISCONNECT POWER BEFORE SERVICING.**



WARNING

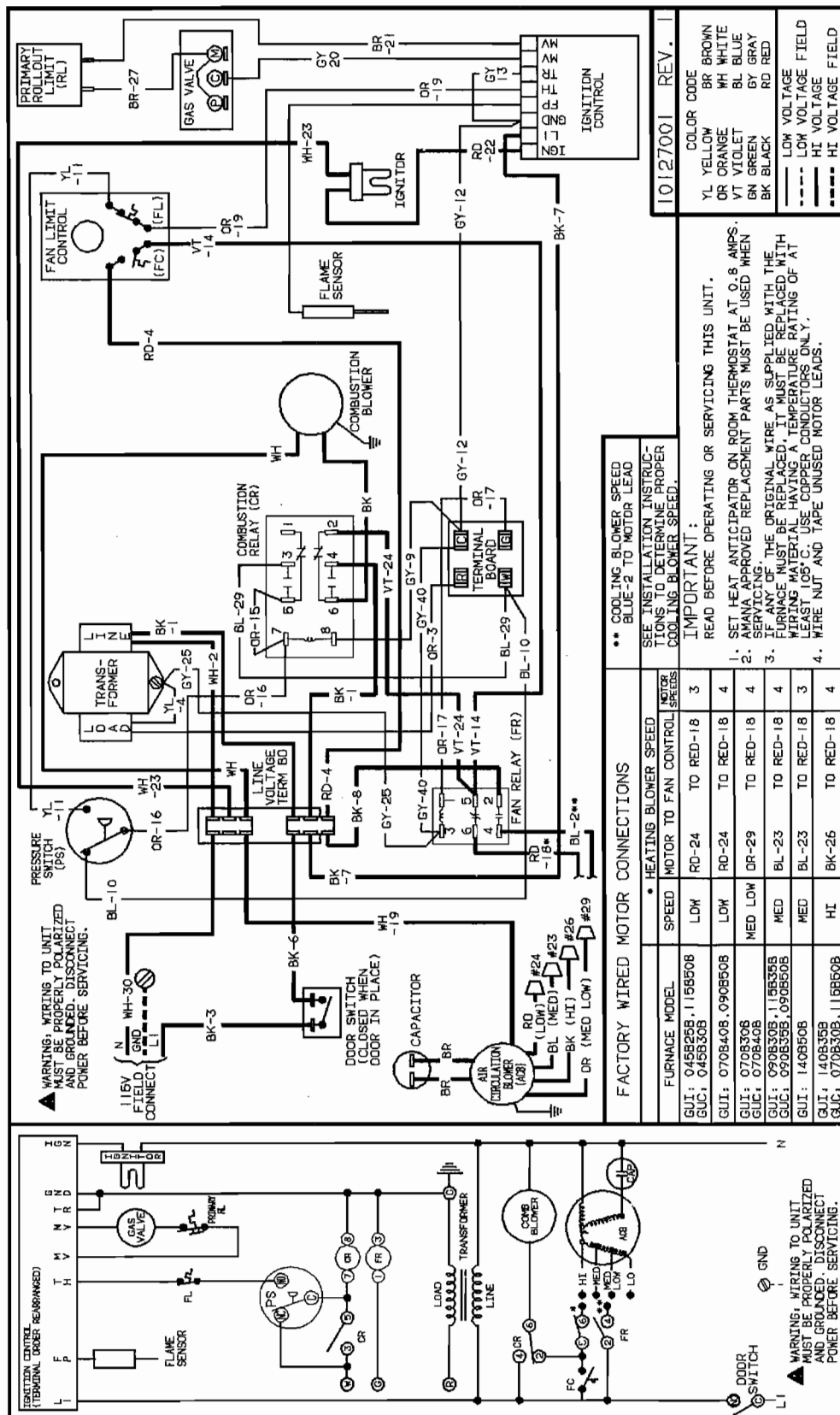
TO AVOID POSSIBLE ELECTRIC SHOCK, PERSONAL INJURY, OR DEATH
DISCONNECT POWER BEFORE SERVICING.



SYSTEM OPERATION



TO AVOID POSSIBLE ELECTRIC SHOCK, PERSONAL INJURY, OR DEATH
DISCONNECT POWER BEFORE SERVICING.



WARNING

WARNING: WIRING TO UNIT MUST BE PROPERLY POLARIZED AND GROUNDED. DISCONNECT POWER BEFORE SERVICING.

REGULATION CONTROL (TERMINAL ORDER REVERSED)

115V FIELD WINDING CONNECT

TRANSFORMER

LINE VOLTAGE TERM BD

DOOR SWITCH (CLOSED WHEN DOOR IN PLACE)

CAPACITOR

AIR CIRCULATION BLOWER (M3)

FAN RELAY (FR)

VENT SAFETY SWITCH

COMB BLOWER

FLAME SENSOR

GAS VALVE

IGNITOR

TERMINAL BOARD

COMBUSTION RELAY (CR)

FAN LIMIT CONTROL

PRIMARY ROLLOUT LIMIT (RL)

IGNITION CONTROL

IMPORTANT:

- SET HEAT ANTICIPATOR ON ROOM THERMOSTAT AT 0.8 AMPS.
- AMANA APPROVED REPLACEMENT PARTS MUST BE USED WHEN SERVICING. THE ORIGINAL WIRE AS SUPPLIED WITH THE FURNACE MUST BE REPLACED. IT MUST BE REPLACED WITH WIRING MATERIAL HAVING A TEMPERATURE RATING OF AT LEAST 105°C. USE COPPER CONDUCTORS ONLY.
- WIRE NUT AND TAPE UNUSED MOTOR LEADS.

FACTORY WIRED MOTOR CONNECTIONS

FURNACE MODEL	* HEATING BLOWER SPEED		* COOLING BLOWER SPEED	
	SPEED	MOTOR TO FAN CONTROL	BLUE-2 TO MOTOR LEAD	SEE INSTALLATION INSTRUCTIONS TO DETERMINE PROPER COOLING BLOWER SPEED.
GUI 045C25B, 115C50B	LOW	RD-24 TO RED-18	3	
GUI 070C40B, 090C50B	LOW	RD-24 TO RED-18	4	
GUI 070C30B	MED LOW	RD-29 TO RED-18	4	
GUI 090C30B, 115C35B	MED	BL-23 TO RED-18	4	
GUI 140C50B	MED	BL-23 TO RED-18	3	
GUI 140C35B	HI	BK-26 TO RED-18	4	

COLOR CODE

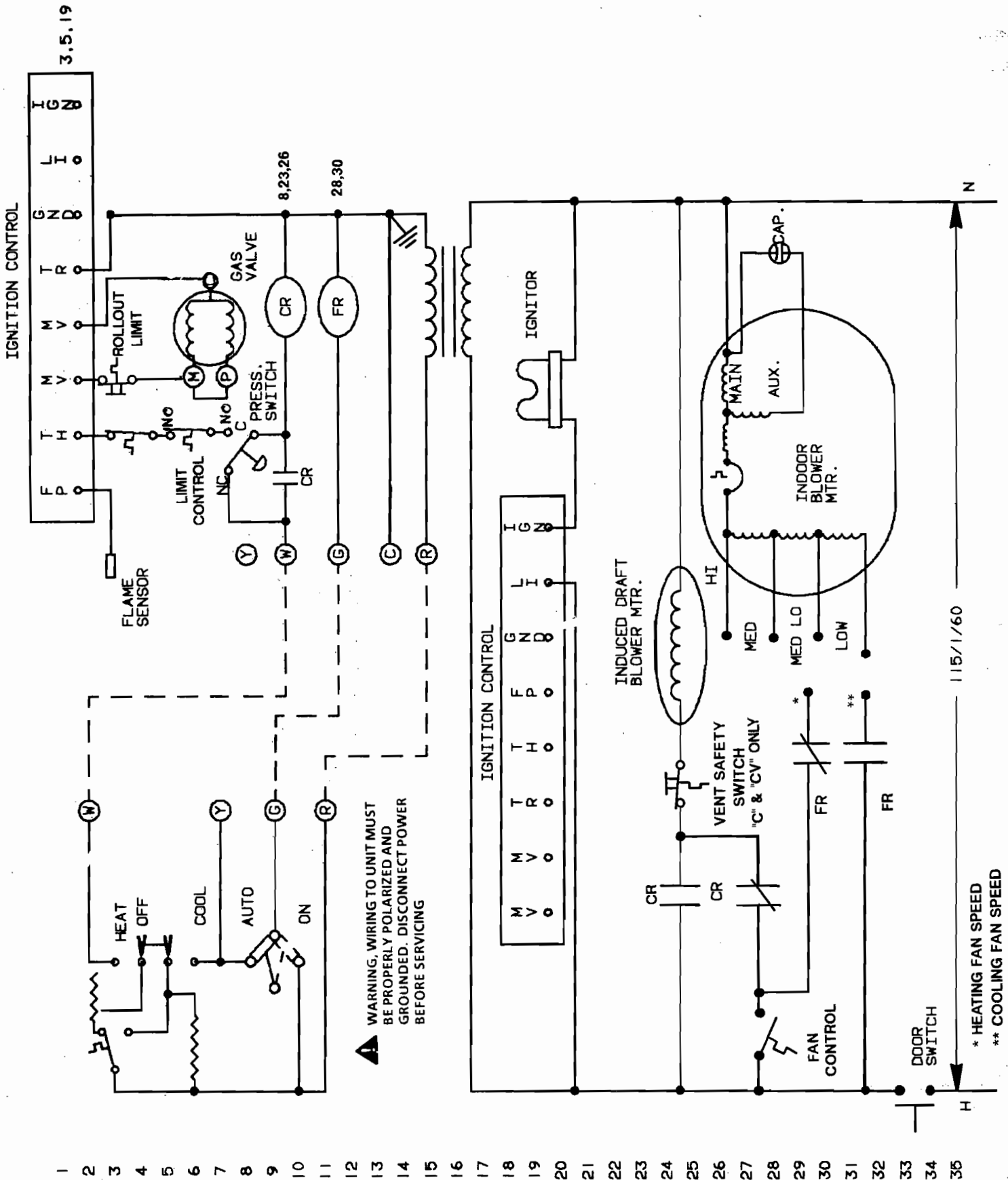
YL YELLOW BR BROWN
 DR ORANGE WH WHITE
 GN GREEN BL BLUE
 BK BLACK RD RED

--- LOW VOLTAGE
--- HI VOLTAGE
--- HT VOLTAGE
--- EFT/ID

WARNING: WIRING TO UNIT MUST BE PROPERLY POLARIZED AND GROUNDED. DISCONNECT POWER BEFORE SERVICING.

WARNING

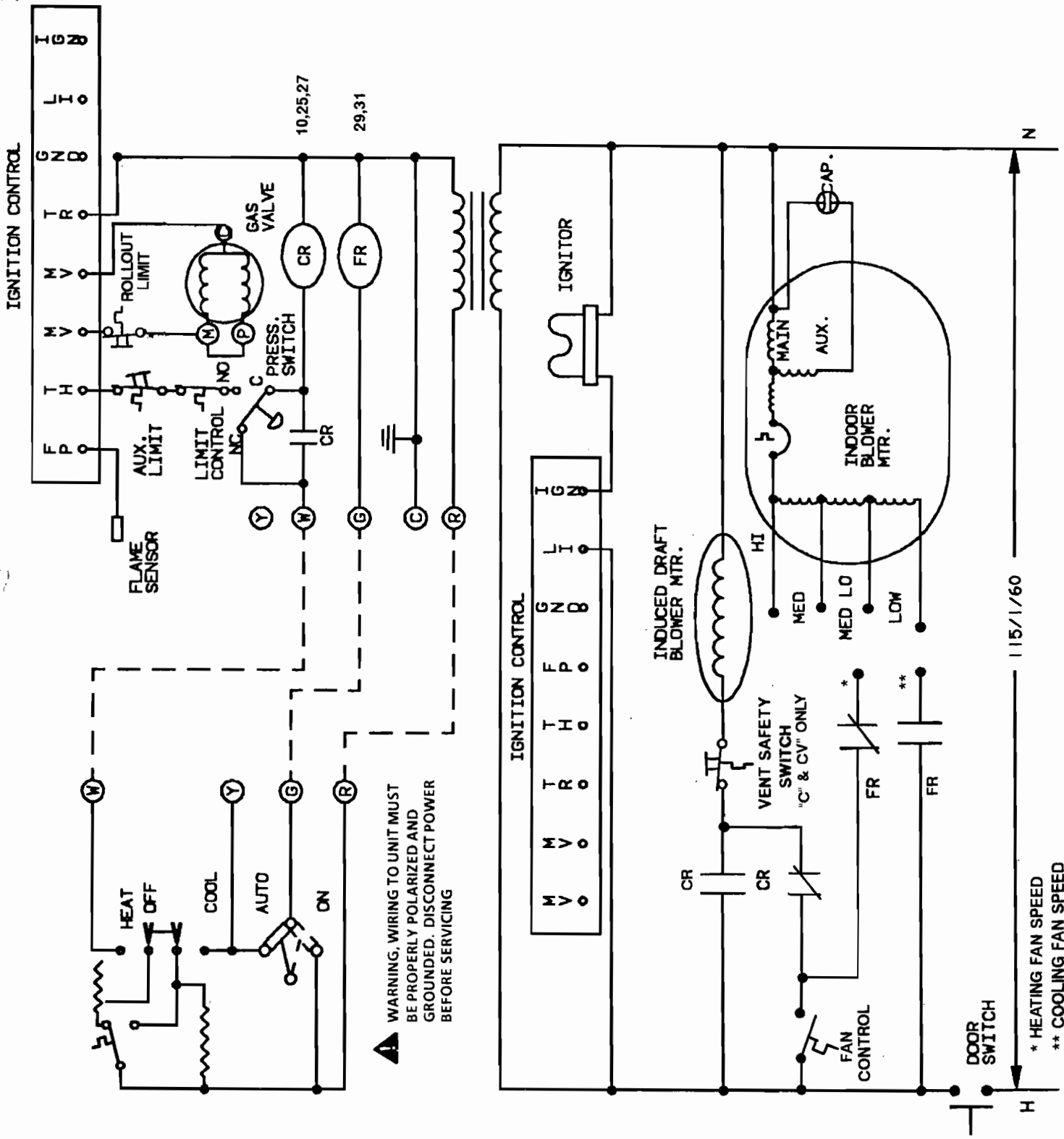
[illegible]



WARNING

DISCONNECT ELECTRICAL POWER
SUPPLY BEFORE SERVICING.

3.5.19

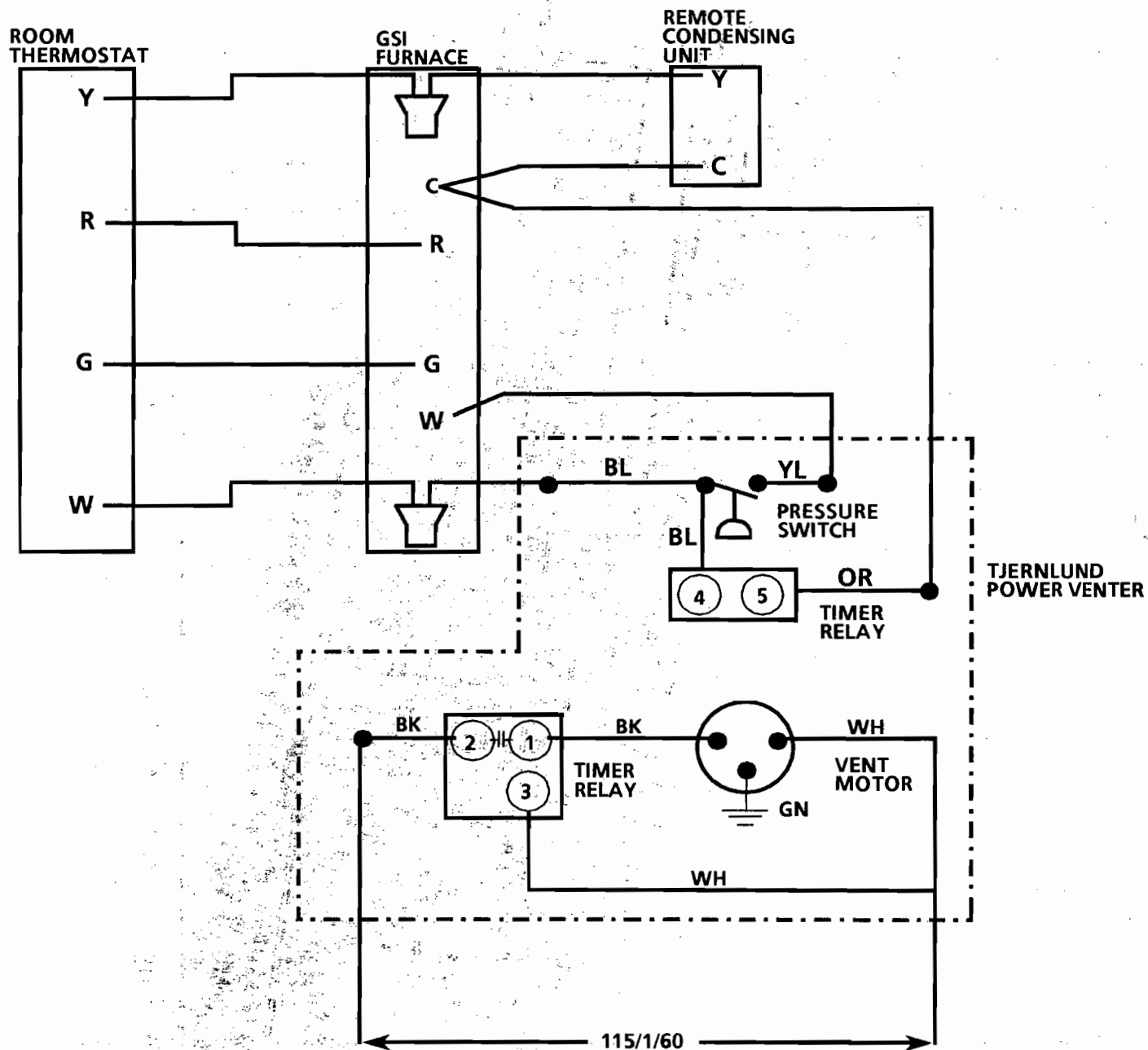


WARNING

DISCONNECT ELECTRICAL POWER SUPPLY BEFORE SERVICING.



TO AVOID POSSIBLE ELECTRIC SHOCK, PERSONAL INJURY, OR DEATH
DISCONNECT POWER BEFORE SERVICING.

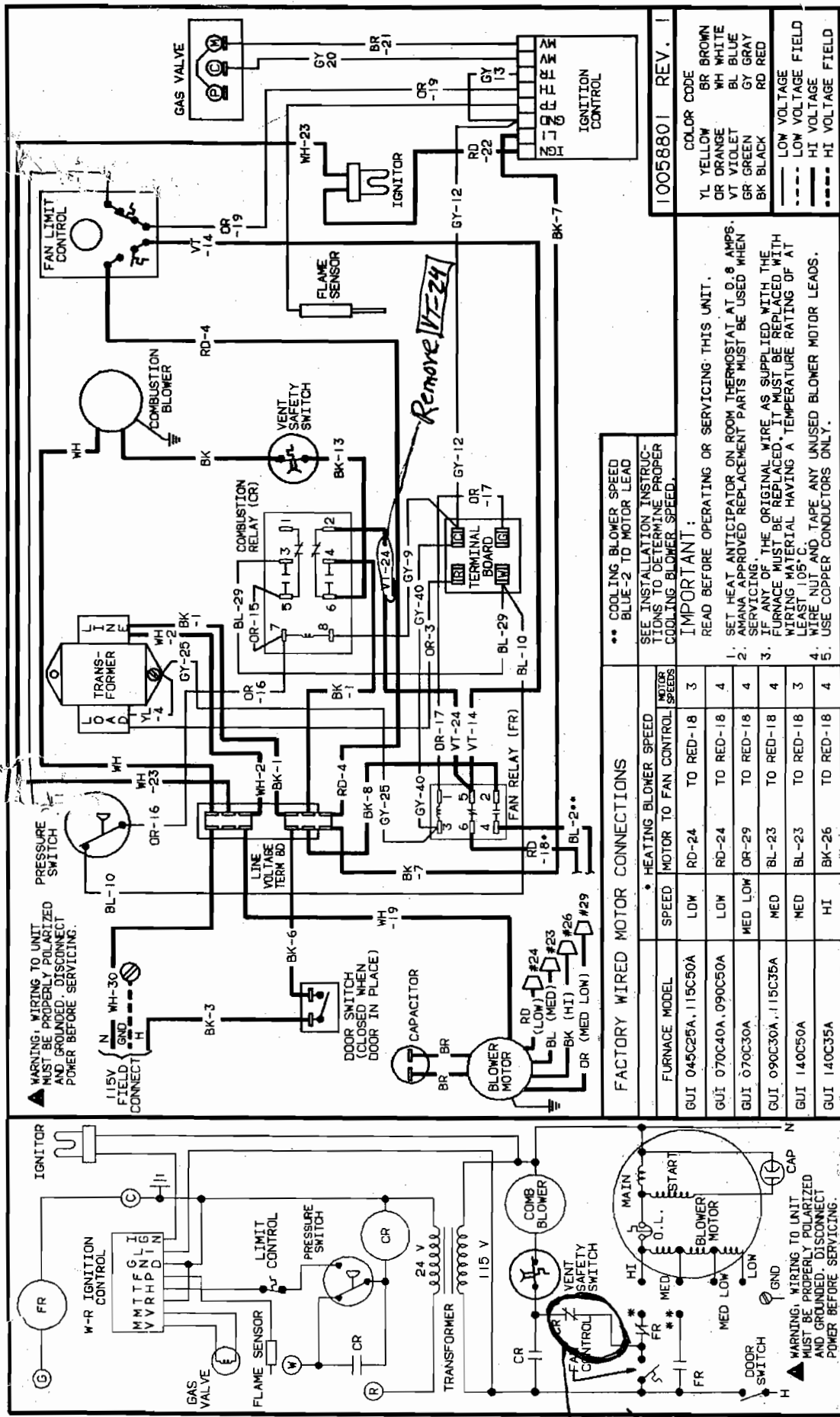


TYPICAL SCHEMATIC GSI with TJERNLUND Power Venter



WARNING

TO AVOID THE RISK OF PERSONAL INJURY, ELECTRICAL SHOCK OR DEATH, DISCONNECT POWER BEFORE SERVICING.



FACTORY WIRED MOTOR CONNECTIONS

FURNACE MODEL	HEATING BLOWER SPEED		COOLING BLOWER SPEED	
	SPEED	MOTOR TO FAN CONTROL	BLUE-2 TO MOTOR LEAD	WIRING SPEEDS
GUI 045C25A, 115C50A	LOW	RD-24 TO RED-18	TO RED-18	3
GUI 070C40A, 090C50A	LOW	RD-24 TO RED-18	TO RED-18	4
GUI 070C30A	MED LOW	OR-29 TO RED-18	TO RED-18	4
GUI 090C30A, 115C35A	MED	BL-23 TO RED-18	TO RED-18	4
GUI 140C50A	MED	BL-23 TO RED-18	TO RED-18	3
GUI 140C35A	HI	BK-26 TO RED-18	TO RED-18	4

IMPORTANT:

- 1. SET HEAT ANTICIPATOR ON ROOM THERMOSTAT AT 0.8 AMPS.
- 2. AMANA APPROVED REPLACEMENT PARTS MUST BE USED WHEN SERVICING.
- 3. IF ANY OF THE ORIGINAL WIRE AS SUPPLIED WITH THE FURNACE MUST BE REPLACED, IT MUST BE REPLACED WITH WIRING MATERIAL HAVING A TEMPERATURE RATING OF AT LEAST 105° C.
- 4. WIRE NUT AND TAPE ANY UNUSED BLOWER MOTOR LEADS.
- 5. USE COPPER CONDUCTORS ONLY.

10058801 REV. 1	COLOR CODE
YL	YELLOW
OR	ORANGE
VT	VIOLET
GR	GREEN
BK	BLACK
GY	GRAY
RD	RED
BR	BROWN
WH	WHITE
BL	BLUE
GY	GRAY
RD	RED
---	LOW VOLTAGE FIELD
---	LOW VOLTAGE FIELD
---	HI VOLTAGE FIELD
---	HI VOLTAGE FIELD

REMOVE CYCLE WHEN HEATING MISADVICE VENT SAFETY SWITCH TRIPS.

Remove this wire to shut off Comb. Blower at the end of the heating cycle when the thermostat is satisfied.

100-443887-10